City-Wide Long Term CSO
Control Planning Project

Jamaica Bay Waterbody/Watershed Facility Plan Report

The City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

November 2012

TABLE OF CONTENTS

Page

Page

Page

Page

Page

Page

Page

Page

LIST OF FIGURES

Number	**Title**	**Page**

LIST OF TABLES

Executive Summary

The New York City Department of Environmental Protection (DEP) has prepared this Jamaica Bay and CSO Tributaries Waterbody/Watershed (WB/WS) Facility Plan Report as required by the Administrative Order on Consent between the DEP and the New York State Department of Environmental Conservation (DEC). Designated as DEC Case #CO2-20000107-8 (January 14, 2005, as modified April 14, 2008 as DEC Case #CO2-20070101-1 and September 3, 2009 as DEC Case #CO2-20090318-30) and also known as the Combined Sewer Overflow (CSO) Consent Order. The Administrative Consent Order requires the DEP to submit an "approvable WB/WS Facility Plan" for Jamaica Bay and the CSO Tributaries to the DEC by June 2007. This WB/WS Facility Plan Report expanded on the numerous CSO facility planning studies conducted over the past 20 years for Jamaica Bay and its tributaries. The Jamaica Bay and CSO Tributaries WB/WS Facility Plan covers six of the 18 drainage areas defined by the 2005 CSO Consent Order that encompass the entirety of the waters of the City of New York.

DEP submitted a draft report in June 2007 for Jamaica Bay and CSO Tributaries. This updated WB/WS Facility Plan incorporates comments received from the DEC in 2008. All WB/WS Facility Plans, including the Jamaica Bay and CSO Tributaries WB/WS Facility Plan, contain all elements required by the *Federal CSO Policy* and the United States Environmental Protection Agency (USEPA). A final Citywide Long Term Control Plan (LTCP) incorporating the plans for all watersheds within the City of New York is scheduled for completion by 2017.

Purpose

The purpose of this WB/WS Facility Plan is to take the first step toward development of a LTCP for Jamaica Bay and its tributaries affected by CSO including Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin. This WB/WS Plan assesses the ability of existing New York City CSO Facility Plans for Jamaica Bay and its CSO tributaries to provide compliance with the existing water quality standards. Where these facilities will not result in full attainment of the existing standards, certain additional alternatives have been evaluated.

Context

This WB/WS Facility Plan is one element of the City's extensive multi-phase approach to CSO control that was started in the early 1970s. As described in more detail in Section 5, New York City has been investing in CSO control for decades. DEP has already built or is planning to build over $2.9 billion (2010 dollars) in targeted grey infrastructure to reduce CSO volumes. This does not include millions spent annually on the Nine Minimum Controls that have been in place since 1994 to control CSOs.

Regulatory Setting

This WB/WS Facility Plan has been developed in fulfillment of and pursuant to the 2005 CSO Consent Order requirements. It represents one in a series of several WB/WS Facility Plans that will be developed prior to development of a final approvable Citywide LTCP. All WB/WS Facility Plans, including the Jamaica Bay and CSO Tributaries WB/WS Facility Plan, contain all the elements required by the USEPA of an LTCP.

Goal of Plan

The goal of this WB/WS Facility Plan is to attain existing water quality standards using cost-effective CSO controls designed to reduce CSO volume and pollutants discharged into Jamaica Bay and its CSO tributaries. This WB/WS Facility Plan assesses the effectiveness of CSO controls now in place within New York City and those that are required by the CSO Consent Order to be put in place, to attain water quality that complies with the DEC water quality standards. Where existing or proposed controls are expected to fall short of attaining water quality standards, this WB/WS Facility Plan also assesses certain additional cost-effective CSO control alternatives and strategies (i.e., water quality standards revisions) that can be employed to provide attainment with the water quality standards. The goal of the LTCP will be to attain existing water quality standards and/or highest attainable appropriate use.

Adaptive Management Approach

Post-construction compliance monitoring, discussed in detail in Section 8, is an integral part of this WB/WS Facility Plan and provides the basis for adaptive management for Jamaica Bay. Monitoring will commence just prior to implementation of CSO controls and will continue for several years thereafter in order to quantify the difference between the expected and actual performance once controls are fully implemented. Any performance gap identified by the monitoring program can then be addressed through design modifications, operational adjustments, or additional controls. If it becomes clear that the implemented plan will not result in full attainment of applicable standards, DEP will pursue necessary regulatory mechanisms for a Variance and/or Water Quality Standards Revision.

If additional controls are required, protocols established by DEP and the City of New York for capital expenditures require that certain evaluations are completed prior to the construction of additional CSO controls. Depending on the technology implemented and the engineer's cost estimate for the project, these evaluations may include pilot testing, detailed facility planning, preliminary design, and value engineering. Each of these steps provides additional opportunities for refinement and adaptation so that the fully implemented program achieves the goals of the original WB/WS Facility Plan.

Project Description

Jamaica Bay is a shallow bar-built embayment that connects with Lower New York Bay to the west through Rockaway Inlet. Jamaica Bay contains approximately 16,000 acres of surface waters and 3,000 acres of islands and marshes. The mean depth of the Bay is approximately 13 feet, with maximum depths reaching 30 to 50 feet in navigation channels and sand borrow pit areas. Jamaica Bay lies at the southwestern tip of Long Island and is located primarily within the New York City boroughs of Brooklyn and Queens. A relatively small portion of the Bay is located in the Town of Hempstead in Nassau County, New York. This portion of the Bay and its watershed located in Nassau County is outside the jurisdiction of the DEP, the need for any controls on pollutant sources for that area are not addressed herein.

Jamaica Bay serves as an important ecological resource for populations of flora and fauna. The Bay has evolved over the last 25,000 years as a complex network of open water, salt marsh, grasslands, coastal woodlands, maritime shrublands, and brackish and freshwater wetland communities. The wildlife use of these systems is commensurate with this complex network of natural systems. These varied natural communities support 91 species of fish, 325 bird species and provide important habitat for many species of reptiles, amphibians, and small mammals. The Bay is a critical stopover area along the Eastern Flyway avian migration route. Jamaica Bay also provides numerous recreational opportunities such as fishing, boating, bird watching, bicycling, walking, and picnicking.

The Jamaica Bay estuary is only about half of its pre-colonial extent and the salt marsh wetlands that have been a defining ecological feature of the Bay are decreasing at an accelerated rate. Over the last 150 years, interior wetland islands and perimeter wetlands have been permanently lost as a result of extensive filling operations; shorelines have been hardened and bulkheaded to stabilize and protect existing residential communities and infrastructure; deep channels and sand borrow pit areas have been dredged, altering bottom contours and affecting natural flows within the Bay; natural tributaries providing freshwater inputs and coarse sediment exchange with the Bay have essentially disappeared, resulting in accumulations of silts and particulates from urban runoff. These activities have altered historic flow patterns in the Bay, eradicated large portions of natural habitat, impacted water quality, and modified the rich ecosystem that was present prior to the extensive urban development of the watershed.

Urbanization of the watershed has significantly altered the runoff yield from upland areas tributary to Jamaica Bay by increasing their impervious cover. Urbanization brings with it increased population, increased pollutants from sewage and industry, construction of sewer systems, and physical changes affecting the surface topography and imperviousness of the watershed. Increased surface imperviousness generates more runoff that is less attenuated by infiltration processes, and sewer systems replaced natural overland runoff pathways with a conveyance system that routes the runoff directly to the waterbody—without the attenuation formerly provided by surrounding wetlands. Urbanization of the Jamaica Bay watershed reduced infiltration and natural subsurface transport and eliminated natural streams previously tributary to Jamaica Bay. Stormwater runoff is transported via roof leaders, street gutters, and catch basins into the combined and separate sewer system, which then discharges directly to Jamaica Bay.

Urbanization has thus simultaneously decreased the retention and absorption of runoff and decreased the travel time for runoff to reach the waterbody. This, combined with the increased volume of runoff due to increased imperviousness of the watershed, results in increased peak discharge rates and higher total discharge volumes to the waterbody during wet weather.

CSO discharges to Jamaica Bay originate in its tributaries. The main subject areas for the evaluation of CSO control alternatives for this WB/WS Facility Plan are the combined sewer drainage areas of the 26th Ward and Jamaica WWTPs. The 26th Ward WWTP drainage area has three tributaries with CSO outfalls: Fresh Creek, Hendrix Creek, and Spring Creek. However, Spring Creek has an Auxiliary WPCP that captures CSO and provides preliminary treatment (settleable solids and floatables control) during wet weather events. The Jamaica WWTP drainage area has two tributaries with CSO outfalls: Bergen Basin and Thurston Basin. The Coney Island WWTP drainage area has one tributary with CSO outfalls: Paerdegat Basin, which is addressed in a separate LTCP that was approved by the NYSDEC in February 2007. The Rockaway WWTP service area is a partially separated area, which DEP plans to continue to separate. Collection system modeling analyses indicate that the combined sewers in Rockaway overflow very infrequently and in fact were not predicted to overflow at all during the typical rainfall year used during the planning process.

According to collection system numerical modeling results (for baseline conditions, with 1988 precipitation data), the combined sewer systems tributary to 26th Ward, Jamaica Bay, Rockaway WWTP and Spring Creek AWPCP discharge 2,185 million gallons (MG) of combined sewer overflow into the Jamaica Bay CSO Tributaries. Table ES-1 summarizes the annual overflow volume for each outfall under baseline conditions.

Table ES-1. Summary of Baseline Calculated Overflow Events(1)

Outfall	Baseline Annual CSO Volume (MG)	Number of CSO Events
26W-003	494	47
26W-004	36	16
26W-005	98	5
JAM-003	319	47
JAM-003A	300	57
JAM-005	868	96
JAM-006	30	91
JAM-007	40	50
TOTAL	**2185**	

(1) Baseline condition reflects design precipitation record (JFK, 1988), treatment plant capacity reaches 2003 sustained wet weather flow and projected sanitary flows for year 2045.

The open water areas of Jamaica Bay are classified by NYSDEC as Class SB waters with designated uses of primary and secondary contact recreation, fishing, suitable for fish propagation and survival. The CSO tributaries are classified as Class I with designated uses of secondary contact recreation, fishing, and shall by suitable for fish propagation and survival as well. To support these uses, numerical criteria for dissolved oxygen (DO) and bacteria concentrations have been established. Jamaica Bay is generally in attainment with the DO standard on an annual basis in the southwest portion of the Bay, in 90 percent attainment in the central portion of the Bay, and achieves 70 to 90 percent attainment in the eastern portion of the Bay. During summer months, however, attainment with the DO standards is calculated to decrease to 30 to 60 percent in the eastern portion of the Bay. An analysis conducted as part of this WB/WS Facility Plan to assess how CSOs impact attainment of the DO standards showed that complete removal of CSOs would not appreciably change dissolved oxygen levels in Jamaica Bay. Jamaica Bay is in 100 percent attainment on an annual basis for total coliform bacteria indicators. However, in the extreme eastern portions of the Bay, the fecal coliform concentrations are not attained as much as 35 percent of the time during the year.

In the CSO tributaries, attainment of DO numeric criteria are calculated to be out of attainment with the standards as much as 20 to 30 percent of the time in Bergen and Thurston Basins and anywhere from 20 to 50 percent of the time in Fresh, Spring, and Hendrix Creeks. The basins are impacted differently in that conditions are generally depressed throughout Bergen and Thurston Basins, while DO concentrations in Fresh, Spring, and Hendrix Creeks are more impacted at the head ends. Annual total coliform levels are in 100 percent attainment in Hendrix and Spring Creeks and half of Thurston Basin. Annual total coliform attainment in Fresh Creek and Bergen Basin ranges from 65 percent at the head end to 100 percent at the mouth of these waterbodies. Annual fecal coliform levels are in 100 percent attainment in Hendrix and Spring Creeks and most of Thurston Basin. Annual fecal coliform attainment in Fresh Creek and Bergen Basin ranges from 65 percent at the head end to 100 percent at the mouth.

In 1996 NYSDEC designated the eastern portion of Jamaica Bay and its tributaries located in Queens County as high priority waterbodies for TMDL development with their inclusion on the Section 303(d) List. The cause of the listing was nitrogen, oxygen demand, and pathogens. A TMDL for mercury was developed for these waterbodies in 1996. In 1998, Hendrix Creek and Bergen Basin were added to the NYSDEC 303(d) list and designated as high priority waterbodies for TMDL development for pathogens and oxygen demand, respectively. In 2002, Hendrix Creek was newly listed for nitrogen and oxygen demand and Bergen Basin was newly listed for pathogens. The above referenced 303(d) listings remained in effect for both the 2004 and the proposed final 2006 cycles. However, the proposed final 2010 303(d) list also indicates that TMDL development for these waterbodies may be deferred as impairments are being addressed by a 2005 Order on Consent with New York City to develop and implement watershed and facility plans to address CSO discharges and bring New York City waters into compliance with the Clean Water Act. This WB/WS Facility Plan (or the subsequent Long-Term Control Plan) can serve in place of a TMDL when approved by NYSDEC as it will address the sources of the impairments.

NYCDEP has undertaken several project and studies of the waterbody including the Jamaica Bay Combined Sewer Overflow Facility Planning Project (O'Brien & Gere, 1993), Jamaica Tributaries CSO Facility Planning Project (Hazen and Sawyer, 1996, 2003), and the Paerdegat Basin CSO Facility Planning Project (Hazen and Sawyer, 1989, 2004). The 2003 Jamaica Bay CSO Facility Plan (O’Brien & Gere, 2003) considers the open waters of Jamaica Bay and those tributaries to Jamaica Bay that were not addressed individually under the CSO Abatement Program. These Facility Plans collectively cover the entirety of the waters of Jamaica Bay. While the earlier CSO Facility Planning Projects recommended various CSO abatement elements, follow-up planning efforts have both eliminated some of the original recommended actions and advanced others. The results of those activities and decisions have led to a short list of CSO control related actions listed in Appendix A of the 2005 CSO Consent Order.

A variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Jamaica Bay. Evaluated alternatives achieve a range of CSO reductions from the Baseline condition up to approximately 100 percent CSO abatement. Full-year model simulations were performed for each engineering alternative and the results were compared to baseline conditions to determine the relative benefit of each alternative.

All of the alternatives include the following elements: Meadowmere and Warnerville DWO Abatement, Shellbank Basin Destratification System, Laurelton and Springfield Blvd Storm Sewer Buildout, Regulator Automation at J2, Sewer Cleaning in the 26th Ward WWTP Drainage Area, Hendrix Creek Dredging, New 48" Parallel Sewer, new bending weirs at regulators J3, J6, and J14, enlarging the orifice at regulator J3, High Level Sewer Separation in the Fresh Creek portion of the 26th Ward service area, 26th Ward WTTP Wet Weather Stabilization, 26th Ward Green Infrastructure Demonstration Project, and continued Solids and Floatables Controls. A description of each alternative along with the CSO volumes, associated CSO reductions, and costs of the aforementioned alternatives are summarized in Table ES-2.

Table ES-2. Costs and Benefits of Analyzed Alternatives

Alternative	**Description**	**PTPC ($ millions)**	**Events per year**	**Annual Untreated Overflow Volume[1, 2] (MG/year)**	**% CSO Reduction from Baseline**
	Baseline	N/A	195	2185	N/A
1	2005 Consent Order Mandated Controls	$1,482.5	55	1129	48
2	Select Elements of 2005 Consent Order with Additional Combination of CSO Reduction Technologies	$439.0	62	737	66
3	Alternative 2 with 24 MG Fresh Creek CSO Storage Tunnel	$1,373.8	62	575	74
4	Alternative 2 with 14 MG Fresh Creek CSO Storage Tunnel	$1,256.2	62	629	71
5	Alternative 2 with 40 MG Bergen Basin CSO Storage Tunnel	$1,579.3	26	527	76
6	Alternative 2 with 22 MG CSO Storage Tunnel in Bergen Basin	$1,407.2	26	715	67
7	Alternative 2 with 6.1 MG CSO Storage Shaft in Thurston Basin	$1,028.8	62	701	68
8	Alternative 2 with 4 MG CSO Storage Shaft in Thurston Basin	$967.9	62	709	68
9	Alternative 2 with Jamaica Bay WWTP Service Area Sewer Separation	--	--	--	--
10	Alternative 2 with 100% Capture Tunnels/Shaft	$3,620.1	16	170	92
1. Based on number of CSO events >0.01 MG.					

Alternative	Description	PTPC ($ millions)	Events per year	Annual Untreated Overflow Volume[1, 2] (MG/year)	% CSO Reduction from Baseline
2. Includes 135 MG of annual overflow from Spring Creek AWPCP which provides preliminary treatment. 3. For Alternative 2, the Laurelton and Springfield Blvd Storm Sewer Buildout project was included in various projected CSO reductions, component analysis, and overall water quality attainment in Thurston Basin.					

The Selected Plan

After a complete examination of the costs and benefits of these CSO control alternatives, Alternative 2 is a cost-effective and highly-implementable CSO reduction plan for Jamaica Bay that produces a 66 percent decrease in the annual CSO volumes discharged to the Bay and will also further reduce floatables. At an estimated cost of $439 Million (October 2011 dollars), the Jamaica Bay and CSO Tributaries WB/WS Facility Plan is expected to attain the existing numerical criteria for a Class SB waterbody under typical conditions. Attainment of numeric criteria may not occur at all times, but the Plan is adaptive enough to address any shortcoming identified during post-construction compliance monitoring, and represents a more cost-effective approach than full CSO removal, which would cost $3.62 Billion.

A complete summary with costs of each element of this selected plan is presented in Table ES-3.

Table ES-3: Summary of Costs for the Jamaica Bay and CSO Tributaries Recommended Plan

Component	PTPC ($ Million)
Meadowmere and Warnerville DWO Abatement	$37.6
Shellbank Basin Destratification System	$2.6
Regulator Automation at J2	$2.27
Upgrading the Spring Creek AWWTP	$147.69
Sewer Cleaning in the 26th Ward WWTP Drainage Area	$5.78
Hendrix Creek Dredging	$25.42
New 48-inch Parallel Sewer in JB WWTP	$17.6
Regulator Improvements at J3, J6, and J14	$3.6
26th Ward High Level Sewer Separation	$110.75
26th Ward WTTP Wet Weather Stabilization	$127.7
26th Ward Green Infrastructure Demonstration Project	$0.45
Total	**$439.0**
1. The Laurelton and Springfield Blvd Storm Sewer Buildout project in ongoing with an estimated total project cost of $870 million and is included in the modeling for this plan.	

The *NYC Green Infrastructure Plan*, as described in section 5.8, includes five key components: construct cost effective grey infrastructure; optimize the existing wastewater system through interceptor cleaning and other maintenance measures; control runoff from 10 percent of impervious surfaces through green infrastructure; institute an adaptive management approach to better inform decisions moving forward; and engage stakeholders in the development/implementation of these green strategies.

As part of the LTCP process, DEP will evaluate green infrastructure in combination with other LTCP strategies to better understand the extent to which green infrastructure would provide incremental benefits and would be cost-effective. DEP models will be refined by including new data collected from green infrastructure pilots, new impervious cover data and extending predictions to ambient water quality for the development of the LTCP. Based on these evaluations, and in combination with cost effective grey infrastructure, DEP will reassess the green infrastructure strategy.

Post-Construction Monitoring

Post-construction monitoring will provide feedback to facility operations, data for modeling, and information for compliance evaluations by DEC. Each year's data set will be compiled and evaluated to refine the understanding of the interaction between Jamaica Bay and the CSOs tributary to it, with the ultimate goal of improving water quality and fully attaining the numerical water quality criteria protective of the existing designated uses. DEP will monitor the performance of the proposed elements of the Plan for a number of years, during which the SPDES Permit for the 26^{th} Ward, Rockaway and Jamaica WWTPs may require variance relief from water quality-based effluent limits (WQBELs).

Summary of Expected Water Quality Benefits

As documented herein, implementation of the WB/WS Facility Plan is projected to substantially improve water quality relative to Baseline conditions. Based on water quality model runs of the WB/WS Facility Plan, dissolved oxygen concentrations throughout the Jamaica CSO tributaries all see improvement over the baseline conditions. As noted previously, additional alternatives (including 100 percent CSO capture and sewer separation) are not projected to achieve attainment of applicable DEC Class I and IEC Class A standards for DO 100 percent of the time. Improvements are also seen in the areas where total and fecal coliform are not achieved 100 percent of the time.

Table ES-4: Annual Attainment of DO, Total and Fecal Coliform for Jamaica CSO Tributaries

Location		Dissolved Oxygen				Total Coliform				Fecal Coliform			
		Class I (≥ 4.0mg/L)		IEC Class A (≥5.0 mg/L)		Class I (GM < 10,000)				Class I (GM < 10,000)			
		Annual % Attainment				Annual % Attainment		Recreation Season % Attainment		Annual % Attainment		Recreation Season % Attainment	
		Baseline	WWFP	Baseline	WWFP	Baseline	WWFP	Baseline	WWFP	Baseline	WWFP	Baseline	WWFP
Fresh Creek	Head	57	58	29	51	75	100	100	100	75	92	100	100
	Mid-Creek	79	85	55	77	92	100	100	100	75	100	100	100
	Mouth	82	89	60	81	100	100	100	100	100	100	100	100
Hendrix Creek	Head	61	63	21	58	100	100	100	100	100	100	100	100
	Mid-Creek	70	77	52	67	100	100	100	100	100	100	100	100
	Mouth	82	87	64	79	100	100	100	100	100	100	100	100
Spring Creek	Head	87	86	70	77	100	100	100	100	100	100	100	100
	Mid-Creek	93	95	73	85	100	100	100	100	100	100	100	100
	Mouth	83	87	65	78	100	100	100	100	100	100	100	100
Bergen Basin	Head	72	73	62	64	67	83	100	100	67	75	100	100
	Mid-Creek	75	76	67	67	92	100	100	100	92	100	100	100
	Mouth	79	80	72	73	100	100	100	100	100	100	100	100
Thurston Basin	Head	63	75	55	64	92	100	100	100	92	100	100	100
	Mid-Creek	72	75	65	66	100	100	100	100	100	100	100	100
	Mouth	79	81	71	72	100	100	100	100	100	100	100	100

Based on water quality model runs of the WB/WS Facility Plan, dissolved oxygen concentrations throughout Jamaica Bay do not see a significant increase in DO attainment, except at the head end of the bay at the South Transect. As noted previously, additional alternatives (including 100 percent CSO capture and sewer separation) are not projected to achieve attainment of applicable DEC Class SB/SC standards for DO 100 percent of the time.

Table ES-5: Annual Attainment of DO, Total and Fecal Coliform for Jamaica Bay

Location		Dissolved Oxygen		Total Coliform				Fecal Coliform			
		Class SB/SC and IEC Class A (≥ 5.0 mg/L)		Class SB/SC – Annual				Class SB/SC (GM ≤ 200)			
		Annual Percent Attainment		Median < 2,400 % Attainment		80th Percentile < 5,000 % Attainment		Annual % Attainment		Recreation Season % Attainment	
		Baseline	WWFP	Baseline	WWFP	Baseline	WWFP	Baseline	WWFP	Baseline	WWFP
North Transect	Paerdegat Basin	100	100	100	100	100	100	100	100	100	100
	Spring Creek	99	99	100	100	100	100	100	100	100	100
	Bergen Basin	95	95	100	100	100	100	100	100	100	100
	Grassy Bay & JFK	79	79	100	100	100	100	100	100	100	100
South Transect	Beach Channel	100	100	100	100	100	100	100	100	100	100
	Grass Hassock Channel	99	99	100	100	100	100	100	100	100	100
	Head of Bay	93	95	100	100	100	100	100	100	100	100
Rockaway Inlet		100	100	100	100	100	100	100	100	100	100

Water quality model runs indicate that the WB/WS Facility Plan is projected to achieve no exceedances of the fecal coliform or total coliform monthly geometric mean numerical criteria during the summer recreation season in Jamaica Bay or the CSO tributaries.

With respect to the narrative water quality criteria for aesthetics, the WB/WS Facility Plan is expected to substantially reduce floatables and odors. The Plan will reduce the volume of untreated CSO discharged to Jamaica Bay and CSO tributaries by 66 percent overall. With respect to floatables issues, the Plan will augment ongoing programmatic controls such as street sweeping, catch basin retention, and other best management practices described in the Citywide Comprehensive CSO Floatables Plan. In addition, floatables controls are included in the Spring Creek AWPCP and containment booms in Bergen and Thurston Basins will remain in service and continue to be evaluated for their effectiveness in reducing floatables in Jamaica Bay and CSO Tributaries.

Consistency with Federal CSO Policy

The Jamaica Bay and CSO Tributaries WB/WS Facility Plan addresses each of the nine elements of long term CSO control as defined by federal policy and described herein. Through extensive water quality and sewer system modeling, data collection, community involvement, and engineering analysis, the DEP has adopted this Plan to incorporate the findings of over two decades of inquiry to achieve the highest reasonably attainable use of Jamaica Bay and its tributaries.

Summary

The Jamaica Bay and CSO Tributaries WB/WS Facility Plan satisfies federal CSO policy requirements. Through extensive water quality and sewer system modeling, data collection, community involvement, and engineering analysis, the NYCDEP has developed a Plan that incorporates the findings of over two decades of inquiry to achieve the highest reasonably attainable water quality and associated use of Jamaica Bay.

1.0 Introduction

The City of New York owns and operates 14 wastewater treatment plants (WWTPs) and their associated collection systems. The system contains approximately 450 combined sewer overflows (CSOs) located throughout the New York Harbor complex. The New York City Department of Environmental Protection (DEP) operates and maintains the wastewater collection system and WWTPs and has executed a comprehensive watershed-based approach to address the impacts of these CSOs on water quality and uses of the waters of New York Harbor. As illustrated in Figure 1-1, multiple waterbody assessments are being conducted that consider all causes of non-attainment of water quality standards (WQS) and identify opportunities and requirements for maximizing beneficial uses. This Waterbody/Watershed (WB/WS) Facility Plan Report provides the details of the assessment and the actions that will be taken to improve water quality in Jamaica Bay and its tributaries that receive CSOs: Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin and Thurston Basin.

New York City's environmental stewardship of the New York Harbor began in 1909 with water quality monitoring "to assess the effectiveness of New York City's various water pollution control programs and their combined impact on water quality" that continues today (annual DEP NY Harbor Water Quality Survey Reports, 2000-2007). CSO abatement has been ongoing since at least the 1950s, when conceptual plans were first developed for the reduction of CSO discharges into Spring Creek, other confined tributaries in Jamaica Bay, and the East River. From 1975 through 1977, the City conducted a harbor-wide water quality study funded by a Federal Grant under Section 208 of the Water Pollution Control Act Amendments of 1972. That study confirmed tributary waters in the New York Harbor were negatively impacted by CSOs. In addition, occurrences of dry weather discharges – which DEP has since eliminated – were also confirmed. In 1984 a Citywide CSO abatement program was developed that initially focused on establishing planning areas and defining how facility planning should be accomplished. As part of that plan, the City was divided into eight individual project areas that together encompass the entirety of the New York Harbor. Four open water project areas (East River, Jamaica Bay, Inner Harbor and Outer Harbor), and four tributary project areas (Flushing Bay, Paerdegat Basin, Newtown Creek, and Jamaica Tributaries) were defined. For each project area, water-quality CSO Facility Plans were developed as required under the NY State Pollutant Discharge Elimination System (SPDES) permits for each WWTP. The SPDES permits for each WWTP, administered by the New York State Department of Environmental Conservation (DEC), apply to CSO outfalls as well as plant discharges and contain conditions for compliance with applicable federal and New York State requirements for CSOs.

In 1992, DEP entered into an Administrative Consent Order with DEC which incorporated into the SPDES permits a provision stating that the consent order governs DEP's obligations for its CSO program. The 1992 Order was modified in 1996 to add a catch basin cleaning, construction, and repair program. A new Consent Order became effective in 2005 that superseded the 1992 Consent Order and its 1996 modifications with the intent to bring all CSO related matters into compliance with the provisions of the Federal Clean Water Act (CWA) and New York State Environmental Conservation Law. The new Order contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for Citywide long-term CSO control. DEP and DEC also entered into a separate Memorandum of Understanding (MOU) to facilitate WQS reviews in accordance

Environmental Protection

City-wide Assessment Area

with the federal CSO control policy. The 2005 Order was subsequently modified in 2008 and 2009.

The 2005 Consent Order requires several Waterbody/Watershed (WB//WS) Facility Plan reports that collectively encompass the Bay and its CSO tributaries under milestones VI.B.1, VI.B.2, XII.B.1, XII.B.2, XII.B.3, and XII.B.4. These individual Waterbody/Watershed (WB//WS) Facility Plans were combined into this one WB/WS Facility Plan for Jamaica Bay and CSO Tributaries and provide all relevant milestones, as explicitly required in Appendix A of the 2005 Consent Order. This Plan is intended to be consistent with the United States Environmental Protection Agency's (USEPA) CSO Control Policy promulgated in 1994. The policy requires municipalities to develop a Long Term Control Plan (LTCP) for controlling CSOs. The CSO policy became law in December 2000 with the passage of the Wet Weather Water Quality Act of 2000. The approach to developing the LTCP is specified in USEPA's CSO Control Policy and Guidance Documents, and involves the following nine minimum elements:

1. System Characterization, Monitoring and Modeling
2. Public Participation
3. Consideration of Sensitive Areas
4. Evaluation of Alternatives
5. Cost/Performance Consideration
6. Operational Plan
7. Maximizing Treatment at the Treatment Plant
8. Implementation Schedule; and
9. Post Construction Compliance Monitoring Program

Subsequent sections of this report will discuss each of these elements in more depth, along with the simultaneous coordination with the New York State WQS review and revision as appropriate.

1.1 WATERBODY/WATERSHED ASSESSMENT AREA

Jamaica Bay is one of the most valuable natural resources within the New York City urban area. The waterbody portion of the report assessment area follows the DEC designation of Jamaica Bay in its Codes, Rules and Regulations. The specific area of Jamaica Bay and associated tributaries is identified on Figure 1-2. Jamaica Bay is a 39-square mile estuarine lagoon that is bounded by portions of Brooklyn, Queens, and Nassau County and Rockaway Peninsula to the south which separates Jamaica Bay from the Atlantic Ocean. It opens into the Lower New York Bay and the Atlantic Ocean through Rockaway Inlet. For the purpose of the WB/WS Facility Plan, the waterbodies within the Jamaica Bay and CSO Tributaries assessment area have been divided as follows:

- Fresh Creek is an inlet on the northwest shore of Jamaica Bay in Brooklyn. Fresh Creek Park surrounds the northern reaches of the creek.

NYC Environmental Protection

Jamaica Bay and CSO Tributaries Study Area

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

Figure 1-2

- Hendrix Creek stretches approximately 7,000 feet from the north of Jamaica Bay into Brooklyn.
- Spring Creek discharges into the north channel of Jamaica Bay via Old Mill Creek. The majority of the shoreline is park land included in the Gateway National Recreation Area. Spring Creek Park is located along the southeastern shoreline of the creek while Fountain Avenue Park is located on the southwest shoreline.
- Bergen Basin is located on the northeast side of Jamaica Bay and is adjacent to John F. Kennedy (JFK) International Airport.
- Thurston Basin is located between Queens and Nassau County. It discharges into Jamaica Bay from the east. JFK International Airport is directly northwest of the basin.

Jamaica Bay covers over 16,000 acres and is characterized by open waters, islands, wetlands, and shipping channels. The mean water depth in Jamaica Bay is approximately 13 feet with a semi-diurnal tidal range of 5 to 6 feet. A significant amount of dredging and filling has historically altered the Bay and its shores including the alteration of tidal marshes to channelized and bulkheaded tributaries and the creation of islands.

Jamaica Bay receives drainage from approximately 91,000 acres of land. The surrounding land is characterized by residential, recreational, municipal, commercial, and industrial uses. Recreational activities of the Bay are typified by boating, fishing, hiking, picnicking, and bird watching. The shoreline along the Bay is varied and includes rip-rap fill, bulkheads, beaches, and upland forests. Jamaica Bay is a unit of the Gateway National Recreation Area, with its waters and shorelines supporting a diverse array of habitats and a variety of plants, fish, and wildlife. The Jamaica Bay assessment area comprises Community Districts 5, 9, and 14 through 18 in the Borough of Brooklyn, and Community Districts 9, 10, 13 and 14 and a portion of 12 in the Borough of Queens.

1.2 REGULATORY CONSIDERATIONS

The waters of the City of New York are primarily subject to New York State regulation, but must also comply with the policies of the USEPA, as well as water quality standards established by the Interstate Environmental Commission (IEC). The following sections detail the regulatory issues relevant to long-term CSO planning.

1.2.1 Clean Water Act

Although federal laws protecting water quality were passed as early as 1948, the most comprehensive approach to clean water protection was enacted in 1972, with the adoption of the Federal Water Pollution Control Act Amendments commonly known as the CWA including the amendments adopted in 1977. The CWA established the regulatory framework to control surface water pollution, and gave the USEPA the authority to implement pollution control programs. Among the key elements of the CWA was the establishment of the National Pollutant Discharge Elimination System (NPDES) permit program, which regulates point sources that discharge pollutants into waters of the United States. CSOs and municipal separate storm sewer systems (MS4) are also subject to regulatory control under the NPDES program. In New York

State, the NPDES permit program is administered by DEC, through its SPDES program. New York State has had an approved SPDES program since 1975.

The CWA requires that discharge permit limits be based on receiving WQS established by the State of New York. These standards should "wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation" (40 CFR 131.2). The standards must also include an antidegradation policy for maintaining water quality at acceptable levels, and a strategy for meeting those standards must be developed for those waters not achieving State WQS. The most common type of strategy is the development of a Total Maximum Daily Load (TMDL). TMDLs determine what level of pollutant load would be consistent with meeting WQS. TMDLs also allocate acceptable loads among the various sources of the relevant pollutants which discharge to the waterbody.

Section 305(b) of the CWA requires States to periodically report the water quality of waterbodies under their respective jurisdictions, and Section 303(d) requires States to identify impaired waters where specific designated uses are not fully supported. The DEC Division of Water addresses these requirements by following its Consolidated Assessment and Listing Methodology (CALM). The CALM includes monitoring and assessment components that determine water quality standards attainment and designated use support for all waters of New York State. Waterbodies are monitored and evaluated on a five-year cycle. Information developed during monitoring and assessment is inventoried in the Waterbody Inventory/Priority Waterbody List (WI/PWL). The WI/PWL incorporates monitoring data, information from state and other agencies, and public participation. The Waterbody Inventory refers to the listing of all waters, identified as specific individual waterbodies, within the state that are assessed. The Priority Waterbodies List is the subset of waters in the Waterbody Inventory that have documented water quality impacts, impairments or threats. The Priority Waterbodies List provides the candidate list of waters to be considered for inclusion on the Section 303(d) List.

In 1998, DEC listed Hendrix Creek in the Section 303(d) List as a high priority for TMDL development due to high nitrogen and low dissolved oxygen (DO)/high oxygen demand. In 2002, the DEC added Jamaica Bay, Eastern Bay and tributaries, to the Section 303(d) List for high nitrogen and low DO/high oxygen demand. Bergen Basin was also added to the Section 303(d) List in 2002 for low DO/ high oxygen demand and then added again in 2006 for high nitrogen. Furthermore, Spring Creek is listed in Part 3c - Waterbodies for which TMDL Development May Be Deferred (Pending Implementation/Evaluation of Other Restoration Measures) of the Final 2010 Section 303(d) List due to the presence of pathogens and low DO/oxygen demand. A TMDL for this waterbody may not be required and may in fact delay the ability to meet the pathogen and DO requirements as compared to the various control measures currently being developed and implemented which include this WB/WS Facility Plan. If after implementation of this WB/WS Plan, Jamaica Bay and its CSO tributaries achieve the pathogen and DO requirements associated with each waterbody, they would be removed from the 303(d) List for these pollutants.

Table 1-1 presents a summary of the New York State water quality classification and 303(d) list designations for each water body in the assessment area.

Table 1-1. Water Quality Designations

Waterbody Segment	NYS Water Quality Standards Designation	2010 NYS 303(d) List Impairment Designations
Jamaica Bay, Eastern and Tributaries in Queens	SB	Nitrogen DO/Oxygen Demand Pathogens
Bergen Basin	I	Nitrogen DO/Oxygen Demand Pathogens
Thurston Basin	I	DO/Oxygen Demand
Spring Creek	I	DO/Oxygen Demand Pathogens
Fresh Creek	I	Not Listed
Hendrix Creek	I	Nitrogen DO/Oxygen Demand Pathogens

Another important component of the CWA is the protection of uses. USEPA regulations state that a designated use for a waterbody may be refined under limited circumstances through a Use Attainability Analysis (UAA) which is defined as "*a structured scientific assessment of the chemical, biological, and economic condition in a waterway*" (USEPA, 2000). In the UAA, the DEC would demonstrate that one or more of a limited set of circumstances exists to make such a modification. It could be shown that the current designated use cannot be achieved through implementation of applicable technology-based limits on point sources, or cost-effective and reasonable best management practice for non-point sources. Additionally, a determination could be made that the cause of non-attainment is due to natural background conditions or irreversible human-caused conditions. Another circumstance might be to establish that attaining the designated use would cause substantial environmental damage or substantial and widespread social and economic hardship. If the findings of a UAA suggest authorizing the revision of a use or modification of a WQS is appropriate, the analysis and the accompanying proposal for such a modification must go through the public review and participation process and the USEPA approval process.

1.2.2 Federal CSO Policy

The first national CSO Control Strategy was published by USEPA in the Federal Register on September 8, 1989 (54 FR 37370). The goals of that strategy were to minimize impacts to water quality, aquatic biota, and human health from CSOs by ensuring that CSO discharges comply with the technology and water quality based requirements of the CWA. On April 19, 1994, USEPA officially noticed the CSO Control Policy (59 FR 18688), which established a consistent National approach for controlling discharges from all CSOs to the waters of the United States. The CSO Control Policy provides guidance to permittees and NPDES permitting authorities such as DEC on the development and implementation of a LTCP in accordance with the provisions of the CWA to attain water quality standards in accordance with the CWA. On

December 15, 2000, amendments to Section 402 of the CWA (known as the Wet Weather Water Quality Act of 2000) were enacted incorporating the CSO Control Policy by reference.

USEPA has stated that its CSO Control Policy represents a comprehensive national strategy to ensure that municipalities, permitting authorities, water quality standards authorities and the public engage in a comprehensive and coordinated planning effort to achieve cost-effective CSO controls that ultimately meet appropriate health and environmental objectives and requirements (USEPA, 1995a). Four key principles of the CSO Control Policy ensure that CSO controls are cost effective and meet the objectives of the CWA:

1. Clear levels of control are provided that would be presumed to meet appropriate health and environmental objectives;
2. Sufficient flexibility is allowed to municipalities to consider the site-specific nature of CSOs and to determine the most cost effective means of reducing pollutants and meeting CWA objectives and requirements;
3. A phased approach to implementation of CSO controls is acceptable; and
4. Water quality standards and their implementation procedures may be reviewed and revised,as appropriate, when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs.

In addition, the CSO Control Policy clearly defines expectations for permittees, WQS authorities, and NPDES permitting and enforcement authorities. Permittees were expected to have implemented USEPA's nine minimum controls (NMCs) by 1997, after which long-term control plans should be developed. The NMCs are embodied in the 14 Best Management Practices (BMPs) required by DEC as discussed in Section 5.3, and include:

1. Proper operations and maintenance of combined sewer systems and combined sewer overflow outfalls;
2. Maximum use of the collection system for storage;
3. Review and modification of pretreatment requirements to determine whether non-domestic sources are contributing to CSO impacts;
4. Maximizing flow to the Publicly Owned Treatment Works (POTWs);
5. Elimination of CSOs during dry weather;
6. Control of solid and floatable material in CSOs;
7. Pollution prevention programs to reduce contaminants in CSOs;
8. Public notification; and
9. Monitoring to characterize CSO impacts and the efficacy of CSO controls.

WQS authorities should review and revise, as appropriate, State WQS during the CSO long-term planning process. NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.

In July 2001, USEPA published *Coordinating CSO Long-Term Planning with Water Quality Standards Reviews*, additional guidance to address questions and describe the process of integrating development of CSO long-term control plans with water quality standards reviews (USEPA, 2001d). The guidance acknowledges that the successful implementation of an LTCP requires coordination and cooperation among CSO communities, constituency groups, states and USEPA using a watershed approach. As part of the LTCP development, USEPA recommends that WQS authorities review the LTCP to evaluate the attainability of applicable water quality standards. The data collected, analyses and planning performed by all parties may be sufficient to justify a water quality standards revision if a higher level of designated uses is attainable or if existing designated uses are not reasonably attainable. If the latter is true, then the USEPA allows the State WQS authorities to consider several options:

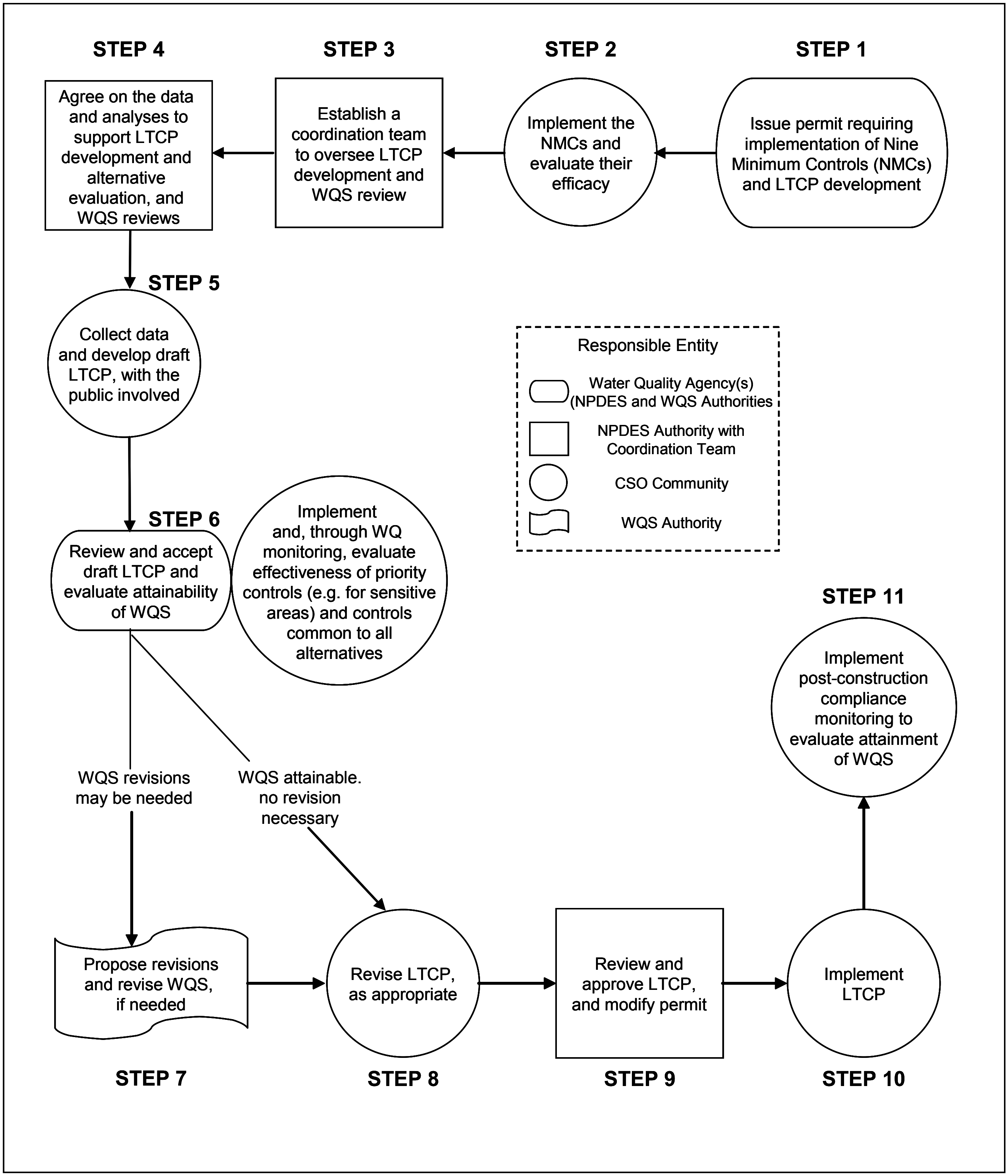
- Apply site-specific criteria;
- Apply criteria at the point of contact rather than at the end-of-pipe through the establishment of a mixing zone, waterbody segmentation, or similar;
- Apply less stringent criteria when it is unlikely that recreational uses will occur or when water is unlikely to be ingested;
- Consider subcategories of uses, such as precluding swimming during or immediately following a CSO event or developing a CSO subcategory of recreational uses; and
- Consider a tiered aquatic life system with subcategories for urban systems.

If the waterbody supports a use with more stringent water quality requirements than the designated use, USEPA requires the State to revise the designated use to reflect the higher use being supported. Conversely, USEPA requires that a UAA be performed whenever the state proposes to reduce the level of protection for the waterbody. States are not required to conduct UAAs when adopting more stringent criteria for a waterbody. Once water quality standards are revised, the CSO Control Policy requires post-implementation compliance monitoring to evaluate the attainment of designated uses and water quality standards and to determine if further water quality revisions and/or additional long-term control planning is necessary. USEPA provides a schematic chart (Figure 1-3) in its guidance for describing the coordination of LTCP development and water quality standards review and revision.

It is important to note that New York City's CSO abatement efforts were prominently displayed as model case studies by USEPA during a series of seminars held across the United States in 1994 to discuss the CSO Control Policy with permittees, WQS authorities, and NPDES permitting authorities (USEPA, 1994). New York City's field investigations, watershed and receiving water modeling, and facility planning conducted during the Paerdegat Basin Water Quality Facility Planning Project were specifically described as a case study during the seminars. Additional City efforts in combined sewer system characterization, mathematical modeling, water quality monitoring, floatables source and impact assessments, and use attainment were also displayed as model approaches to these elements of long-term CSO planning.

1.2.3 New York State Policies and Regulations

In accordance with the provisions of the Clean Water Act, the State of New York has promulgated water quality standards for all waters within its jurisdiction. The State has



Environmental Protection

LTCP and Water Quality Standards Review Flow Chart

developed a system of waterbody classifications based on designated uses that includes five marine classifications, as shown in Table 1-2. New York State Water Quality classifications for the assessment area are shown in Figure 1-4.

Table 1-2. New York State Numeric Surface Water Quality Standards (Saline)

Classes	Usage	DO (mg/L)	Total Coliform(1,3) (per 100 mL)	Fecal Coliform(2,3) (per 100 mL)
SA	Shellfishing for market purposes, primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8(1) ≥3.0(2)	≤ 70 (3)	N/A
SB	Primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8(1) ≥3.0(2)	≤ 2,400 (4) ≤ 5,000 (5)	≤ 200 (6)
SC	Limited primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8(1) ≥3.0(2)	≤ 2,400 (4) ≤ 5,000 (5)	≤ 200 (6)
I	Secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.0(2)	≤ 10,000 (6)	≤ 2,000 (6)
SD	Fishing. Suitable for fish survival. Waters with natural or man-made conditions limiting attainment of higher standards.	≥ 3.0(2)	N/A	N/A

Notes:

(1) Chronic standard based on daily average. The DO concentration may fall below 4.8 mg/L for a limited number of days, as defined by:

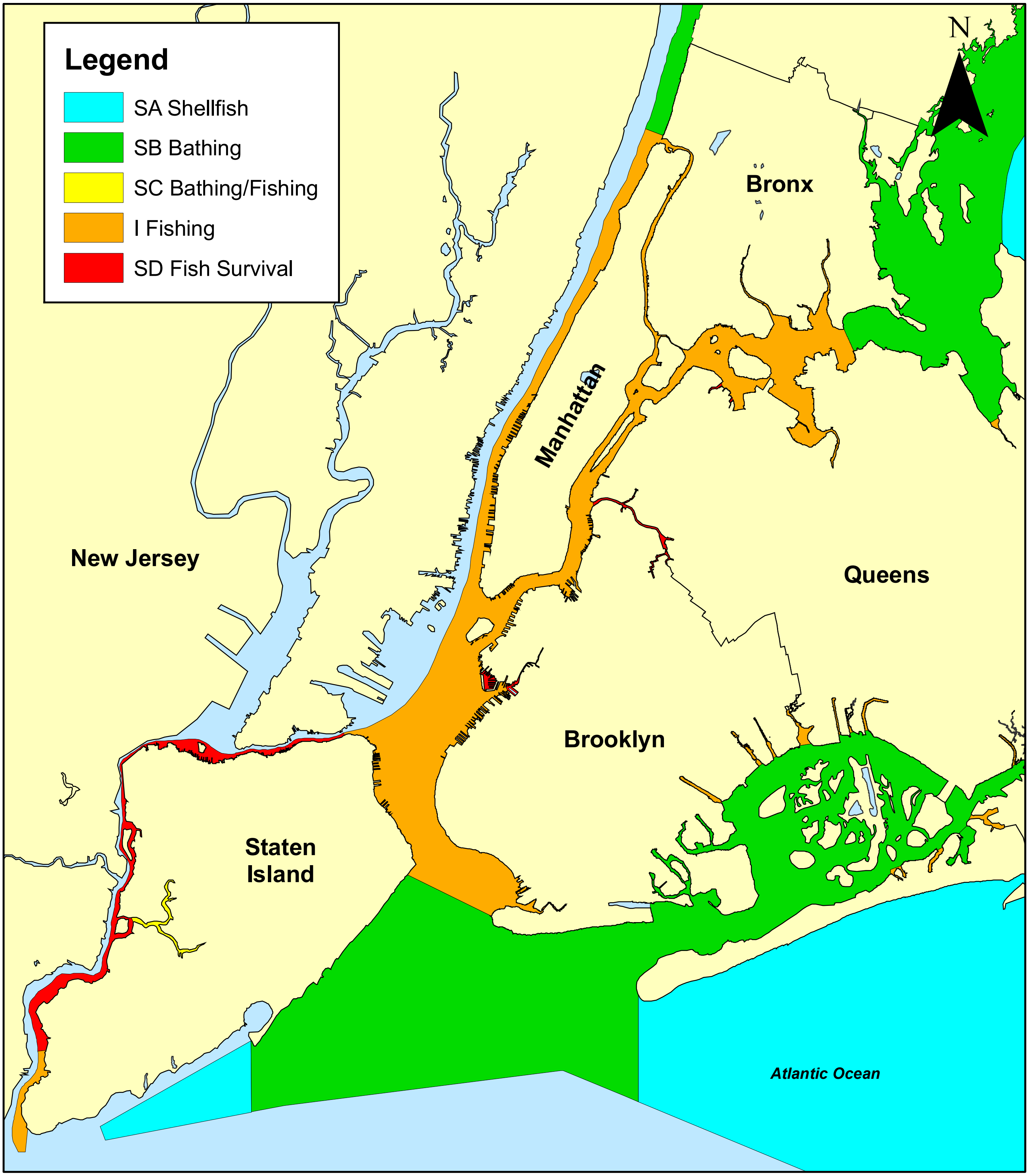
$$DO_i = \frac{13.0}{2.80 + 1.84e^{-0.1t_i}}$$

Where DO_i = DO concentration in mg/L between 3.0-4.8 mg/L and t_i = time in days. This equation is applied by dividing the DO range of 3.0-4.8 mg/L into a number of equal intervals. DO_i is the lower bound of each interval (i) and t_i is the allowable number of days that the DO concentration can be within that interval. The actual number of days that the measured DO concentration falls within each interval (i) is divided by the allowable number of days that the DO can fall within interval (T_i). The sum of the quotients of all intervals (I …. N) cannot exceed 1.0: i.e.,

$$\sum_{i=1}^{n} \frac{t_i\ (actual)}{t_i\ (allowed)} < 1.0$$

(2) Acute standard (never less than 3.0 mg/L)
(3) Median most probable number (MPN) value in any series of representative samples
(4) Monthly median value of five or more samples
(5) Monthly 80th percentile of five or more samples
(6) Monthly geometric mean of five or more samples

Jamaica Bay is classified by New York State as Class SB saline surface waters with best uses designated for primary and secondary contact recreation and fishing. Each of the Jamaica Bay CSO tributaries are classified as Class I saline surface waters with best uses designated for secondary recreation contact and fishing. The waters of Jamaica Bay and its CSO tributaries are required to be suitable for fish, shellfish and wildlife propagation and survival.



Environmental Protection

Best Use Water Classifications

DEC considers the SA and SB classifications to fulfill the Clean Water Act goals of fully supporting aquatic life and recreation. Class SC supports aquatic life and recreation but the recreational use of the waterbody is limited due to other factors. Class I supports the Clean Water Act goal of aquatic life protection and supports secondary contact recreation. SD waters shall be suitable for fish survival only because natural or manmade conditions limit the attainment of higher standards.

Dissolved Oxygen

DO is the water quality parameter that DEC uses to establish whether a waterbody supports aquatic life uses. The numerical DO standard for Jamaica Bay (Class SB) requires that DO concentrations are at or above 4.8 milligrams/liter (mg/L) on a daily average. The dissolved oxygen numerical standard for the Class I CSO Tributaries (Fresh, Spring and Hendrix Creeks; Bergen and Thurston Basins) requires that dissolved oxygen concentrations are at or above 4.0 mg/L at all times at all locations within the waterbody.

Bacteria

Total and fecal coliform bacteria concentrations are the numerical standards used by DEC to establish whether a waterbody supports recreational uses. The numerical bacteria standards for Jamaica Bay (Class SB) require that total coliform bacteria must have a monthly geometric mean of less than 2,400 colonies per 100 milliliters (mL) from a minimum of five examinations. Fecal coliform for Class SB waters must have a monthly geometric mean of less than 200 colonies per 100 mL from a minimum of five examinations.

The numerical criteria for the CSO tributaries (Class I) requires that total coliform bacteria must have a monthly geometric mean of less than 10,000 colonies per 100 mL from a minimum of five examinations. Fecal coliform for the CSO tributaries must have a monthly geometric mean of less than 2,000 colonies per 100 mL from a minimum of five examinations.

An additional DEC standard for primary contact recreational waters within Jamaica Bay is a maximum allowable enterococci concentration of a geometric mean of 35 colonies per 100 mL for a representative number of samples. This standard, although not promulgated, is now an enforceable standard in New York State since the USEPA established January 1, 2005 as the date upon which the criteria must be adopted for all coastal recreational waters.

For areas of primary contact recreation that are used infrequently and are not designated as bathing beaches, the USEPA criteria suggest that a reference level indicative of pollution events be considered to be a single sample maxima enterococci concentration of 501 colonies per 100 mL. These reference levels, in accordance with the USEPA documents are not standards but are to be used as determined by the state agencies in making decisions related to recreational uses and pollution control needs. For bathing beaches, these reference levels (104 colonies per 100 mL single sample maxima enterococci concentration) are to be used for announcing bathing advisories or beach closings in response to pollution events. In anticipation of the new bacteria standards, DEP has started measuring enterococci in its Harbor Survey program and at WWTP influents and effluents and the New York City Department of Health and Mental Hygiene has started to monitor enterococci concentrations at designated bathing beaches.

Narrative Standards

In addition to numerical standards, New York State also has narrative criteria to protect aesthetics in all waters within its jurisdiction, regardless of classification. These standards also serve as limits on discharges to receiving waters within the State. Unlike the numeric standards, which provide an acceptable concentration, narrative criteria generally prohibit quantities that would impair the designated use or have a substantial deleterious effect on aesthetics. Important exceptions include garbage, cinders, ashes, oils, sludge and other refuse, which are prohibited in any amounts. The term “other refuse” has been interpreted to include floatable materials such as street litter that finds its way into receiving waters via uncontrolled CSO discharges. It should be noted that in August 2004, USEPA Region II recommended that DEC “revise the narrative criteria for aesthetics to clarify that these criteria are meant to protect the best use(s) of the water, and not literally required 'none' in any amount, or provide a written clarification to this end” (Mugdan, 2004). Table 1-3 summarizes the narrative water quality standards.

Table 1-3. New York State Narrative Water Quality Standards

Parameters	Classes	Standard
Taste, color, and odor producing toxic and other deleterious substances	SA, SB, SC, I, SD A, B, C, D	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	SA, SB, SC, I, SD A, B, C, D	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	SA, SB, SC, I, SD A, B, C, D	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	SA, SB, SC, I, SD A, B, C, D	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
Garbage, cinders, ashes, oils, sludge and other refuse	SA, SB, SC, I, SD A, B, C, D	None in any amounts.
Phosphorus and nitrogen	SA, SB, SC, I, SD A, B, C, D	None in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages.

1.2.4 Interstate Environmental Commission (IEC)

The states of New York, New Jersey, and Connecticut are signatory to the Tri-State Compact that designated the Interstate Environmental District and created the IEC. The Interstate Environmental District includes all tidal waters of greater New York City. Originally established as the Interstate Sanitation Commission, the IEC may develop and enforce waterbody classifications and effluent standards to protect waterbody uses within the Interstate Environmental District. The applied classifications and effluent standards are intended to be consistent with those applied by the signatory states. There are three waterbody classifications defined by the IEC, as shown in Table 1-4.

Table 1-4. Interstate Environmental Commission Numeric Water Quality Standards

Class	Usage	DO (mg/L)	Waterbodies
A	All forms of primary and secondary contact recreation, fish propagation, and shellfish harvesting in designated areas	≥ 5.0	East R. east of the Whitestone Br.; Hudson R. north of confluence with the Harlem R; Raritan R. east of the Victory Br. into Raritan Bay; Sandy Hook Bay; lower New York Bay; Atlantic Ocean
B-1	Fishing and secondary contact recreation, growth and maintenance of fish and other forms of marine life naturally occurring therein, but may not be suitable for fish propagation.	≥ 4.0	Hudson R. south of confluence with Harlem R.; upper New York Harbor; East R. from the Battery to the Whitestone Bridge; Harlem R.; Arthur Kill between Raritan Bay and Outerbridge Crossing.
B-2	Passage of anadromous fish, maintenance of fish life	≥ 3.0	Arthur Kill north of Outerbridge Crossing; Newark Bay; Kill Van Kull

In general, IEC water quality regulations require that all waters of the Interstate Environmental District are free from floating and settleable solids, oil, grease, sludge deposits, and unnatural color or turbidity to the extent necessary to avoid unpleasant aesthetics, detrimental impacts to the natural biota, or use impacts. The regulations also prohibit the presence of toxic or deleterious substances that would be detrimental to fish, offensive to humans, or unhealthful in biota used for human consumption. The IEC also restricts CSO discharges to within 24 hours of a precipitation event, consistent with the DEC definition of a prohibited dry weather discharge. Beyond that restriction, however, IEC effluent quality regulations do not apply to CSOs if the combined sewer system is being operated with reasonable care, maintenance, and efficiency.

Although IEC regulations are intended to be consistent with State water quality standards, the three-tiered IEC system and the five New York State marine classifications in New York Harbor do not overlap exactly; for example, the Class A DO numeric criterion (5 mg/L) differs from New York State's Class I criterion (4 mg/L). Primary contact recreation is defined in the IEC regulations as recreational activity that involves significant ingestion risk, including but not limited to wading, swimming, diving, surfing, and waterskiing. It defines secondary contact recreation as activities in which the probability of significant contact with the water or water ingestion is minimal including but not limited to boating, fishing and shoreline recreational activities involving limited contact with surface waters.

1.2.5 Other Regulatory Considerations

The majority of land within the Jamaica Bay complex is publicly owned by the federal government and the City of New York. Most of Jamaica Bay proper and portions of the uplands and barrier beach are part of the Gateway National Recreation Area (GNRA). Administered by the National Park Service, GNRA includes the Jamaica Bay Wildlife Refuge, Breezy Point, and Floyd Bennett Field which totals approximately 9,155 acres. There are several City parks within the Bay complex, including Marine Park and Edgemere Park, and numerous smaller parcels of city-owned land. John F. Kennedy International Airport is owned by the City of New York and operated by the Port Authority of New York and New Jersey. Jamaica Bay has been designated and mapped as a protected beach unit pursuant to the federal Coastal Barrier Resources Act, prohibiting incompatible Federal financial assistance or flood insurance within the unit. The New York State Natural Heritage Program, in conjunction with The Nature Conservancy, recognizes two Priority Sites for Biodiversity within the Jamaica Bay and Breezy Point habitat complex: Breezy Point (very high biodiversity significance) and Fountain Avenue Landfill (high biodiversity significance). Jamaica Bay and Breezy Point have been designated as Significant Coastal Fish and Wildlife Habitats by the New York State Department of State, and the Bay up to the high tide line was designated as a Critical Environmental Area by the DEC. Jamaica Bay was also designated as one of three special natural waterfront areas by New York City's Department of City Planning.

1.2.6 Administrative Consent Order

New York City's 14 WWTP SPDES permits include conditions which require compliance with Federal and State CSO requirements. DEP was unable to comply with deadlines included within their 1988 SPDES permits for completion of CSO abatement projects initiated in the early 1980s. As a result, DEP entered into an Administrative Consent Order with DEC on June 26, 1992 which was incorporated into the SPDES permits with a provision stating that the Consent Order governs DEP's obligations for its CSO program. It also required that DEP implement CSO abatement projects within nine facility planning areas in two tracks: those areas where DO and coliform standards were being contravened (Track One), and those areas where floatables control was necessary (Track Two). The 1992 Order was modified on September 19, 1996 to add catch basin cleaning, construction, and repair programs.

DEP and DEC negotiated a new Consent Order, signed January 14, 2005, that supersedes the 1992 Order and its 1996 Modifications, with the intent to bring all DEP CSO-related matters into compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The new Order contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for Citywide long-term CSO control in accordance with USEPA CSO Control Policy. This Order was recently modified and signed on April 14, 2008 and again on September 3, 2009. DEP and DEC also entered into a separate MOU to facilitate water quality standards reviews in accordance with the CSO Control Policy.

1.3 CITY POLICIES AND OTHER LOCAL CONSIDERATIONS

New York City's waterfront is approximately 578 miles long, encompassing 17 percent of the total shoreline of the State. This resource is managed through multiple tiers of zoning, regulation, public policy, and investment incentives to accommodate the diverse interests of the waterfront communities and encourage environmental stewardship. The local regulatory considerations are primarily applicable to proposed projects and do not preclude the existence of non-conforming waterfront uses. However, evaluation of existing conditions within the context of these land use controls and public policy anticipate the nature of long-term growth in the watershed.

1.3.1 New York City Waterfront Revitalization Program

The New York City Waterfront Revitalization Program (WRP) is the City's principal coastal zone management tool and is implemented by the New York City Department of City Planning (NYCDCP). The WRP establishes the City's policies for development and use of the waterfront and provides a framework for evaluating the consistency of all discretionary actions in the coastal zone with City coastal management policies. Projects subject to consistency review include any project located within the coastal zone requiring a local, state, or federal discretionary action, such as a Uniform Land Use Review Procedure (ULURP) or a City Environmental Quality Review (CEQR). An action is determined to be consistent with the WRP if it would not substantially hinder and, where practicable, would advance one or more of the 10 WRP policies. The New York City WRP is authorized under the New York State Waterfront Revitalization and Coastal Resource Act of 1981 which, in turn, stems from the Federal Coastal Zone Management Act of 1972. The original WRP was adopted in 1982 as a local plan in accordance with Section 197-a of the City Charter, and incorporated the 44 state policies, added 12 local policies, and delineated a coastal zone to which the policies would apply. The program was revised in 1999, and the new WRP policies were issued in September 2002. The revised WRP condensed the 12 original policies into 10 policies: (1) residential and commercial redevelopment; (2) water-dependent and industrial uses; (3) commercial and recreational boating; (4) coastal ecological systems; (5) water quality; (6) flooding and erosion; (7) solid waste and hazardous substances; (8) public access; (9) scenic resources; and (10) historical and cultural resources.

1.3.2 New York City Comprehensive Waterfront Plan

The City's long-range goals are contained in the Comprehensive Waterfront Plan (CWP). The CWP identifies four principal waterfront functional areas (natural, public, working, and redeveloping) and promotes use, protection, and redevelopment in appropriate waterfront areas. The companion Borough Waterfront Plans (1993-1994) assess local conditions and propose strategies to guide land use change, planning and coordination, and public investment for each of the waterfront functional areas. The CWP has been incorporated into local law through land use changes, zoning text amendments, public investment strategies, and regulatory revisions, which provide geographic specificity to the WRP and acknowledge that certain policies are more relevant than others in particular portions of the waterfront.

1.3.3 Department of City Planning Actions

The NYCDCP was contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Jamaica Bay. NYCDCP reviews any proposal that would result in a fundamental alteration in land use, such as zoning map and text amendments, special permits under the Zoning Resolution, changes in the City Map, the disposition of City-owned property, and the siting of public facilities. In addition, NYCDCP maintains a library of Citywide plans, assessments of infrastructure, community needs evaluations, and land use impact studies. These records were reviewed and evaluated for their potential impacts to waterbody use and runoff characteristics, and the NYCDCP community district liaison for the Community District was contacted to determine whether any proposals in process that required NYCDCP review might impact the WB/WS Plan.

1.3.4 New York City Economic Development Corporation

The New York City Economic Development Corporation (NYCEDC) was contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Jamaica Bay. The NYCEDC is charged with dispensing City-owned property to businesses as a means of stimulating economic growth, employment, and tax revenue in the City of New York while simultaneously encouraging specific types of land use in targeted neighborhoods. As such, NYCEDC has the potential to alter land use on a large scale.

Additionally, the NYCEDC serves as a policy instrument for the Mayor's Office, and recently issued a white paper on industrial zoning (Office of the Mayor, 2005) intended to create and protect industrial land uses throughout the City. The policy directs the replacement of the current In-Place Industrial Parks (IPIPs) with Industrial Business Zones (IBZs) that more accurately reflect the City's industrial areas. Policies of this nature can have implications on future uses of a waterbody as well as impacts to collection systems. Accordingly, a thorough review of NYCEDC policy and future projects was performed to determine the extent to which they may impact the WB/WS Plan. John F. Kennedy International Airport (JFK) is included in the JFK Industrial Business Area.

1.3.5 Local Law

Local law is a form of municipal legislation that has the same status as an act of the State Legislature. The power to enact local laws is granted by the New York State Constitution, with the scope and procedures for implementation established in the Municipal Home Rule Law. In New York City, local laws pertaining to the use of the City waterways and initiatives associated with aquatic health have been adopted beyond the requirements of New York State. Recent adoptions include Local Law 71 of 2005, which required the development of the Jamaica Bay Watershed Protection Plan (JBWPP) and Local Law 5 of 2008 which requires City-owned buildings or City-funded construction to include certain sustainable practices, as well as requiring the City to draft a sustainable stormwater management plan by October 1, 2008. These initiatives are discussed in Section 5 in detail.

1.3.6 Bathing Beaches

Bathing beaches in New York City are regulated, monitored and permitted by the City and State under Article 167 of the New York City Health Code and Section 6-2.19 of the New York City Sanitary Code. Siting requirements imposed by State and City codes must be considered to evaluate the potential use of a waterbody for primary contact recreation. These requirements include minimum distances from certain types of regulated discharges (such as CSO outfalls), maximum bottom slopes, acceptable bottom materials, minimum water quality levels, and physical conditions that ensure the highest level of safety for bathers.

1.4 REPORT ORGANIZATION

This report has been organized to clearly describe the proposed WB/WS Facility Plan that supports a Long-Term CSO Control Planning process and the environmental factors and engineering considerations that were evaluated in its development. The nine elements of long-term CSO control planning are listed in Table 1-5 along with relevant sections within this document for cross-referencing.

Table 1-5. Locations of the Nine Minimum Elements of Long-Term Control Planning

No.	Element	Section(s) Within Report
1	Characterization of the Combined Sewer System	3.0
2	Public Participation	6.0
3	Consideration of Sensitive Areas	4.7
4	Evaluation of Alternative	7.0
5	Cost/Performance Considerations	7.0
6	Operational Plan	8.0
7	Maximizing Treatment at the Existing WWTP	7.0 & 8.0
8	Implementation Schedule	8.0
9	Post-Construction Compliance Monitoring	8.0

Section 1 describes general planning information and the regulatory considerations in order to describe the setting and genesis of the LTCP and the CSO Control Policy. Sections 2, 3, and 4 describe the existing watershed, collection system, and waterbody characteristics, respectively. Section 5 describes related waterbody improvement projects within the waterbody and the greater New York Harbor. Section 6 describes the public participation and agency interaction that went into the development of this WB/WS Facility Plan, as well as an overview of DEP's public outreach program. Sections 7 and 8 describe the development of the plan for the waterbody. Section 9 discusses the review and revision of water quality standards. The report concludes with references in Section 10 and a glossary of terms and abbreviations is included in Section 11. Attached for reference are the Wet Weather Operating Plans for the 26th Ward, Rockaway, and Jamaica Bay WWTPs.

NO TEXT ON THIS PAGE

2.0 Watershed Characteristics

Jamaica Bay has played an important part in the history and development of the New York City metropolitan area. The Bay is situated at the southwestern tip of Long Island and is located primarily within the New York City boroughs of Brooklyn and Queens. A relatively small portion of the Bay is located in the Town of Hempstead in Nassau County, New York. Jamaica Bay connects with Lower New York Bay to the west through Rockaway Inlet. Jamaica Bay contains approximately 16,000 acres of surface waters and 3,000 acres of islands and marshes and is among the largest estuarine complexes in New York State. It measures approximately 10 miles at its widest point east to west and approximately 4 miles at its widest point north to south. The mean depth of the Bay is approximately 13 feet, with maximum depths reaching 30 to 50 feet in navigation channels and borrows areas (West-Valle, 1992).

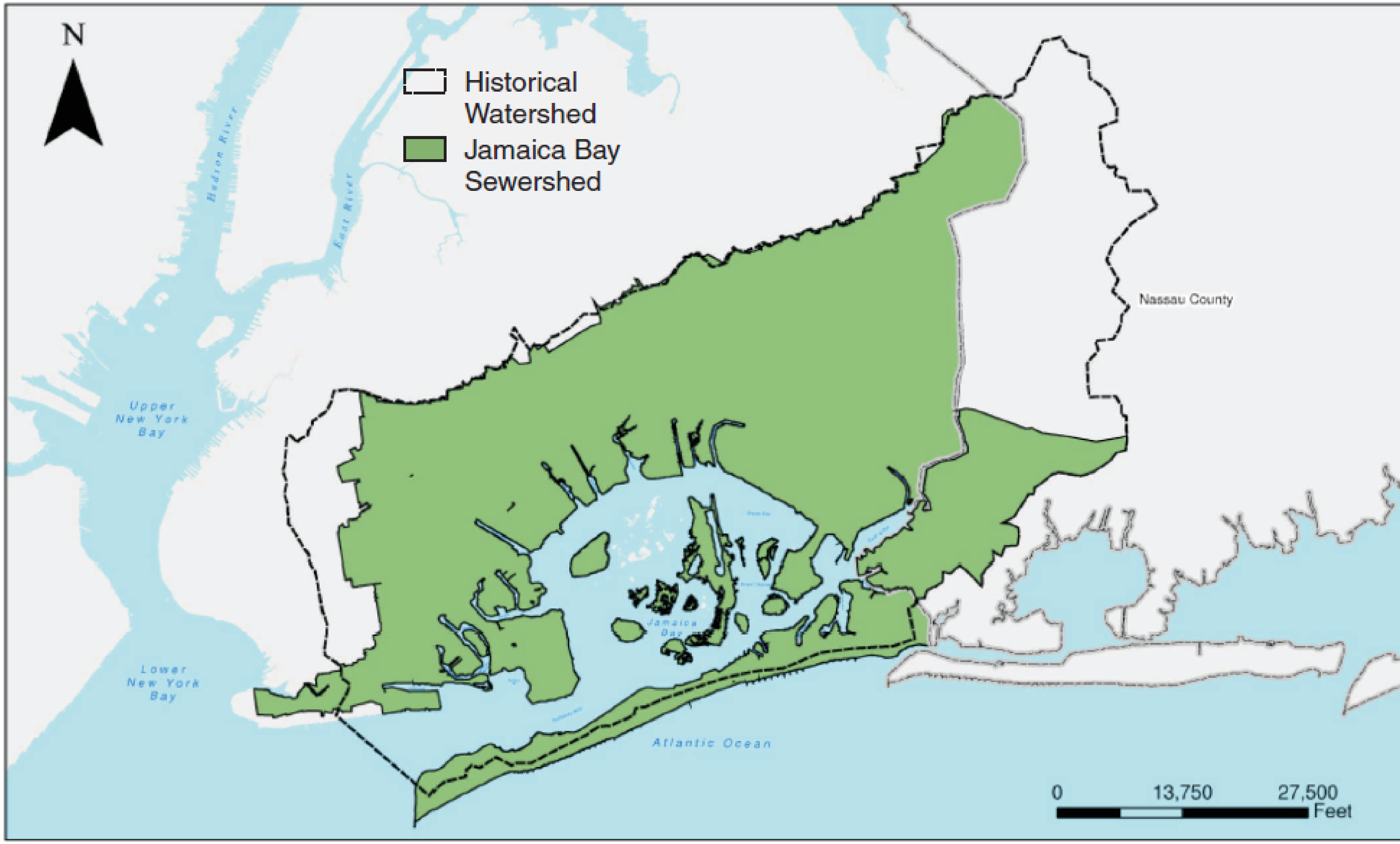
The following sections present the historical context of changes in Jamaica Bay and CSO tributary watersheds, current and future land use, and shoreline characteristics that have influenced pollutant loadings from the watershed to the waterbody.

2.1 HISTORICAL CONTEXT OF WATERSHED URBANIZATION

Urbanization has resulted in both a highly impervious watershed and receiving water generally less capable of assimilating stormwater-based pollutants, a combination that has directly contributed to water quality in Jamaica Bay. Anthropomorphic changes to the watershed surrounding Jamaica Bay have replaced most of the natural watershed with a series of sewersheds. These changes include the following:

- Replacement of natural drainage pathways with channeling of flows through sewers, either separate storm sewers or combined sewers, resulting in an increase in freshwater flow volume and peak intensity;
- The complete reconstruction of tributary waterbodies into straight navigation channels with hardened shoreline structures such as bulkheads and sea walls;
- The creation of several large dredge material borrow pits throughout the Bay that have been used to provide fill for the construction of JFK, among other projects; and
- Substantial loss of wetlands and upland buffer zones due to filling activities and land development (DEP, 1994).

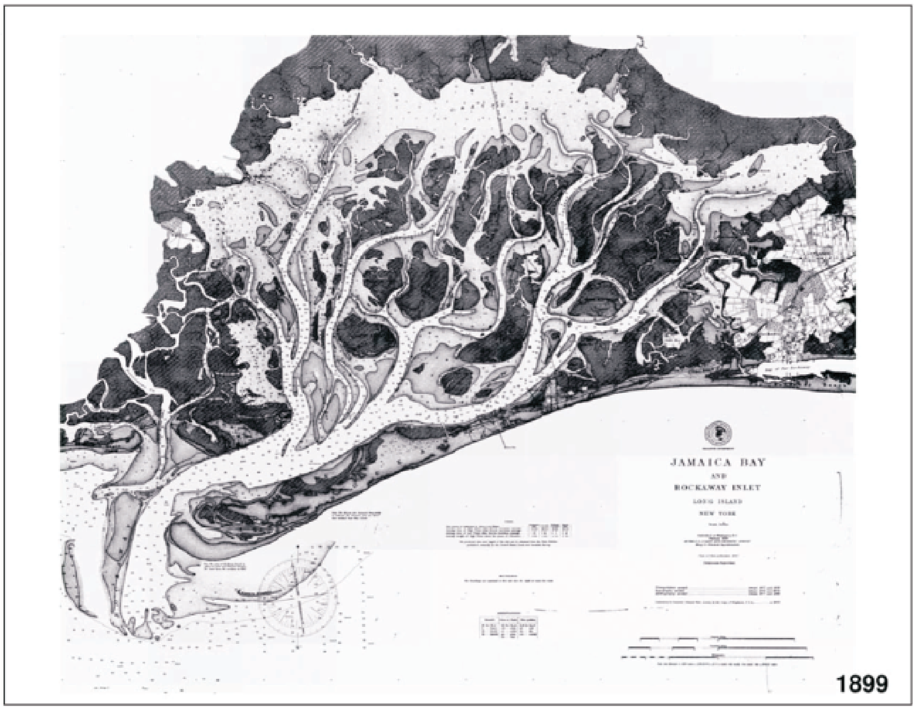
Figure 2-1 shows the existing Jamaica Bay Sewershed and its historical watershed. The Bay currently includes areas of open water, tidal flatlands, salt marshes, and a number of islands. Figure 2-2 presents a comparison of nautical charts of Jamaica Bay from an 1899 nautical chart of Jamaica Bay and a nautical chart developed in 2002. Many of the natural tributaries have been altered for navigational purposes, and large changes in bathymetry and marshland are evident, likely resulting in different circulation patterns than in the natural condition. The channelization, elimination of freshwater sources, and loss of wetlands and open space due to urban development in the watershed is evident.

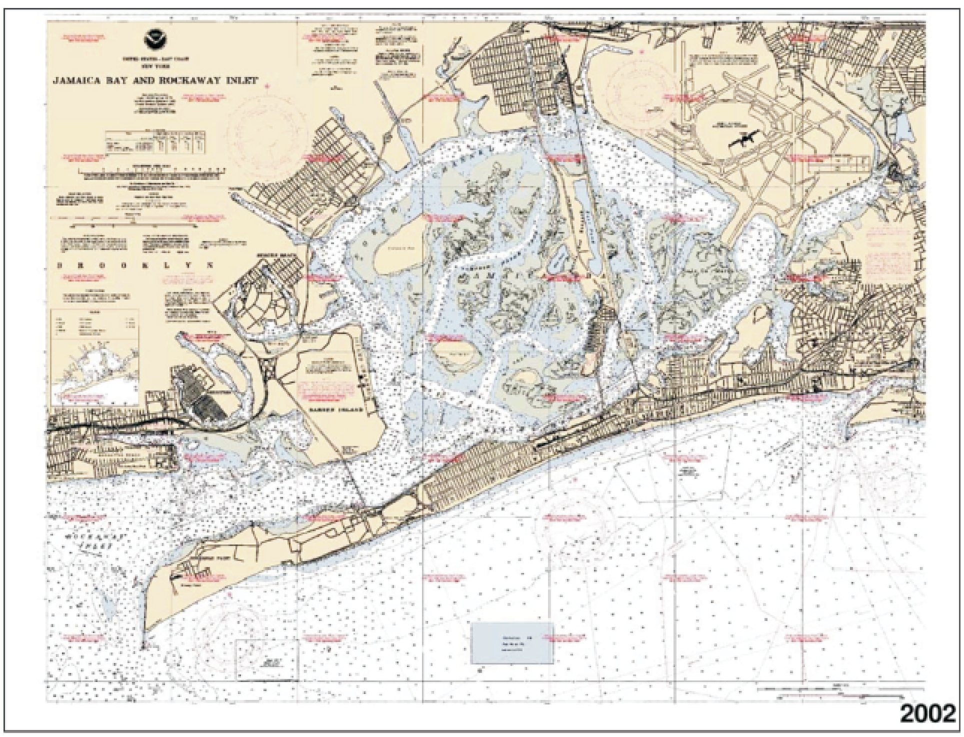


Environmental Protection

Comparison of Jamaica Bay Sewershed and Historical Watershed

Figure 2-1





Environmental Protection

**Nautical Charts of Jamaica Bay
1899 and 2002**

The historical uses of the watershed are tied to the development of Brooklyn and Queens. The following subsections present a summary of the historical development for each borough.

2.1.1 Brooklyn History

A review of historical maps shows that the area of Brooklyn adjacent to Jamaica Bay was largely undeveloped marshland until the turn of the 20th century. The neighborhoods of East New York and Flatbush were the closest developed areas of Brooklyn to Jamaica Bay, although limited development had occurred in Canarsie Landing and Bergen Beach on high ground that extended into the marshes of Jamaica Bay (Figure 2-3). Brooklyn was originally inhabited by the Lenape, American Indians who planted corn and tobacco and fished in the rivers. The Dutch settled in Manhattan in the early 1600s, and subsequently founded five villages on Long Island: Bushwick, Brooklyn, Flatbush, Flatlands, and New Utrecht. A sixth village, Gravesend, was founded in 1643 by an Englishwoman. The British captured the Dutch territory in 1674, and incorporated the six villages into Kings County, which is now part of New York City. A 1698 census counted 2,017 people in Kings County, about half of whom were Dutch.

Brooklyn quickly became an important commercial port, in part due to the supply of foods grown on Long Island to New York City. The Navy opened a shipyard on Wallabout Bay in 1801, and Robert Fulton began a steam-ferry service across the East River in 1814. The Village of Brooklyn was incorporated in 1816, roughly encompassing what is now known as Brooklyn Heights. By 1860, 40 percent of Brooklyn’s wage earners worked in Manhattan, and ferries carried more than 32 million passengers a year. The intense pressure on ferry service led to the construction of the Brooklyn Bridge, which opened in 1883, spawning a surge in population and development. The City of Brooklyn, created in 1834, expanded to accommodate the new population, eventually encompassing all of Kings County. Brooklyn was incorporated into the City of New York in 1898.

The early 20th century saw a vast expansion in the population and urbanization of Brooklyn. New bridges, trolley lines, elevated railroads, and subway lines went further into the borough. Each expansion opened new settlement and development areas. The rural character of Brooklyn quickly vanished. By the 1930s, the tributary waterbodies had been dredged, straightened, and armored, and by about 1960, most of the shoreline area was developed and expanded around Jamaica Bay.

2.1.2 Queens History

Prior to 1865, nearly all those living near Jamaica Bay pursued farming. Early farmers did not specialize, but practiced a general type of agriculture (Black, 1981). As in Brooklyn, expansion of mass transportation system influenced growth and urbanization in Queens dramaticially. By 1915, most of Queens came within reach of the New York City subway. The Interborough Rapid Transit service opened to Long Island City (1915), Astoria (1917), and Queensboro Plaza (1916). Another branch extended along Queens Boulevard and Roosevelt Avenue, reaching Corona (1917) and Flushing (1928). In southern Queens, the Brooklyn Rapid Transit Company built an elevated line along Liberty Avenue through Ozone Park and Woodhaven to Richmond Hill in 1915 and along Jamaica Avenue from the Brooklyn border through Woodhaven and Richmond Hill to Jamaica during 1917-1918.

Environmental Protection

Alteration of Jamaica Bay Shorelines

Figure 2-3

These improvements in transportation promoted rapid growth. During the 1920s, the population of Queens more than doubled, from 469,042 to 1,079,129. Farms and open areas were replaced with urban street grids aligned without regard to streams, marshes, and other waterbodies that would have to be buried or filled. While the Great Depression of the 1930s ended this boom, transportation improvements continued with new bridges (the Triborough Bridge in 1936 and the Bronx-Whitestone in 1939), roadways (the Interboro Parkway in 1935 and the Grand Central Parkway in 1936), and airports (LaGuardia Airport in 1939 and Idlewild in 1948).

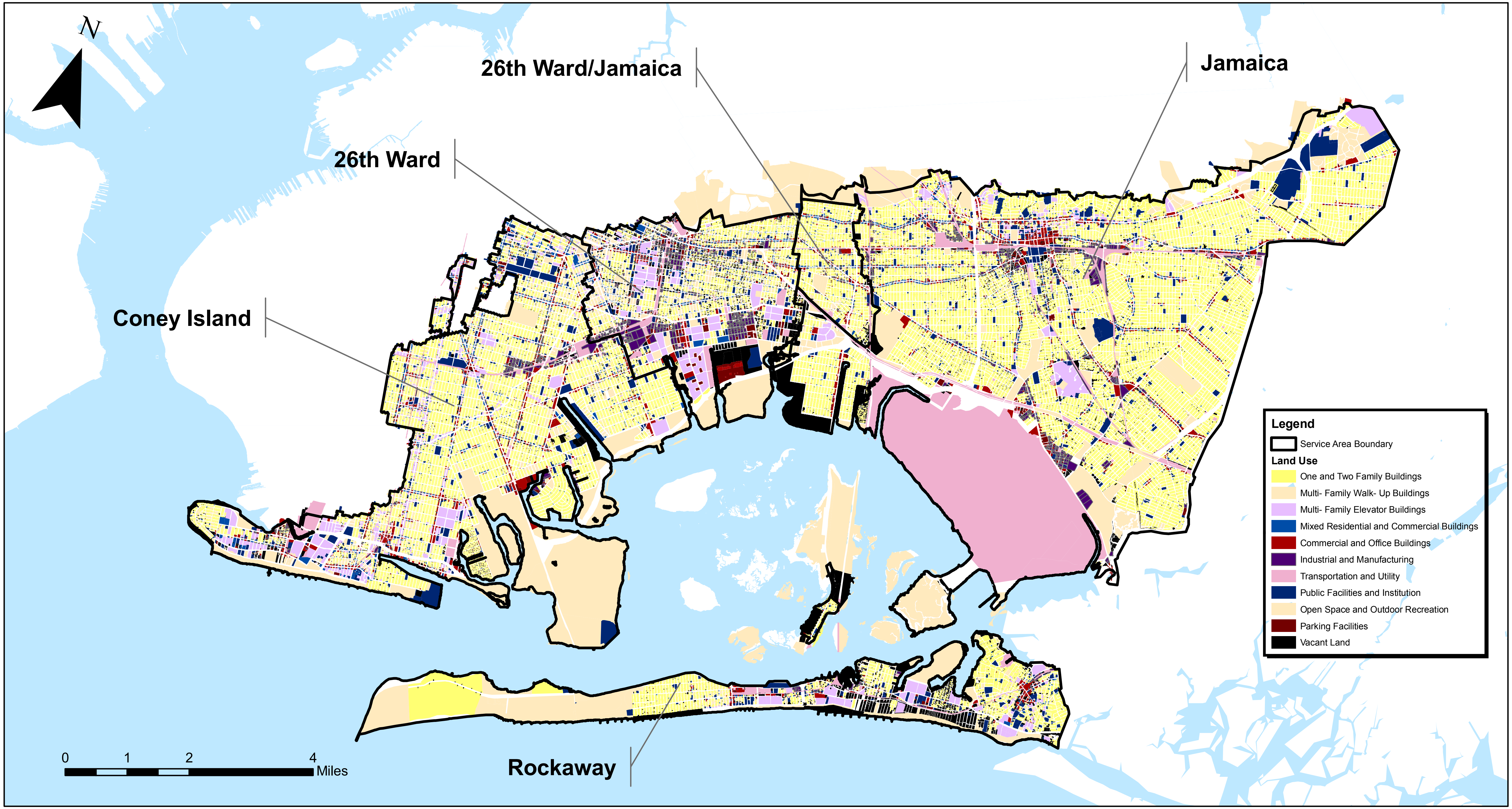
2.1.3 Rockaway History

Although a part of Queens, Rockaway was settled separately and earlier than other areas around Jamaica Bay. In 1833, the Rockaway Association purchased most of the oceanfront property on the Richard Cornell homestead to construct an oceanfront resort called the Marine Hotel in Far Rockaway. Transportation to and from Rockaway originally consisted of horses and horse-drawn carriages, but by the mid-1880s, railroad access was provided, terminating at the present Far Rockaway station of the Long Island Railroad. Land values increased and business expanded rapidly as a consequence, and the population of Far Rockaway was large enough to apply for incorporation in 1888. On July 1, 1897, the Village of Rockaway Park was incorporated into the City of Greater New York. Streets were graded and sections of Rockaway Park, Belle Harbor, and Neponsit began to be developed. Completion of the Cross Bay Bridge in 1925, further development of the beach and boardwalk in 1930, the opening of the Marine Parkway Bridge in 1937, and improvements to the railroad services in 1941 all made Rockaway more accessible, encouraging population growth, development, and urbanization.

2.2 LAND USE CHARACTERIZATION

The Jamaica Bay watershed area would cover approximately 91,000 acres had anthropogenic changes not occurred. Changes to the natural drainage patterns have resulted in a reduction of the existing drainage area to approximately 46,000 acres within New York City limits. As noted previously, a portion of the Jamaica Bay watershed, approximately 9,500 acres, is also located in Nassau County. As may be expected over such a large area, land use within the drainage area varies. This report addresses the land use by Community District in the Jamaica Bay drainage area to gain a better understanding of the land use patterns.

The current land use in the watershed has a substantial effect on water quality, as well as the volume, frequency, and timing of CSOs generated. The presence of hard structures, roads, parking lots, and other impervious surfaces alongside parkland, undeveloped open space, and other vegetated, water-retaining land uses creates a complex runoff dynamic. The current land use is largely an artifact of historical urbanization, but future use is controlled by zoning, public policy, and land use regulations intended to promote activities appropriate to neighborhood character and the community. Existing land use and future changes based on zoning, known land use proposals, and current consistency with relevant land use policies are presented below. Existing land use within the Jamaica Bay watershed is represented graphically in Figure 2-4. Existing zoning within the Jamaica Bay watershed is represented graphically in Figure 2-5.

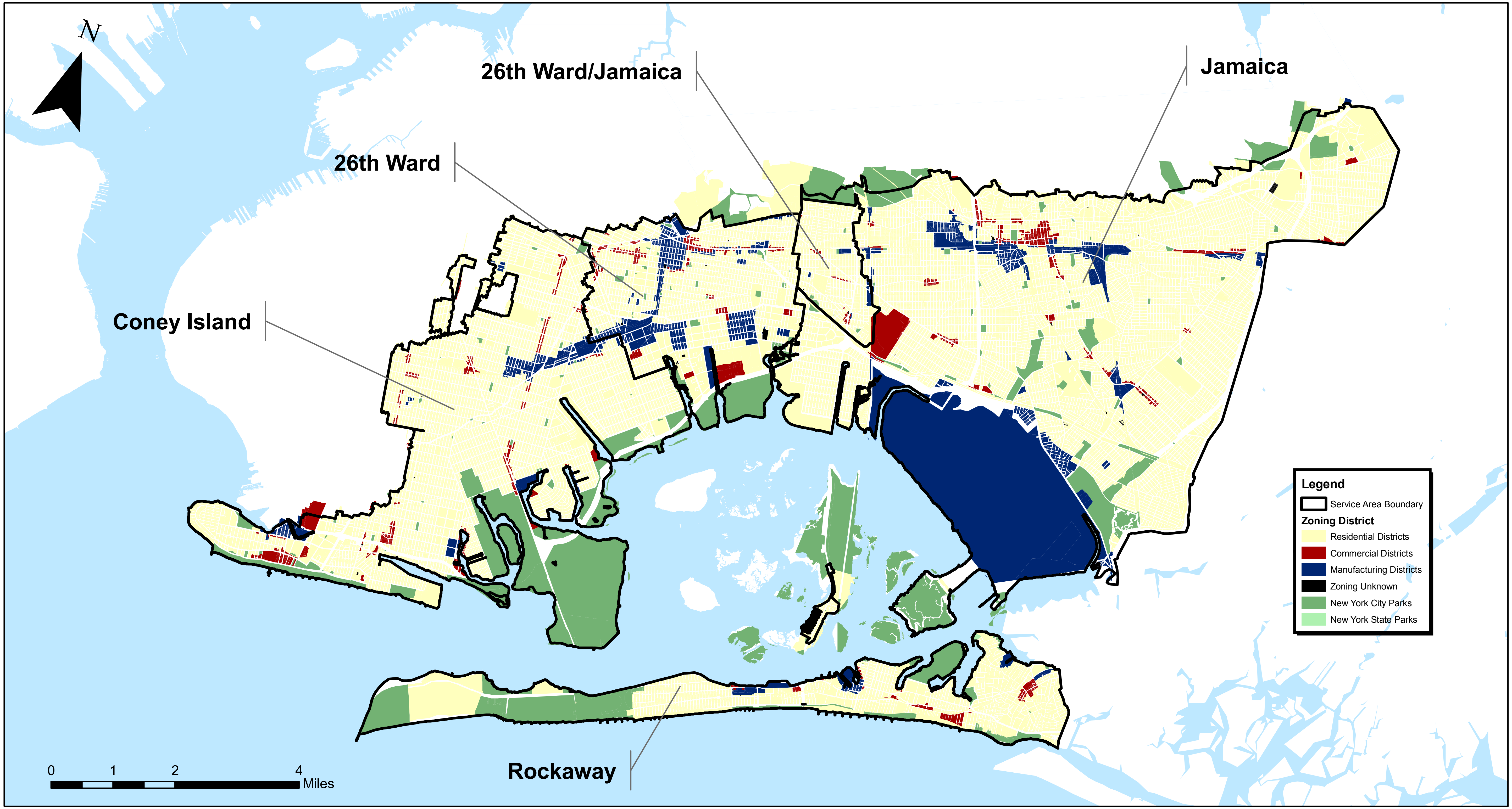


Environmental Protection

Jamaica Bay Land Use

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

Figure 2-4



Environmental Protection

Jamaica Bay Zoning

2.2.1 Existing Land Use

The Jamaica Bay watershed is approximately 46,000 acres in land area. The watershed overall is extensively developed, with the predominant land use residential, comprised mostly of one- and two- family homes (44.7%). Two high-density areas are located within the watershed that represent a mixture of residential, commercial, and industrial land use districts: Downtown Jamaica in Queens located at the northeastern part of the watershed and Broadway Junction-East New York which straddles the Brooklyn-Queens border in the northern reach of the watershed.

Table 2-1 and Table 2-2 show the percentages of the eleven land use categories defined by NYCDCP present in the Brooklyn and Queens portions of the Jamaica Bay watershed, respectively. Table 2-3 compares the land use of the Jamaica Bay Drainage Area to the whole of Brooklyn, Queens, and New York City. It is noteworthy that over half of the land use in the Jamaica Bay drainage area is residential (1 and 2-Family and Multi-Family), compared to 38 percent in Brooklyn as a whole, 46 percent in Queens as a whole, 39 percent in New York City as a whole. Open space is also a significant percentage of the watershed due to the presence of National Park Service (NPS) properties and facilities. The Jamaica Bay Unit of the Gateway National Recreation Area (GNRA) consists of approximately 12,000 acres including the waters surrounding the Jamaica Bay Wildlife Refuge but also significant land areas that surround the Bay including Floyd Bennett Field, Canarsie Pier, Dead Horse Bay, Plumb Beach, Bergen Beach and portions of the Rockaway Peninsula. GNRA property within the watershed is characterized as open space on the land use map (Figure 2-4). The watershed contains numerous city parks and one state park. The relatively large percentage of land use under the Transportation/utility category is primarily due to the presence of the JFK Airport, which is almost 5,000 acres in size.

Table 2-1. Land Use of Brooklyn Community Districts Within Drainage Area

Land Use Category	CD 13	CD 15	CD 18	CD 5	CD 17	CD 16	CD 14	CD 9
1-2 Family Residential	12.4%	50.6%	37.7%	26.0%	44.7%	22.9%	48.3%	33.8%
Multi-Family Residential	22.1%	17.9%	6.6%	20.0%	24.2%	37.0%	24.4%	26.1%
Mixed Res./Commercial	4.0%	3.4%	1.2%	2.4%	4.8%	4.7%	5.1%	8.6%
Commercial/Office	3.8%	6.2%	3.8%	3.5%	3.6%	4.4%	5.2%	3.7%
Industrial	0.9%	0.4%	2.7%	6.2%	3.8%	4.7%	0.3%	1.3%
Transportation Utility	1.3%	2.6%	2.0%	3.2%	2.8%	3.1%	2.5%	1.3%
Institutions	6.7%	7.9%	2.9%	7.3%	7.0%	9.3%	8.5%	20.7%
Open Space/Recreation	38.4%	2.6%	38.7%	11.1%	5.7%	4.9%	3.6%	1.7%
Parking Facilities	1.7%	0.9%	0.8%	5.5%	1.7%	2.2%	0.8%	1.7%
Vacant Land	7.8%	6.8%	3.1%	13.8%	1.2%	6.1%	1.1%	1.2%
Miscellaneous	1.1%	0.7%	0.5%	1.0%	0.5%	0.9%	0.1%	0.1%

Notes:
CD stands for Community District
Source: New York City Department of City Planning, 2010 Data

Table 2-2. Land Use of Queens Community Districts Within Drainage Area

Land Use Type	CD 10	CD 9	CD 12	CD 13	CD 14
1-2 Family Residential	54.6%	60.0%	61.0%	62.0%	30.8%
Multi-Family Residential	5.8%	14.4%	7.5%	7.3%	9.2%
Mixed Res./Commercial	1.6%	4.4%	1.6%	0.6%	0.7%
Commercial/Office	2.9%	4.5%	4.0%	2.6%	1.6%
Industrial	0.5%	3.2%	3.8%	2.2%	0.6%
Transportation/Utility	1.2%	4.0%	3.2%	1.1%	0.6%
Institutions	2.5%	4.6%	7.3%	8.4%	4.4%
Open Space/Recreation	10.8%	2.0%	6.5%	13.3%	35.0%
Parking Facilities	1.0%	1.8%	2.1%	1.0%	0.6%
Vacant Land	19.0%	1.0%	2.6%	1.6%	16.2%
Miscellaneous	0.2%	0.1%	0.3%	0.1%	0.5%

Notes:
CD stands for Community District
Percentage may not add up to 100.0% due to rounding
Source: New York City Department of City Planning, 2010 Data

Table 2-3. Comparison of Land Use in the Jamaica Bay Drainage Area to Brooklyn, Queens and New York City

Land Use Type	Drainage Area(1)	Brooklyn(2)	Queens(2)	New York City(2)
1-2 Family Residential	44.7%	22.8%	36.0%	27.3%
Multi-Family Residential	12.2%	16.5%	10.7%	12.2%
Mixed Res./Commercial	2.2%	3.8%	1.7%	3.0%
Commercial/Office	3.2%	3.3%	3.3%	4.0%
Industrial	2.4%	4.6%	3.4%	3.6%
Transportation/Utility	2.0%	3.0%	11.7%	7.1%
Institutions	6.4%	6.0%	4.5%	6.9%
Open Space/Recreation	16.1%	34.5%	20.6%	27.0%
Parking Facilities	1.5%	1.7%	1.2%	1.3%
Vacant Land	8.8%	3.2%	4.6%	5.8%
Miscellaneous	0.6%	0.8%	2.2%	1.8%

Note:
Percent of Borough Values may not add up to 100.0% due to rounding
Source: (1) New York City Department of City Planning, 2010 Data
(2) Based on 2008 PLUTO database

2.2.2 Existing Zoning

The Zoning Resolution of the City of New York regulates the size of buildings and properties, the density of populations, and the locations that trades, industries, and other activities are allowed within the City limits. The Resolution divides the City into districts, defining residential, commercial, and manufacturing districts with use, bulk, and other controls. Residential districts are defined by the allowable density of housing, lot widths, and setbacks, with a higher number generally indicating a higher allowable density (e.g., single-family detached residential districts include R1 and R2, whereas R8 and R10 allow apartment buildings). Commercial Districts are divided primarily by usage type, such that local retail districts (C1) are distinguished from more regional commerce (C8). Manufacturing districts are divided based on the impact of uses on sensitive neighboring districts to ensure that heavy manufacturing (M3) is buffered from residential areas by lighter manufacturing zones (M1 and M2) that have higher performance levels and fewer objectionable influences.

Figure 2-5 presents zoning within the Jamaica Bay watershed. The watershed is primarily comprised of residential zoning districts at approximately 64%. As mentioned above, the residential areas of the watershed are characterized primarily by low density housing; approximately 41% percent of the watershed consists of R1, R2, R3, and R4 districts. In contrast, 22% of the watershed consists of medium density residential zoning districts including R5, R6 and R7 districts and 1% of the watershed is zoned as R8 or other high density residential zoning districts. Commercial zones are a small percentage of the overall watershed at approximately 3% and manufacturing zones are larger at 15%.

The large percentage of "Other" in the table below mostly accounts for the federally designated NPS property of the GNRA Jamaica Bay Unit that occupies much of the area adjacent to the shoreline of Jamaica Bay. Except for Bayswater State Park on Norton Basin and the GNRA lands, the remainder of the designated parklands in the area of the Bay is City-owned and includes the following:

- Marine Park;
- Canarsie Beach Park;
- Parkland within the Belt Parkway right-of-way;
- The area from the shoreline to the first built street from Mill Basin to Spring Creek;
- All of the oceanfront on Rockaway peninsula from Jacob Riis Park to the Nassau County line; and
- Many smaller neighborhood parks and playgrounds.

In addition to standard zoning, there are two "special use districts" within the study area, defined by the Zoning Resolution "...to achieve the specific planning and urban design objectives in defined areas with unique characteristics" (NYCDCP, 2006). The Sheepshead Bay district was identified to protect and strengthen that neighborhood's waterfront recreation and commercial character. New commercial projects and residential development must meet conditions that will support the tourist-related activities along the waterfront. Provision for widened sidewalks, landscaping, useable open space, height limitations, and additional parking areas have been established. The Ocean Parkway Special District encompasses a band of streets east and west of the parkway extending from Prospect Park in the north to Brighton Beach on the south. The purpose of the Special District is to enhance the character and quality of this broad landscaped parkway, a designated Scenic Landmark.

2.2.3 Proposed Land Uses

Both the NYCDCP and NYCEDC were contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use around Jamaica Bay and the CSO Tributaries. NYCDCP reviews any proposal that would result in a fundamental alteration in land use, and NYCEDC advances City land use policy through dispensing City-owned property. The following were those projects identified that could have an effect on the water quality of Jamaica Bay.

- Spring Creek Urban Renewal Area (URA) comprises 230 acres of City- and state-owned land. Some streets have been built, but the adjacent land is vacant except for the New York State Developmental Center. The New York City Housing, Preservation and Development (NYCHPD) plans to develop up to 3,290 residential units and a regional shopping center.
- The application for the second amendment to the Arverne Urban Renewal Plan was filed by the NYCHPD on June 4, 2003, to facilitate the construction of 3,900 residential units. The plan consists of low-density one-and-two-family homes and mid-rise buildings, and the establishment of 770,000 square feet of commercial and retail space, about 65 acres of parkland, community center, and a school.

2.2.4 Consistency of Current Land Use with the Waterfront Revitalization Program

Although the New York City WRP policies are intended to be used to evaluate proposed actions to promote activities appropriate to various waterfront locations, evaluating the consistency of existing land use with those policies can be used to anticipate future waterfront conditions. Ten policies are included in the Program: (1) residential and commercial redevelopment; (2) water-dependent and industrial uses; (3) commercial and recreational boating; (4) coastal ecological systems; (5) water quality; (6) flooding and erosion; (7) solid waste and hazardous substances; (8) public access; (9) scenic resources; and (10) historical and cultural resources.

Jamaica Bay is within the Coastal Zone Boundary and is also a Special Natural Waterfront Area (SNWA). An SNWA is a large area with concentrations of important coastal ecosystem features such as wetlands, habitats and buffer areas, many of which are regulated under other programs. The WRP encourages public investment within the SNWA to focus on habitat protection and improvement and discourages activities that interfere with the habitat functions of the area. Acquisition of sites for habitat protection is presumed consistent with the goals of this policy. Similarly, fragmentation or loss of habitat areas within an SNWA should be avoided.

The Jamaica Bay and CSO Tributaries assessment area is currently not consistent with all policies of the WRP. A comprehensive WRP consistency determination would be performed as part of the environmental review process required for siting any facility DEP constructs.

2.3 REGULATED SHORELINE ACTIVITIES

As part of the WB/WS Facility Plan development, information was gathered from selected existing federal and state databases to identify possible landside sources that have the potential to directly impact water quality in Jamaica Bay. Environmental Data Resources, Inc. (EDR) was contracted to perform the database query in 2006. For this investigation, potential sources included, but were not limited to:

- Existing underground storage tanks;
- Major oil storage facilities;
- Known contaminant spills;
- Existing state or federal Superfund sites;
- Presence of SPDES permitted discharges to the waterbody; and
- Other sources that might degrade the water quality.

The extent of the study area was limited to within approximately 1/2 mile of the Jamaica Bay shorelines as shown on Figure 2-6. Despite this limitation, over 7,500 records were identified by EDR, requiring over 9,400 pages for the report. The summary statistics for the regulatory database search are provided in Table 2-4.

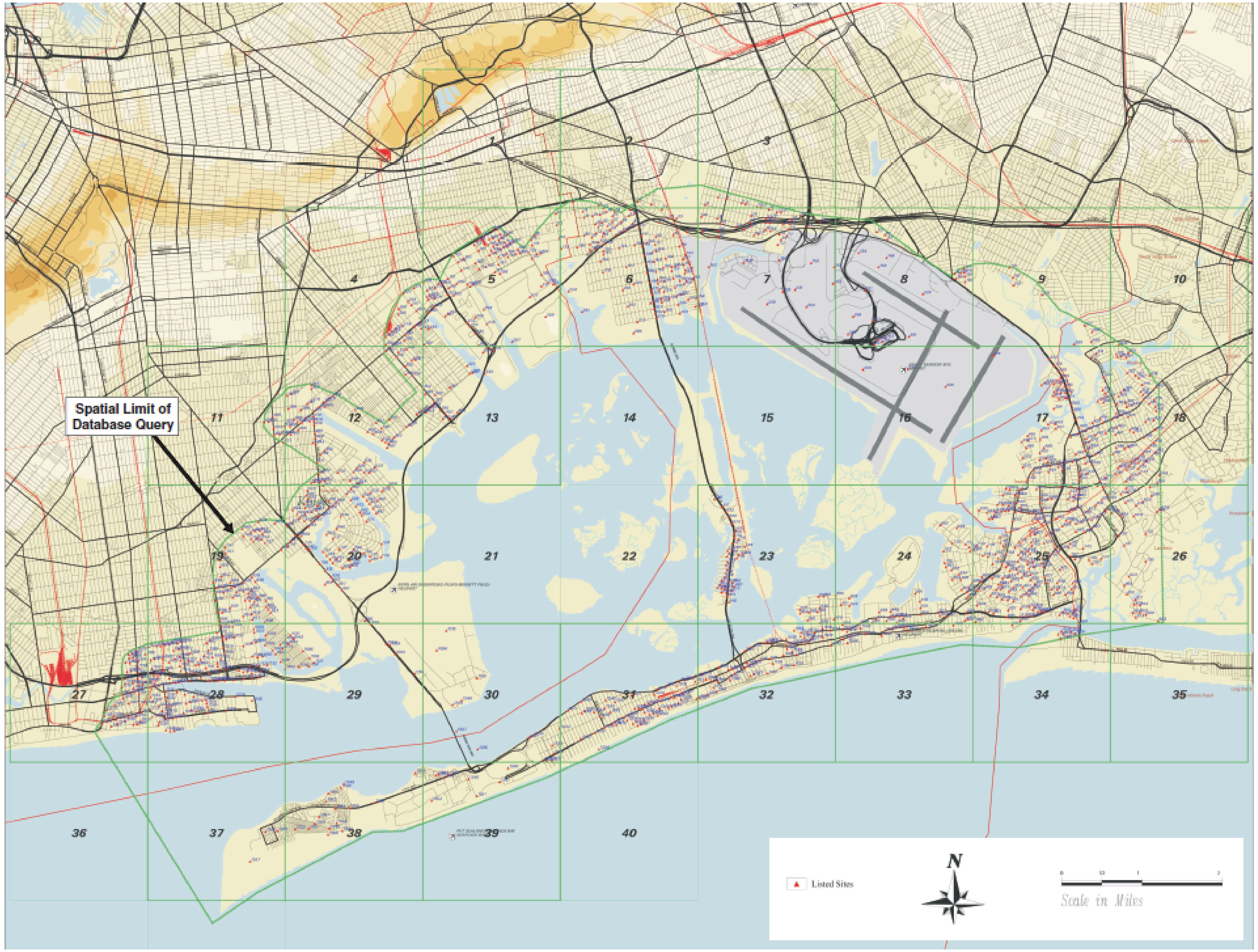
Table 2-4. Summary of Regulatory Database Search

Jurisdiction	Databases Queried	Records Found
Federal	30	2,070
State	23	5,430
Other	2	3
Total	55	7,503

Because of the volume of information recovered, the report is not provided as a practical matter, select findings are discussed below.

2.3.1 Federal Records

The USEPA Superfund Information System contains several databases with information on existing Superfund sites, including the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), the National Priorities List (NPL), Resource Conservation and Recovery Act Information (RCRAinfo), and the Brownfields Management System. The EDR report was primarily reviewed to provide additional information with regard to underground storage tanks (USTs), leaking storage tanks (LUST), and major oil storage facilities (MOSFs). In summary, the following entries were found:



Jamaica Bay
EDR Data Map

Figure 2-6

NYC Environmental Protection

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

- Two CERCLIS sites: Rockaway Metal Products Corporation in Nassau County and the Edgemere Landfill at Beach 49th Street in Rockaway. CERCLIS contains potentially hazardous waste sites that are either on the NPL or are in the screening and assessment phase for possible inclusion on the NPL.
- Six CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP): These sites had been removed from CERCLIS before February 1995 because initial investigations indicated that contamination was not serious enough to require Federal Superfund Action or NPL consideration.
- Nearly 600 RCRA handlers: The generation and disposal of hazardous waste should not have an effect on the environment if in compliance with RCRA. One RCRA handler was identified as having Corrective Action Activity in the CORRACTS database: Terminal 3 at JFK International Airport.

2.3.2 State Records

In addition to the federal databases, several databases managed by NYSDEC were also reviewed, including the Spill Incident Database, UST and LUST programs, the Environmental Site Remediation Database (allows searches in the NYSDEC brownfield cleanup), state Superfund (inactive hazardous waste disposal sites), and environmental restoration and voluntary cleanup programs. In addition to these federal and state databases, additional readily available information that focused on the immediate vicinity of Jamaica Bay was reviewed.

In summary, the State databases contained the following entries that may impact water quality in Jamaica Bay:

- 26 solid waste facilities / landfills;
- Over 600 UST sites;
- 13 Major Oil Storage Facilities with USTs;
- 12 New York SPDES permits, listed in Table 2-5.

Table 2-5. New York SPDES Permits Identified in Database Search

Site	Address
Jamaica WPCP (NYCDEP)	Jamaica, Queens
Rockaway WPCP (NYCDEP)	Rockaway, Queens
26th Ward WPCP (NYCDEP)	Flatlands Avenue, Brooklyn
Lefferts Oil Terminal, Inc.	Queens
Port Authority of NY & NJ	JFK Airport, Queens
Cedarhurst WPCP	Nassau County
Lawrence STP	Nassau County
West Long Beach STP	Nassau County
Motiva Enterprises LLC	Nassau County
Carbo Industries, Inc.	Nassau County

Site	Address
Concord Oil Co.	Nassau County
ExxonMobil Oil Corp.	Nassau County

2.3.3 NYSDEC Region 2

On January 23, 2006, NYSDEC Region 2 was contacted in order to obtain any additional information as to constant or ongoing discharge sources to Jamaica Bay. Mr. Randy Austin noted several potential sources:

- Two landfills;
- A 17 million gallon plume under JFK airport,
- The surface runoff from JFK airport, and
- Major oil terminals located within close proximity to the Bay.

A Freedom of Information Law (FOIL) request was submitted to the NYSDEC on February 9, 2006 asking for any additional information that might exist with regard to intrusion/seepage into the Bay from such as sources as Chemical Bulk Storage and Petroleum Bulk Storage facilities; however, no response was received, presumably due to security restriction on these databases recently imposed by NYSDEC.

3.0 Existing Sewer System Facilities

The Jamaica Bay and CSO Tributaries service area is served, either in whole or in part, by 4 of the 14 WWTPs operated by DEP and by the Spring Creek Auxiliary WWTP (see Table 3-1). The Coney Island WWTP drainage area has one tributary with CSO outfalls to Jamaica Bay, Paerdegat Basin, which is addressed in a separate LTCP that was approved by the NYSDEC in February 2007. Therefore, Coney Island will not be discussed in this WB/WS Facility Plan. The service area for Jamaica Bay and its CSO Tributaries covers approximately 17,000 acres and serves a population of nearly 2,000,000. Figure 3-1 shows the location and respective service area of each WWTP tributary to Jamaica Bay. The following sections describe the four Jamaica Bay WWTPs, their collection systems, and their associated CSO discharge characteristics.

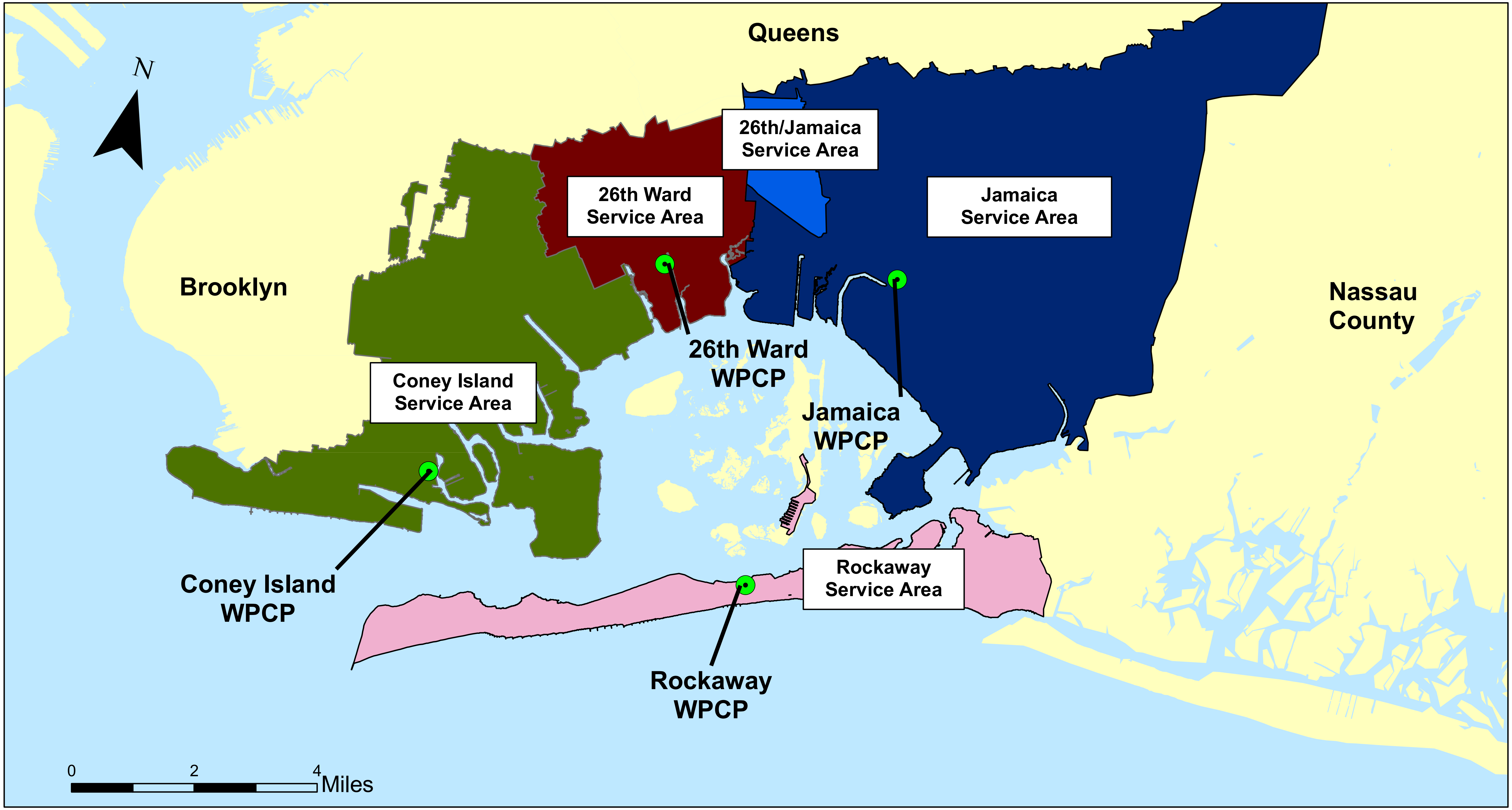
Table 3-1. Waterbodies Impacted by the Jamaica Bay WWTPs

WWTP	CSO Receiving Water(s)	Waterbody Classification
26th Ward	Hendrix St. Canal, Fresh Creek Basin, Hendrix Creek, Spring Creek	I
Jamaica	Bergen Basin, Thurston Basin	I
Rockaway	Open water areas of Jamaica Bay, Norton Basin, Banister Creek, Mott Basin	SB

3.1 WASTEWATER TREATMENT PLANTS

New York City's WWTPs are permitted by the DEC under individual SPDES permits that define numerical discharge limits, acceptable operating practices, and reporting requirements. Section 5 outlines the CSO best management practices as they are contained in the SPDES permits. BMP #3 (Maximize flow to POTW) reads in part: "The treatment plant shall be physically capable of: receiving a minimum of [2DDWF] through the plant headworks; a minimum of [2DDWF] through the primary treatment works (and disinfection works if applicable); and a minimum of [1.5DDWF] through the secondary treatment works during wet weather." DDWF is the design dry weather flow capacity at each WWTP, and is the permitted flow limit for the WWTP except during wet weather.

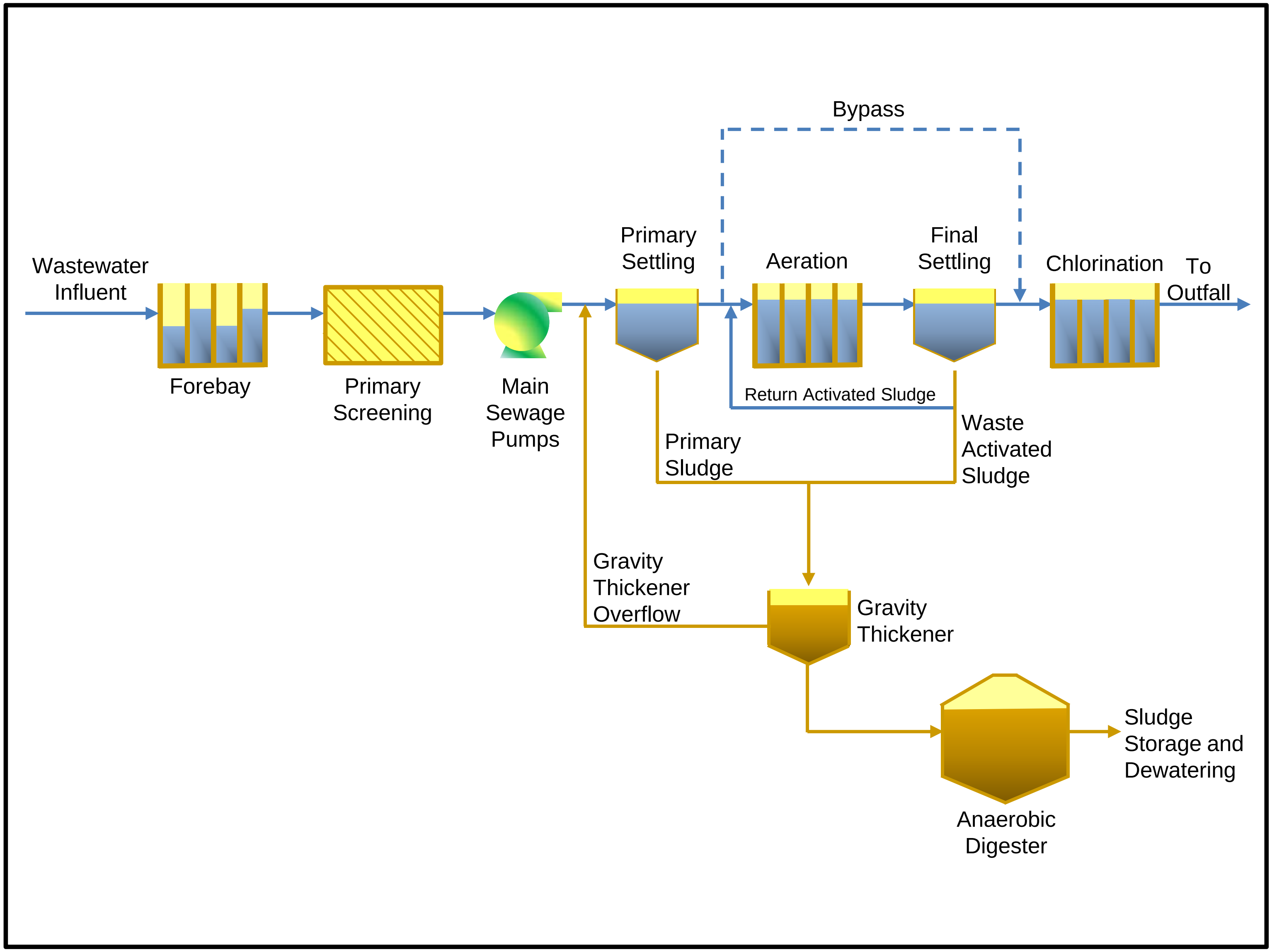
The treatment processes for all four of the Jamaica Bay WWTPs are similar and can be described by the schematic diagram shown in Figure 3-2. Capacities for each of the treatment plants in the assessment area are shown in Table 3-2. Permit limits for these treatment plants are shown in Table 3-3.



Environmental Protection

Jamaica Bay WPCPs and Associated Service Areas

Figure 3-1



Environmental Protection

General WWTP Process Flow Diagram

FIGURE 3-2

Table 3-2. WWTP Permit Capacities

WWTP	Capacity (MGD)			
	Daily Dry Weather Flow (DDWF)	Maximum Secondary Treatment*	Maximum Primary Treatment	Actual Average Sustained Wet Weather Flow, FY 2010
26th Ward	85	127.5	170	128
Jamaica	100	150	200	156
Rockaway	45	67.5	90	35
* 1.5 DDWF				

Table 3-3. WWTP SPDES Effluent Permit Limits

Parameter	Basis	Value	Units
Flow	DDWF Maximum secondary treatment Maximum primary treatment	See Table 3-2	MGD
$CBOD_5$	Monthly average 7-day average	25 40	mg/L
TSS	Monthly average 7-day average	30 45	mg/L
Total Nitrogen	12-month rolling average	45,300	lb/day

3.1.1 General WWTP Process Information

Flow from the collection system is delivered to the WWTPs via the main interceptors of each collection system. Once delivered to the WWTPs, the sewage is treated before discharge to the receiving waterbodies. Many of the WWTPS in New York City use a similar process treatment scheme. The simplified, general description of the WWTP process given below applies to all of the WWTPs in the Jamaica Bay assessment area.

Most of the treatment plants in New York City are designed to meet secondary treatment requirements using a similar process treatment scheme (see Figure 3-2). This scheme consists of the following treatment steps:

- Screening (bar screens)
- Pumping from the WWTP influent wet well to subsequent treatment steps
- Primary treatment
- Secondary treatment
  - o Biological treatment (activated sludge) to remove soluble and colloidal pollutants
  - o Secondary (final) sedimentation to remove bio-organisms grown in the activated sludge tanks

Primary treatment removed heavy solids as well as scum and other floatables. Wastewater enters large, rectangular sedimentation tanks where the flow slows to a relatively quiescent state, allowing heavier solids to fall to the bottom of the tank while floatable solids are collected from the surface of the water. Chain-and-flight collectors are generally used to scrape the settled sludge to the collection sumps at the bottom of the tank and to skim the floatables to a collection point at the surface of the tank.

Secondary treatment removed dissolved and colloidal organic matter. To achieve this, treatment occurs in two stages:

- A biological stage to assimilate the organic matter from the wastewater followed by;
- A sedimentation stage to remove the microorganisms produced during the biological stage.

For the biological stage, all of these plants are designed to allow a form of the step-feed activated sludge process. In this process, the wastewater enters a large, aerated tank at one of the four locations along the length of the tank. This ability to feed the wastewater into the tank at any of these locations gives rise to the name "step-feed". Microorganisms feed on the organic matter, thereby removing it from the wastewater. Because these microorganisms require oxygen, air is pumped in to the tank. The air also helps mix the incoming wastewater with the microorganisms and to keep solids suspended throughout the tank. The microbiological floc produced in this stage forms into larger particles, allowing them to be separated from the wastewater in the next stage.

In the second stage, the wastewater enters the final sedimentation tank. Again, the flow slows to a relatively quiescent state, allowing the microbiological floc particles to settle to the bottom of the tank.

Clarified flow discharged from the final sedimentation tanks is then disinfected by the addition of sodium hypochlorite. To allow sufficient time for the disinfection process to occur, the mixture of wastewater and sodium hypochlorite is sent to contact tanks, which retain the flow before it is discharged in to the receiving waterbody.

As the main stream of wastewater is treated, various solids are removed in the form of screenings, primary sedimentation tank sludge, and secondary sedimentation tank sludge. These solids are subject to further handling and treatment, with the particular steps varying somewhat from plant to plant.

- Screenings: At all the WWTPS, screenings are hauled off site.
- Primary Clarifier Sludge: Primary sludge is degritted then sent to gravity thickeners. Grit removed from the sludge is washed, dewatered and then hauled off-site.
- Secondary Clarifier Sludge: At all WWTPs, excess secondary sedimentation tank sludge is sent to the gravity thickeners (some of the sludge may be recycled to the step-feed, activated sludge tank to maintain a sufficient population of microorganisms).
- Thickener Sludge: All WWTPs use gravity thickeners. Thickened sludge collected from the bottom of the thickeners is sent to anaerobic digesters for stabilization.

Overflow from the top of the thickeners is recycled to the main treatment stream for further treatment.

- Digested Sludge: At all WWTPs, digested sludge is withdrawn from the anaerobic digesters and sent to the storage tanks to await dewatering.

Methane gas generated by anaerobic digestion is stored in the remaining three 55-foot diameter tanks. The rehabilitated tanks provide a reservoir of gas for the on-site power generation system.

Aerial photographs with the site layout for the 26th Ward, Jamaica and Rockaway WWTPs are presented in Figures 3-3 through 3-6.

3.1.2 Wet Weather Operating Plan

Each of the WWTPs has a Wet Weather Operating Plan (WWOP) which indicates a wet weather flow component at two times the DDWF capacity of the WWTP. In some cases there are specific goals for nutrient or solids loading that differ from the dry weather permit limits. The WWOP for the WWTPs in the assessment area can be found in Appendix A. A generalized summary of the typical procedures of a wet weather operating plan are presented in Table 3-4.

Table 3-4. Generalized Wet Weather Operating Procedures

Unit Operation	General Wet Weather Operating Procedures
Influent Gates and Screens	Maximize flow to the WWTP, maintain an operable and safe wet well level, avoid process destabilization, protect the MSPs from damage and prevent flooding of downstream processes. Leave influent gates in normal dry weather operating position until plant flow approaches 2DDWF, available pump capacity is exceeded, the acceptable wet well level is exceeded, or bar screens become overloaded. Put any additional primary or secondary screens into operation. Maintain acceptable wet well level by throttling back on influent gates.
Main Sewage Pumps	Maximize flow to the WWTP, minimize CSOs, and maintain a safe and operable level in plant influent wet well. As wet well level rises, put off-line pumps in service and increase speed of pumps up to maximum capacity, leaving one pump out of service as standby. Restrict flow through influent gates if pumping rate is maximized and wet well levels continue to rise.
Primary Settling Tanks	Maximize the amount of flow that receives primary treatment, prevent flooding, excessive solids accumulation and abnormal wear due to grit abrasion. Maintain maximum number of primary settling tanks in service Maintain adequate primary sludge pumpage on-line. Watch water surface elevations at the weirs for flooding and flow imbalances. Reduce flow and/or back-flush if necessary.
Bypass Channel	Aeration tanks are bypassed to maximize the flow that receives primary treatment, chlorination, and secondary treatment without causing plant failures or violations. Open Bypass when plant flow exceeds 1.5 DDWF, or when the primary clarifier weirs flood or final clarifier blanket levels go over the weirs. The BNR treatment biomass must be protected against high loading rates.
Aeration Tanks	Continue to provide effective secondary treatment to storm flows up to 1.5 DDWF. Keep as many aeration tanks in operation as possible and adjust the airflow to maintain DO above 2 mg/L. Adjust wasting rates if necessary to maintain a desired solids inventory in the aerators. Override automation as necessary for rapid adjustments.
Final Settling Tanks	High flows increase solids loadings, leading to high sludge blankets, high effluent TSS, destabilization of biological reactor, and solids build-up and washout. Observe the clarity of the effluent, check sludge collectors, and watch for solids loss. Adjust RAS and WAS to maintain

Unit Operation	General Wet Weather Operating Procedures
	wet well and sludge blanket levels. Balance flows to the tanks to keep the blanket levels even, Reduce WAS after event to rebuild solids inventory. Initiate secondary bypass if flow exceeds 1.5 DDWF
Chlorination	Hypochlorite demand will increase as flow rises and secondary bypasses occur. Check, adjust, and maintain the hypochlorite feed rates to maintain the target chlorine residual for adequate fecal kill. Place additional sodium hypochlorite pumps in service as necessary
Sludge Handling	Process is generally uninfluenced by wet weather, so proceed as normal.

3.1.3 Other Operational Constraints

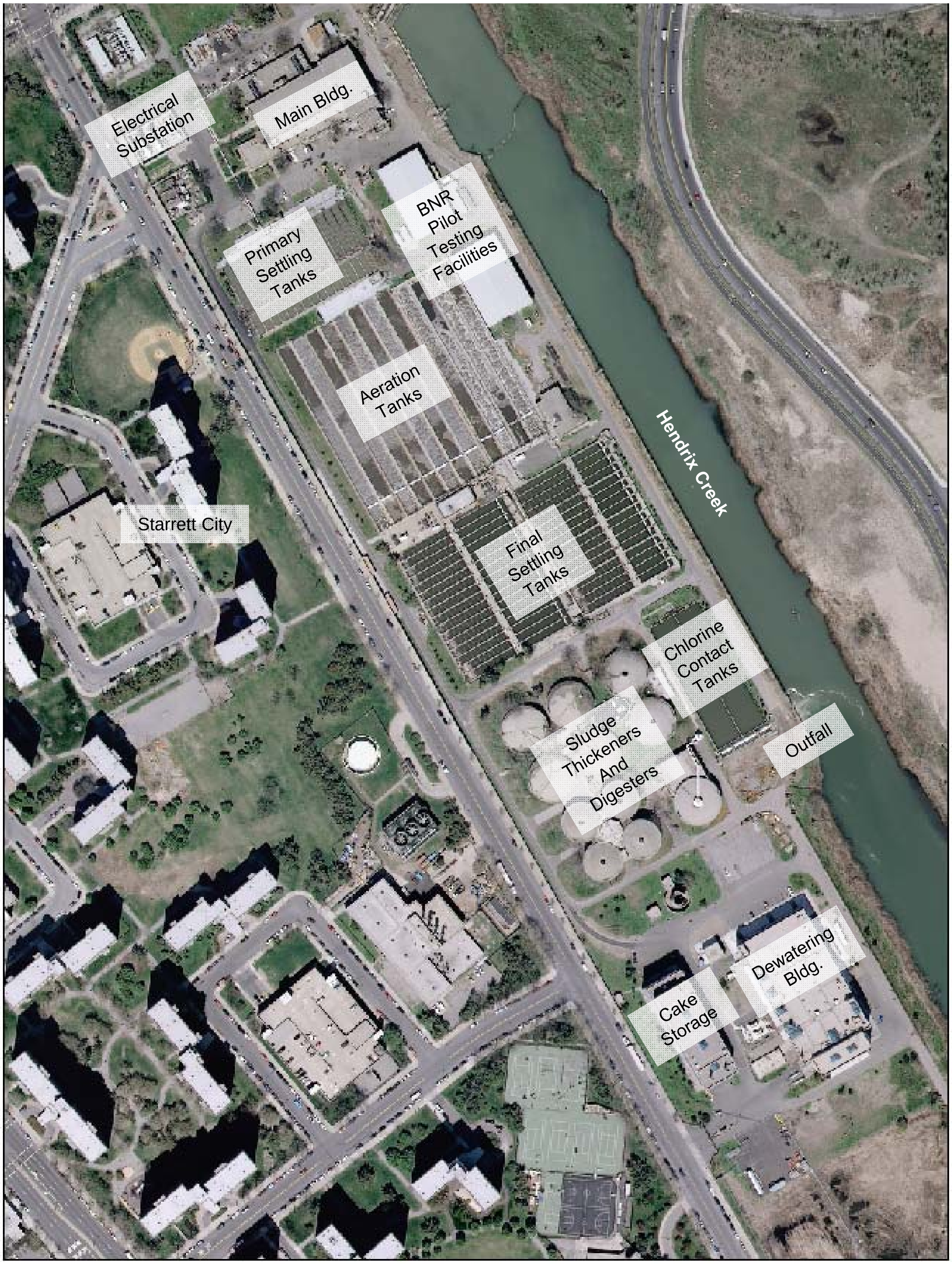
In June 2011, the DEC and the DEP entered into the First Amended Nitrogen Consent Judgment (FANC Judgment), in part to reduce nitrogen discharges from the City's Jamaica Bay WWTPs, thereby protecting and improving water quality and the environment of Jamaica Bay. The FANCJ supersedes all previous provisions, orders, and stipulations from the Nitrogen Consent Judgment previously in force. The new provisions related to Jamaica Bay include the following:

- Schedules of commencement of Level 2 BNR at Jamaica, Level 3 BNR at 26th Ward, and Level 1 BNR at Rockaway and Coney Island.
- Submittal of the Final Comprehensive Jamaica Bay Plan, integrating the Jamaica Bay Eutrophication Project, Use Standards and Attainability Study, and Outfall Relocation Study, to provide recommendations for improving water quality in Jamaica Bay.
- Undertaking of various studies and monitoring programs to enhance the understanding of the impacts of discharges on Jamaica Bay water quality. Studies include the City-Wide Biosolids Centrate Facility Report, the Jamaica Bay Feasibility Study, and the Enhanced Jamaica Bay Water Quality Monitoring program.
- The establishment of the entirety of Jamaica Bay as a vessel waste "No Discharge Zone."
- Modification of the four Jamaica Bay WWTP SPDES permits to incorporate the FANCJ requirements directly, including the establishment of performance-based interim nitrogen limits.

These provisions are partly embodied in 36 enforceable milestones that require the timely submittal of documents, commencement of operational conditions and monitoring programs, and completion of facility construction.

3.2 SPRING CREEK AUXILIARY WATER POLLUTION CONTROL PLANT

The Spring Creek AWPCP retention facility is located on Spring Creek at the confluence with Old Mill Creek along the Brooklyn-Queens border and is approximately 1 mile east of the 26th Ward WWTP. A general location plan is shown on Figure 3-7 and the drainage area for the Spring Creek AWPCP facility is shown in Figure 3-8. Placed into service in the early 1970s and originally named an "Auxiliary Water Pollution Control Plant" (AWPCP), the current primary



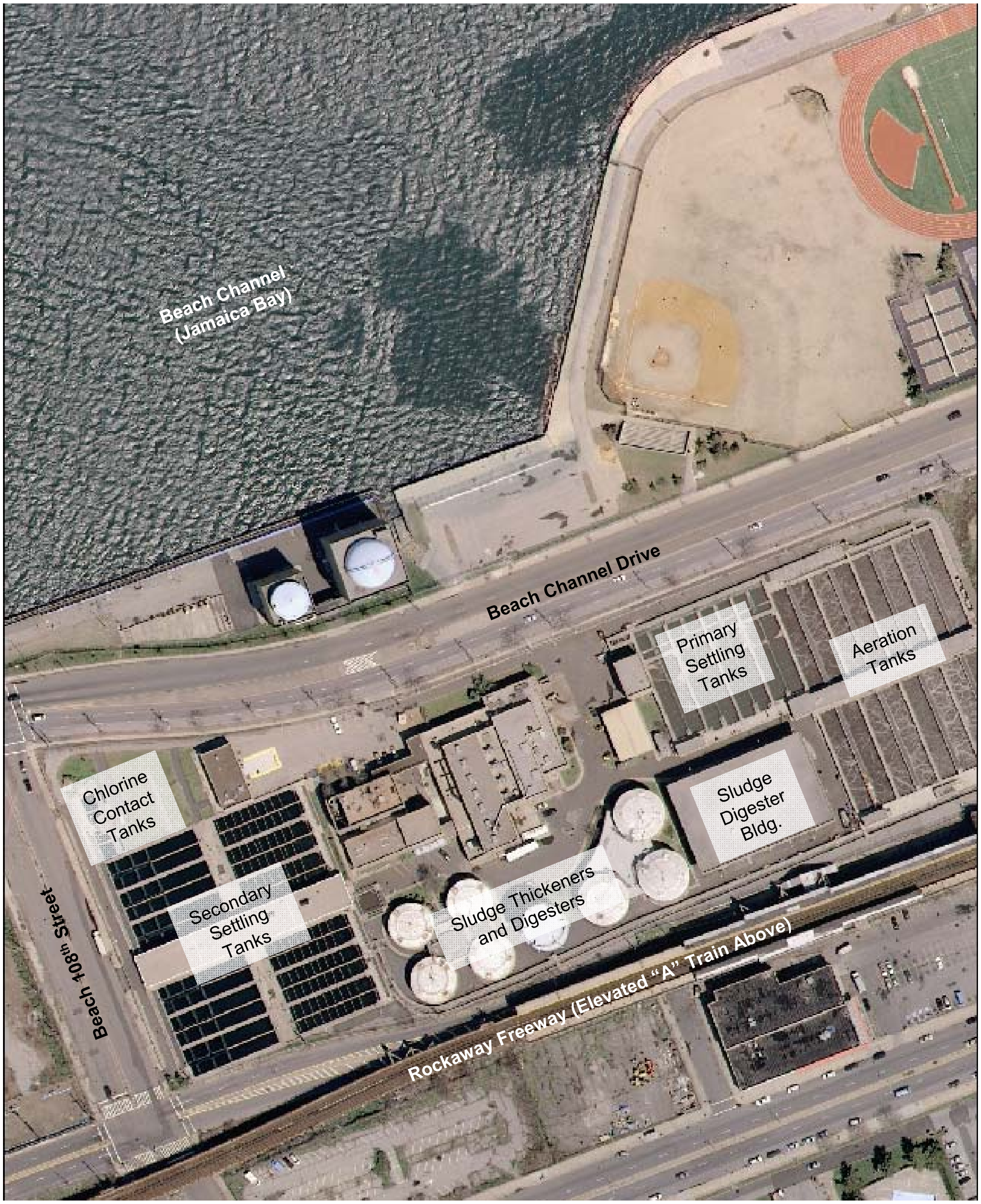
26th Ward WWTP Layout

NYC Environmental Protection

Coney Island WWTP Layout

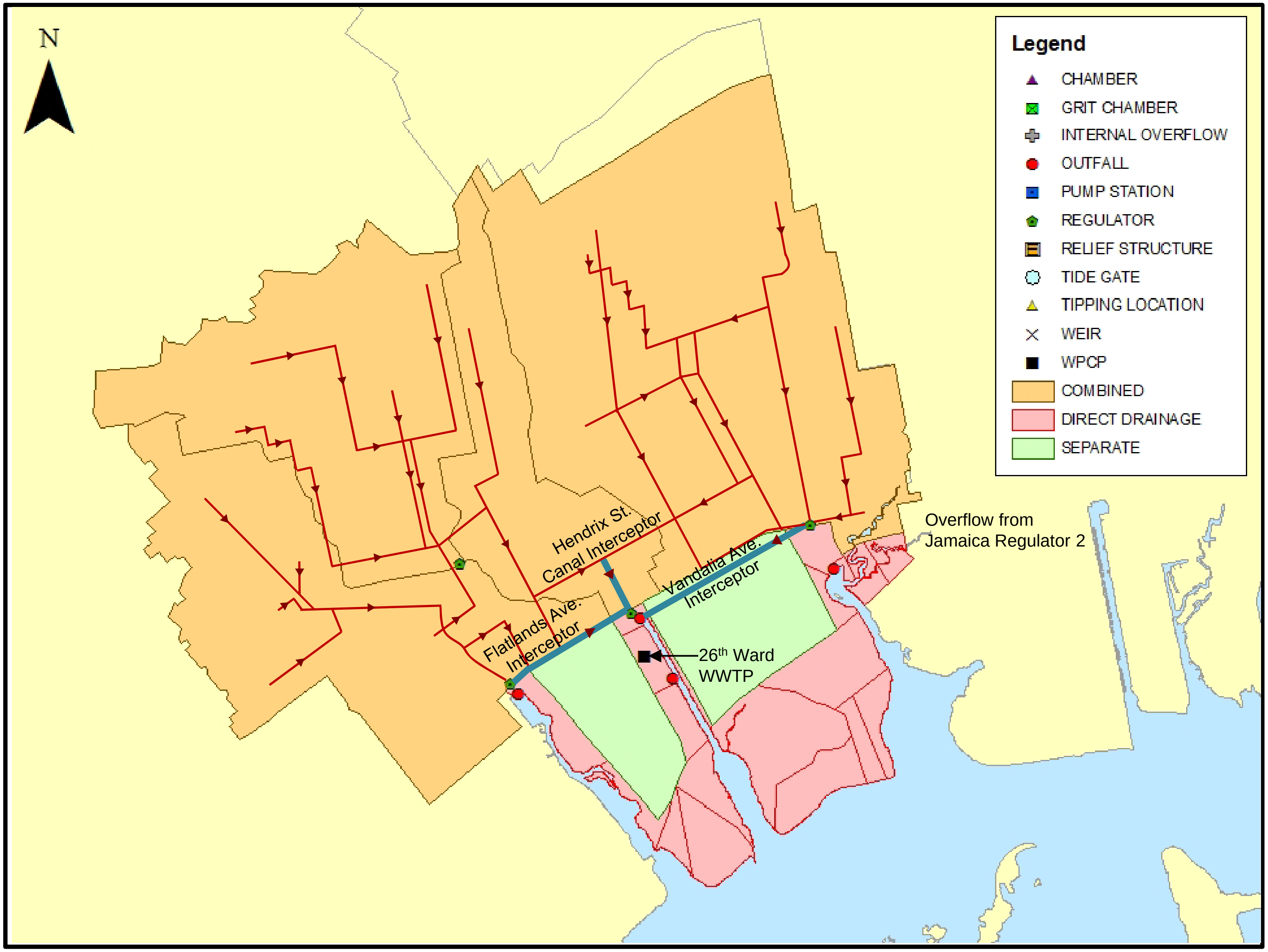
NYC Environmental Protection

Jamaica WWTP Layout



Environmental Protection

Rockaway WWTP Layout



26th Ward WWTP Service Area and Collection System

FIGURE 3-7

function of the Spring Creek AWPCP is to capture CSO from tributary drainage areas in Brooklyn and Queens and convey them to the 26th Ward WPCP for treatment. The Spring Creek AWPCP is permitted as a regional CSO storage facility under the 26th Ward SPDES permit; however, it also receives wet weather overflow from the Jamaica WWTP service area via Regulator J-2 in Queens.

The Spring Creek AWPCP provides approximately 20 MG of storage. Of the total volume, 13.8 MG is within the basin of the facility and 6.2 MG is in the influent barrel. There is a theoretical in-line storage volume of approximately 18 MG in the combined sewer system in addition to the 20 MG of build storage (i.e., 38 MG of total effective storage). The facility overflow weir has an elevation of –section 1.5 ft. Most of the stored volume flows back by gravity to the sewer system; a portion of the stored volume (below elevation -7.00 ft) must be pumped back to the sewer system to be conveyed to the 26th Ward WWTP. Although no information was developed for the facility regarding removal rate of TSS or BOD when the facility overflows, it is reasonable to expect significant removal due to settling under the hydraulic detention times calculated for disinfection listed above. Furthermore, nearly one hundred percent of TSS and BOD are removed from flows that are captured and conveyed to 26th Ward.

The Spring Creek AWPCP recently underwent a major upgrade and went online on April 30, 2007, in compliance with the 2005 CSO Consent Order milestone. The upgrades and improvements included the following:

- A new tide gate control system consisting of effluent sluice gates that are controlled by the differential in the basin elevation and the tide elevation;
- New dewatering pumps consisting of three 5.8 MGD variable speed horizontal centrifugal pumps, new pump controls, and new piping;
- Pump building upgrades, including a new computer-based process instrumentation and control system;
- New high volume, low head basin cleaning system consisting of spray water pumps, distribution piping and spray headers that clean the walls and floor of the basins;
- New odor control system and building with three odor control units rated at 517 MGD; and,
- Extensive structural improvements, including new weir wall, floating booms for floatables retention, the elimination of spray water channels, and the lowering of the existing concrete roof approximately 9 feet to reduce ventilation volumes.

3.3 COLLECTION SYSTEM

3.3.1 Sewer System Overview

This section details sewage collection from each of the WWTP service areas tributary to Jamaica Bay. The function of a sewage collection system is to provide drainage for an area and to convey the collected flow to the WWTP for treatment. Pumping stations are sometimes required at low points within the sewer system to lift flows to a higher level of elevation in order to facilitate conveyance, but collection systems are generally configured to flow by gravity to the WWTP. New York City collection systems have three basic types of sewers: sanitary, storm, and combined sewers. Table 3-5 summarizes the drainage area types tributary to Jamaica Bay, including areas that runoff directly, shown under the WWTP service area that would presumably serve those areas. Note that interconnection between these area types is significant: for example, neighborhoods that are separately sewered typically discharge sanitary flow into a combined sewer prior to reaching the WWTP. Sanitary sewers are connected to each house, apartment building, store, or factory to collect sanitary sewage and convey it to the tributary sewers which may also receive stormwater runoff from the overlying street. Even storm sewers associated with separately sewered areas may eventually convey stormwater to the WWTP. However, the connection of sanitary sewers to storm sewers is avoided altogether, and DEP has programs in place to find and eliminate illegal cross-connections of this nature.

Table 3-5. Summary of WWTP Drainage Areas

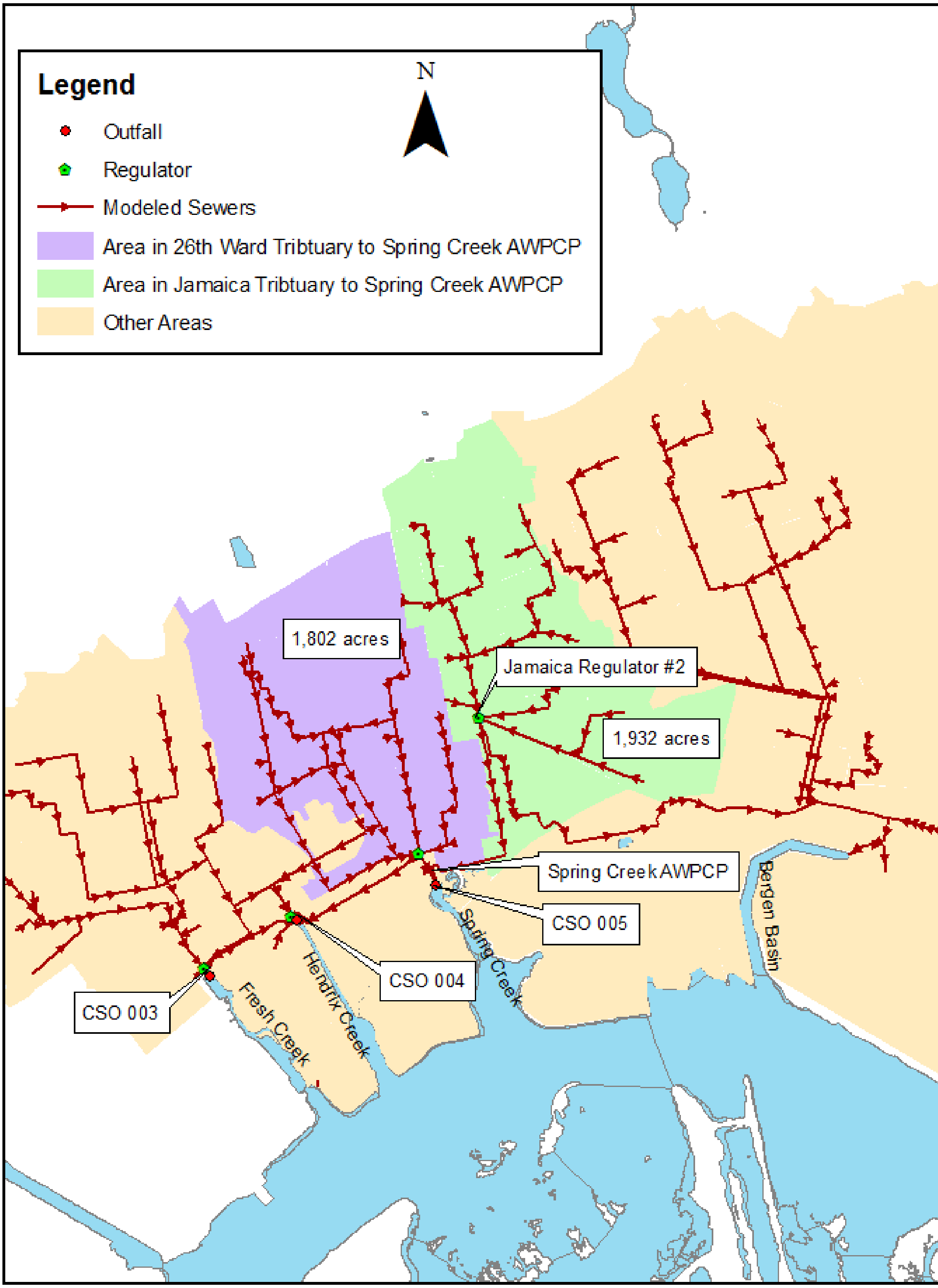
WWTP Service Area	Area (acres)			
	Separated (acres)	Direct (acres)	Combined (acres)	Total (acres)
26th Ward	479	627	4,847	5,953
Jamaica	18,058	2,077	5,386	25,521
Rockaway	2,336	4,738	0	7,074
Spring Creek Aux.	0	0	1,321	1,321
Total Area	16,816	11,317	25,695	53,828

The 26th Ward WWTP drainage area consists of 5,953 acres (combined sewer = 4,847 acres, separate sanitary/storm = 479 acres, direct runoff = 627 acres). Starrett City, located west of the WWTP, and the Fresh Creek Mental Hygiene Center, located on the east side of the WWTP, are the only separately sewered areas in the 26th Ward system. The service area and collection system for the 26th Ward WWTP is depicted in Figure 3-8.

The Jamaica WWTP services approximately 38 percent of the borough of Queens and has a drainage area of approximately 25,500 acres. Approximately 70 percent of the collection system is served by separate sewers, and 21 percent by combined sewers, with the remaining 9 percent providing direct runoff to Jamaica Bay. Portions of the sanitary sewer system flow into the combined system, and other portions of the sanitary system act as combined sewers because stormwater systems have not been constructed. In total, the area is serviced 211 miles of combined sewers, 512 miles of sanitary sewers, and 198 miles of storm sewers. In addition, Jamaica Bay regulator J-2, which has a drainage area of approximately 1,255 acres, directs wet weather flow to the Spring Creek AWPCP. Figure 3-9 shows the Jamaica WWTP service area.

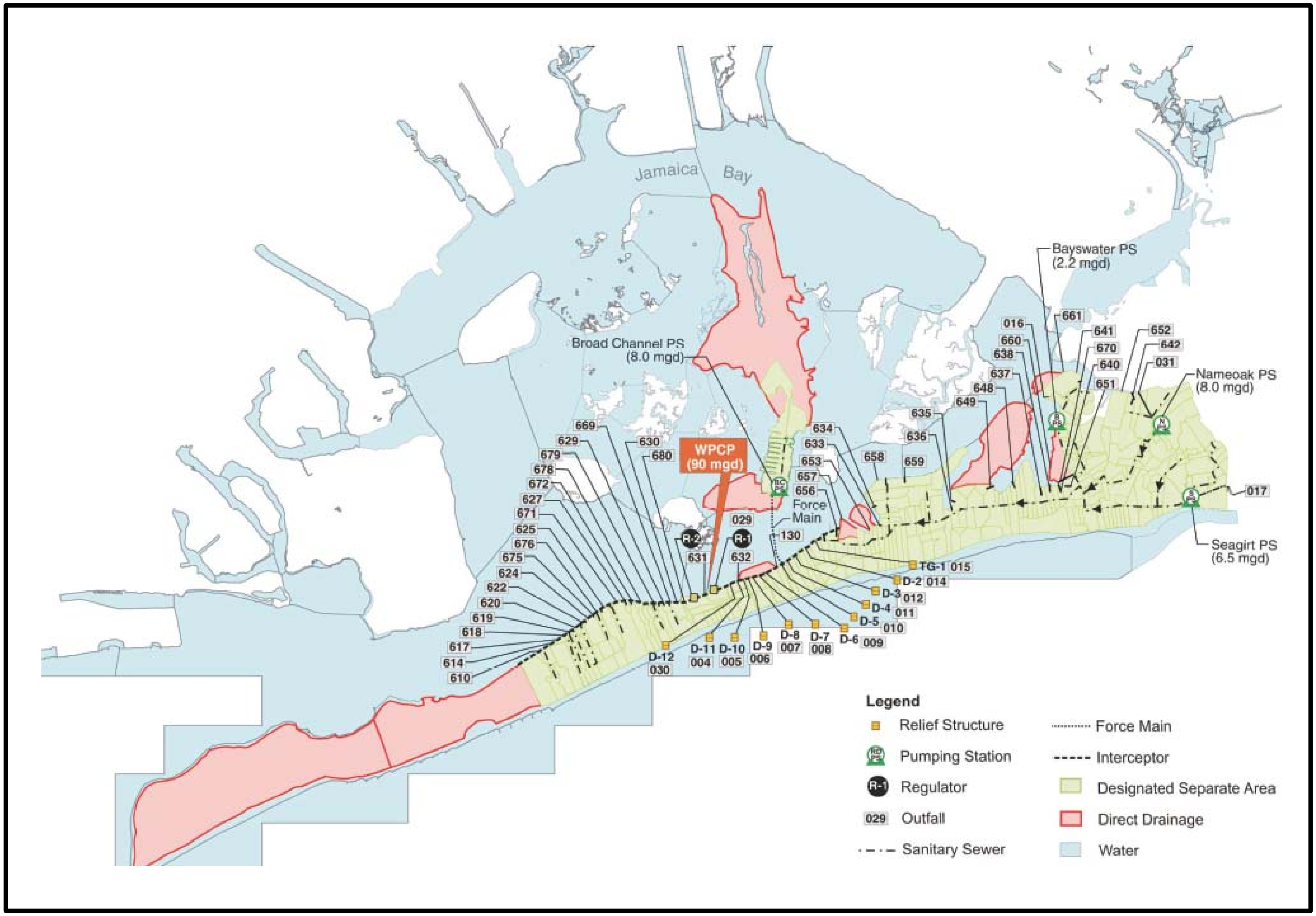
The Rockaway WWTP serves the Rockaway Peninsula and the community of Broad Channel in the middle of Jamaica Bay, a drainage area of approximately 7,000 acres (Figure 3-10). The sewer system was designed as a completely separate system. However, when the sewer system was originally constructed it contained only the sanitary sewers and the storm sewers have not yet been fully built out. The WWTP is located towards the center of the peninsula and receives flow from two interceptors; a 48-inch interceptor that conveys flows from the western portion of the drainage area and a 66-inch interceptor services the eastern part of the drainage area. These interceptors merge on Beach Channel Drive and channel flow to the WWTP through a single conduit. The western interceptor and all of its tributary sewers flow by gravity while the flow from the eastern side of the peninsula is conveyed by a combination of gravity and pumping.

The complete Jamaica Bay drainage area is shown in Figure 3-1, and subwatersheds are shown in Figures 3-8 to Figure 3-10. Separate and combined areas are color-coded.



NYC Environmental Protection

Spring Creek AWPCP Service Area and Collection System



Environmental Protection

Rockaway WWTP Service Area and Collection System

FIGURE 3-9

Environmental Protection

Spring Creek Auxiliary WWTP Layout

FIGURE 3-10

3.3.2 Combined Sewer System

New York City is highly urbanized and contains a high percentage of impervious surfaces. Runoff from roof drains, street gutters, and catch basins are tied into the combined sewer system, generating rapid and intense flow peaks in excess of the WWTP capacity, even though New York City WWTPs were designed to process higher flows during wet weather. Flow regulators in the combined sewer system limit the amount of flow to the interceptor sewer and divert excess flow to a nearby waterbody via an outfall when the hydraulic capacity of the pipe is exceeded. There are also numerous uniquely configured chambers constructed within the combined collection systems serving a similar purpose, relying on side overflow weirs, pipe wall cutouts, and other fixed structures to divert flow. Because the City is situated on the coast, most of the regulator structures have tide gates associated with them to prevent receiving waters from entering the sewer system. Diversion chambers often exist in conjunction with regulators to divert excessive flows to outfalls and subsequently to receiving waters.

There are a total of 32 outfall points in the Jamaica Bay watershed as listed in Table 3-6. Overflow volumes and the number of overflow events by year are shown for each of these in the modeling Section 3.5.1.

Table 3-6. CSOs in Jamaica Bay and CSO Tributaries Assessment Area

Outfall	Latitude	Longitude	Location	Size	Note(s)
26W-001	40,39,4	73,52,38	26th WARD WPCP EFFLUENT OUTFALL	10' X 6'	
26W-002	40,39,1	73,52,37	HENDRIX CREEK & PLANT BYPASS	4BL 11' X 7'6"	
26W-003	40,38,57	73,53,26	FRESH CREEK BASIN & WILLIAMS AVENUE	4BL 15'3" X 9'	Telemetry and Net
26W-004	40,39,17	73,52,49	HENDRIX CREEK & HENDRIX STREET	4BL 11' X 7'6"	Telemetry and Boom
26W-005	40,39,35	73,51,50	SPRING CREEK & SPRING CREEK AUXILIARY WPCP	72BL 7'6" X 2'5"	Telemetry
ROC-001	40,35,4	73,49,47	ROCKAWAY WPCP EFFLUENT OUTFALL	72" DIA	
ROC-003	40,35,5	73,49,44	JAMAICA BAY & PLANT BYPASS	72" DIA	
ROC-009	40,35,16	73,49,4	JAMAICA BAY & BEACH 98th STREET	12" DIA	
ROC-013	40,35,22	73,48,52	JAMAICA BAY & BEACH 93rd STREET	12" DIA	
ROC-014	40,35,28	73,48,44	JAMAICA BAY & BEACH 91st STREET	12" DIA	
ROC-016	40,35,25	73,46,11	NORTON BASIN & BAYS WATER AVENUE	60" DIA	
ROC-017	40,35,47	73,44,20	BANNISTER CREEK & BEACH 3rd STREET	DBL 13'-6"x5'-0"	

Outfall	Latitude	Longitude	Location	Size	Note(s)
ROC-029	40,35,8	73,49,30	JAMAICA BAY & BEACH 106 STREET	72" DIA	Telemetry
ROC-031	40,35,18	73,25,18	MOTT BASIN & REDFERN AVENUE	11' X 4'6"	
ROC-032	40,35,16	73,49,4	JAMAICA BAY & BEACH 98th STREET	36" DIA	
ROC-033	40,35,8	73,49,29	JAMAICA BAY & BEACH 106th STREET	36" DIA	Reclassified as ROC-632
JAM-001	40,39,39	73,48,41	JAMAICA WPCP EFFLUENT OUTFALL	84" DIA	
JAM-003	40,39,42	73,49,8	BERGEN BASIN & 123rd STREET	DBL 8' X 9'	Boom and Telemetry
JAM-003A	40,39,42	73,49,8	BERGEN BASIN & 123rd STREET	DBL 13'6" X 9'	Boom and Telemetry
JAM-005	40,38,53	73,45,22	HEAD OF THURSTON BASIN & JFK AIRPORT	4BL 16' X 8'	Boom and Telemetry
JAM-006	40,39,37	73,48,43	HEAD OF BERGEN BASIN & JFK AIRPORT	3BL 19' X 9'	Boom and Telemetry
JAM-007	40,38,54	73,45,22	HEAD OF THURSTON BASIN & JFK AIRPORT (NEXT TO JA-005)	4BL 17' X 6'	Boom and Telemetry

Note:
1. All Rockaway outfalls are separated sewer outfalls.

3.3.3 Pump Stations

There are no pumping stations in the drainage area other than those used at the 26th Ward WWTP. The entire system is a gravity flow system.

There are four pumping stations in the Rockaway WWTP service area, all of which convey sanitary flows; Broad Channel, Nameoke, Bayswater, Seagirt, and Meadowmere (see Figure 3-7):

- Broad Channel Pumping Station - was put on-line in 1988 and services the island of Broad Channel, which is located just north of the Rockaway Peninsula. A new trunk sewer, lateral sewers, and house connections have been constructed and currently service the majority of the houses and businesses in this area. Prior to their construction, a septic tank system was used and sanitary waste was discharged directly to Jamaica Bay. The station discharges via a 16-inch diameter force main to the sewer system on Rockaway Peninsula.
- Nameoke Pumping Station - located at Nameoke Street and Central Avenue, is in the northern section of Far Rockaway. The pumping station, which went on line in May 1989, has three submersible pumps capable of pumping 2,730 gpm (4 MGD) each. A 24-inch sewer conveys discharge to a 24-inch gravity sewer. The emergency

overflow from the Nameoke Pumping Station wet well is connected to a storm sewer at Redfern Avenue and Nameoke Street. There is a tide gate on this connection to protect the pumping station from back flows from the storm sewer system. The discharge point of the storm sewer to which the emergency overflow is connected is Mott Basin.

- Bayswater Pumping Station - situated on the east side of Norton Basin. There are two Flygt submersible pumps installed at Bayswater each capable of pumping 1,150 gpm (1.66 MGD). A 24-inch and a 12-inch diameter sewer convey sewage to the station. The pump station discharge line is a 14-inch diameter force main, which terminates at a 30-inch gravity sewer. There is an emergency overflow from the wet well that is connected to a 60-inch storm drain that discharges into Norton Basin.
- Seagirt Pumping Station - located on Seagirt Avenue and Beach 9th Street, not far from the Atlantic Ocean. The pumping station is equipped with two pumps that are capable of pumping 4,500 gpm (6.5 MGD) each. A 24-inch sewer conveys flow to the pumping station. Flow from the pump station is discharge in a 20-inch force main to a 36-inch gravity sewer. The Seagirt facility has an emergency connection from the wet well to 20-inch storm sewer which discharges to Bannister Creek. Bannister Creek is a tributary of the Atlantic Ocean and therefore overflows from the Seagirt Pumping Station would not influence the water quality of Jamaica Bay.

There are two pumping stations in the Jamaica WWTP service area as shown on Figure 3-6; Howard Beach and Rosedale.

- Howard Beach Pumping Station - located on 155th Street and 100th Avenue and serves a combined sewered area. There are five pumps currently in place with a capacity of 9,000 gpm (13 MGD) each. The flow from this facility eventually reaches the plant via the 72-inch interceptor. There is a combined sewer overflow upstream of the pumping station located on Cross Bay Boulevard and 157th Avenue. The overflow pipe is approximately 21 feet above the combined sewer and is a 42-inch line that discharges to Shellbank Basin. This facility also receives flow from Regulator J-2 that was designed to pass wet weather flow to the Spring Creek AWPCP.
- Rosedale Pumping Station - located on 147th Avenue west of Brookville Boulevard. The station is currently equipped with three pumps rated at 4,150 gpm (6 MGD) each. The area serviced by the pumping station is separately sewered and pumps to a gravity branch sewer of the JFK interceptor.

3.4 SEWER SYSTEM MODELING

Mathematical watershed models are used to simulate the hydrology (rainfall runoff) and hydraulics (sewer system flows and water levels) of a watershed, and are particularly useful in characterizing sewer system response to rainfall conditions and in evaluating engineering alternatives on a performance basis. In the hydrology portion of the model, climatic conditions (such as hourly rainfall intensity) and physical watershed characteristics (such as slope, imperviousness, and infiltration) are used to calculate rainfall-runoff hydrographs from individual subcatchments. These runoff hydrographs are then applied at corresponding locations in the sewer system as inputs to the hydraulic portion of the model, where the resulting hydraulic grade lines and flows are calculated based on the characteristics and physical features of the sewer system, such as pipe sizes, pipe slopes, and flow-control mechanisms like weirs. Model output includes sewer-system discharges which, when coupled with pollutant concentration information, provide input necessary for receiving-water models to determine water-quality conditions. The following section generally describes the tools employed to model the Jamaica, 26th Ward, and Rockaway watersheds; since the CSOs from the Coney Island watershed will be abated by the Paerdegat LTCP, landside modeling output from the Paerdegat CSO facility model was used as an input. A more detailed description of the model setup, calibration and model-projection processes have been provided under separate cover in the *City-Wide LTCP Landside Modeling Report for Jamaica WWTP, 26th Ward WWTP, and Rockaway WWTP*.

3.4.1 InfoWorks CS™ Modeling Framework

The hydraulic modeling framework used in this effort is a commercially available, proprietary software package called InfoWorks CS (hereafter referred to as the sewer system model), developed by Wallingford Software of the United Kingdom. The sewer system model is a hydrologic/hydraulic modeling package capable of performing time-varying simulations in complex urban settings for either short-term events or long-term periods, with output of calculated hydraulic grade lines and flows within the sewer system network and at discharge points. The sewer system model solves the complete St. Venant hydraulic equations representing conservation of mass and momentum for sewer-system flow and accounts for backwater effects, flow reversals, surcharging, looped connections, pressure flow, and tidally affected outfalls. Similar in many respects to the USEPA's older Storm Water Management Model (SWMM), the sewer system model offers a state-of-the-art graphical user interface with greater flexibility and enhanced post-processing tools for analysis of model calculations. In addition, the sewer system model utilizes a four-point implicit numerical solution technique that is generally more stable than the explicit solution procedure used in SWMM.

Model input for the sewer system model includes watershed characteristics for individual subcatchments, including area, surface imperviousness and slope, as well as sewer-system characteristics, such as information describing the network (connectivity, pipe sizes, pipe slopes, pipe roughness, etc.) and flow-control structures (pump stations, regulators, outfalls, headworks, etc.). Hourly rainfall patterns and tidal conditions are also important model inputs. The sewer system model allows interface with graphical information system (GIS) data to facilitate model construction and analysis.

Model output includes flow and/or hydraulic gradeline at virtually any point in the modeled system, at virtually any time during the modeled period. The sewer system model provides full interactive views of data using geographical plan views, longitudinal sections, spreadsheet-style grids and time-varying graphs. A three-dimensional junction view provides an effective visual presentation of manholes. Additional post-processing of model output allows the user to view the results in various ways as necessary to evaluate system response.

3.4.2 Applications of Model to Collection Systems

The sewer system models for the Jamaica, 26th Ward, and Rockaway collection systems were constructed using information and data compiled from as-built drawings, WWTP data, previous and ongoing planning projects, regulator improvement programs, and inflow/infiltration analyses. This information includes invert and ground elevations for manholes, pipe dimensions, pump-station characteristics, and regulator configurations and dimensions.

Model simulations include WWTP headworks, interceptors, branch interceptors, major trunk sewers, all sewers greater than 48 inches in diameter plus other smaller, significant sewers, and control structures such as pump stations, diversion chambers, tipping locations, reliefs, regulators and tide gates. As presented in the *City-Wide LTCP Landside Modeling Report for Jamaica WWTP, 26th Ward WWTP, and Rockaway WWTP,* the models were calibrated and validated using flow and hydraulic-elevation data collected for this purpose. All CSO and stormwater outfalls permitted by the State of New York are represented in the models, with stormwater discharges from separately sewered areas simulated using separate models as necessary.

Conceptual alternative scenarios representing no-action and other alternatives were simulated for the average year (1988 JFK rainfall). Tidally influenced discharges were calculated on a time-variable basis. Pollutant concentrations selected from field data and best professional judgment were assigned to the sanitary and stormwater components of the combined sewer discharges to calculate variable pollutant discharges. Similar assignments were made for stormwater discharges in separated areas. Discharges and pollutant loadings were then post-processed and used as inputs to the receiving-water model, described in Section 4.

3.4.3 Baseline Design Condition

Watershed modeling can be an important tool in evaluating the impact of proposed physical changes to the sewer system and/or proposed changes to the operation of the system. In order to provide a basis for these comparisons, a "Baseline condition" was developed. For the 26th Ward, Jamaica and Rockaway models, the Baseline conditions parameters were as follows:

- Dry-weather flow rates reflect year 2045 population projections and 2000 per capita flow
- Wet-weather treatment capacity for each WWTP is shown in below Table 3-7. Note that in order to more accurately represent the influence of WWTP performance on CSO, the wet weather capacity at the WWTPs was set equal to the sustained wet weather capacity as reported in Table 3-2 of the 2003 BMP Annual report (most

recent year prior to the current CSO Consent Order) and not the WWTP's 2xDDWF rated capacity.

- Documented sediments in sewers for the 26th Ward service area.

Table 3-7. Baseline and 2xDDWF Capacities for the Jamaica Bay WWTPs

WWTP	WWTP Capacity (MGD)	
	Baseline	2xDDWF
26th Ward	160	170
Jamaica	178	200
Rockaway	39	90

Establishing the future dry weather sewage flow for each WWTP is a critical step in the WBWS Planning analysis since one key element in City's CSO control program is the use of its WWTPs to reduce CSO overflows. Increases in sanitary sewage flows associated with increased populations will reduce the amount of CSO flow that can be treated at the existing WWTPs since the increase sewage flows will use part of the WWTP wet weather capacity.

Dry weather sanitary sewage flows used in the baseline modeling were escalated to reflect anticipated growth within the City. The Mayor's Office along with City Planning has made assessments of the growth and movement of the City's population between the year 2000 census and 2010 and 2030 (NYCDCP, 2006). This information is contained in a set of projections made for some 188 neighborhoods within the City. DEP has escalated these populations forward to 2045 by assuming the rate of growth between 2045 and 2030 could be 50 percent of the rate of growth between 2000 and 2030. These populations were associated with each of the landside modeling sub-catchment areas tributary to each CSO regulator using GIS calculations. Dry sanitary sewage flows were then calculated for each of these sub-catchment areas by associating a conservatively high per capita sanitary sewage flow with the population estimate. The per capita sewage flow was established as the ratio of the year 2000 dry weather sanitary sewage flow and the year 2000 population for each WWTP service area.

The resulting dry weather flows are expected to increase from the Fiscal Year 2000 flow of 52 MGD to 67 MGD at the 26th Ward WWTP, and from the Fiscal Year 2005 flow of 77 MGD to 88 MGD at the Jamaica WWTP. The increase in the dry weather flows at each WWTP will properly account for the potential reduction in wet weather treatment capacity associated with projections of a larger population.

In addition to the above watershed/sewer-system conditions, a comparison between model calculations also dictates that the same meteorological (rainfall) conditions are used in each case. In accordance with the Federal CSO Control Policy the average rainfall year was used. Long-term rainfall records measured in the New York City metropolitan area were analyzed to identify potential rainfall design years to represent long-term, annual average conditions. Statistics were compiled to determine:

- Annual total rainfall depth
- Annual total number of storms

- Annual average storm volume
- Annual average storm intensity
- Annual total duration of storms
- Annual average storm duration
- Annual average time between storms

A more detailed description of these analyses is provided under separate cover (HydroQual, 2004). Although no year was found having the long-term average statistics for all of these parameters, the rainfall record measured at the National Weather Service gage at John F. Kennedy International Airport (JFK) during calendar year 1988 is representative of overall, long-term average conditions in terms of annual total rainfall and storm duration. Table 3-8 summarizes some of the statistics for 1988 and a long-term (1970-2002) record at JFK. Furthermore, the JFK 1988 rainfall record also includes high-rainfall conditions during July (recreational) and November (shellfish) periods, which is useful for evaluating potential CSO impacts on water quality during those particular periods. As a result, the JFK 1988 rainfall record was selected as an appropriate design condition for which to evaluate sewer system response to rainfall.

Table 3-8. Comparison of Annual 1988 and Long-Term Statistics, JFK Rainfall Record (1970-2002)

Rainfall Statistics	1988 Statistics	Long-Term Median (1970-2002)
Annual Total Rainfall Depth (inches) Return Period (years)	40.7 2.6	39.4 2.0
Average Storm Intensity (inch/hour) Return Period (years)	0.068 11.3	0.057 2.0
Annual Average Number of Storms Return Period (years)	100 1.1	112 2.0
Average Storm Duration (hours) Return Period (years)	6.12 2.1	6.08 2.0

3.5 DISCHARGE CHARACTERISTICS

As discussed in Section 3.4, sewer-system modeling is useful to characterize discharges from the sewer system. Because long-term monitoring of outfalls is difficult and sometimes not possible in tidal areas, sewer-system models that have been calibrated to available measurements of water levels and flows can offer a useful characterization of the discharge quantities. Sewer-system models can also be used to estimate the relative percentage of sanitary sewage versus rainfall runoff discharged from a CSO. This is particularly helpful when developing pollutant concentrations, since this sanitary/runoff split for discharge volume can be used to develop pollutant loadings based on concentrations associated with the sanitary and runoff. This method is somewhat more reliable than concentrations assigned based on pollutant concentrations measured in combined sewage, which are particularly variable.

Section 3.5.1 presents information related to the quantity (volume) discharged into the waterbody for the Baseline condition. Section 3.5.2 characterizes the quality (pollutant concentration) developed to assign pollutant concentrations to discharges. Section 3.5.3 summarizes the pollutant loadings discharged to Jamaica Bay and CSO tributaries for the Baseline condition. Section 3.5.4 provides an overview of the effect of urbanization on discharges, and Section 3.5.5 discusses the potential for toxic discharges to Jamaica Bay and CSO tributaries.

3.5.1 Characterization of Discharge Volumes, Baseline Condition

The calibrated watershed models described in Section 3.4 were used to characterize discharges from the 26th Ward and Jamaica WWTP drainage basins under the Baseline condition. Tables 3-9 (26th Ward WWTP) and 3-10 (Jamaica WWTP) summarize the results relating the annual CSO discharges from each point source outfall and the total wet weather discharge for the Baseline condition for the two WWTP drainage basins. There are no CSOs in the Rockaway service area.

In the 26th Ward WWTP drainage basin, there are two outfalls with large annual CSO volumes; the Spring Creek AWWTP and Regulator #2 in Fresh Creek.

Table 3-9. 26th Ward WWTP Drainage Basin CSO Discharges - Baseline Conditions

SPDES Outfall	Waterbody	Regulators and Other Structures	Annual Volume (MG)	Events
26W-003	Fresh Creek	Regulator 2	494	47
26W-004	Hendrix Creek	Regulator 14	36	16
26W-005	Spring Creek	Spring Creek AWWTP	98[1,2]	5
		Total CSO	**628**	

1 - Overflow from the Spring Creek AWWTP receives the equivalent of preliminary treatment
2 - A portion of the Spring Creek AWWTP discharge is from the Jamaica WWTP drainage basin

Within the Jamaica WWTP drainage basin, there four outfalls with large annual CSO volumes; Regulator #3 and Regulator #14 in Bergen Basin, and Regulator #6 and Regulator #7 in Thurston Basin.

Table 3-10. Jamaica WWTP Drainage Basin CSO Discharges – Baseline Conditions

SPDES Outfall	Waterbody	Regulators and Other Structures	Annual Volume (MG)	Events
JAM-003	Bergen Basin	Regulator 3	319	47
JAM-003A	Bergen Basin	Regulator 14	300	57
JAM-006	Bergen Basin	193 St/109 Ave[1] Regulator 4 Linden Blvd/Farmers Blvd[1]	27 2.4 0.6	61 23 7

SPDES Outfall	Waterbody	Regulators and Other Structures	Annual Volume (MG)	Events
JAM-005	Thurston Basin	Regulator 6 Regulator 7	763 105	55 41
JAM-007	Thurston Basin	Springfield Blvd[2]	40	50
		Total CSO	**1,557**	

1- Cross-connection
2 - Sum of 6 diversion chambers

3.5.2 WWTP Effect of Urbanization on Discharges

Pollutant concentrations associated with intermittent, weather-related discharges are highly variable. For this reason, analyses to characterize discharged pollutants utilized estimates of the relative split of sanitary sewage versus rainfall runoff in discharged flows. Pollutant concentrations for sanitary sewage are attributed to the sanitary portion and concentrations for stormwater are attributed to the rainfall runoff portion of the discharged flow volumes.

Table 3-11 presents the pollutant concentrations associated with the sanitary and stormwater components of discharges to Jamaica Bay and CSO tributaries. Sanitary concentrations were developed based on sampling of WWTP influent during dry-weather periods, as described elsewhere in more detail (DEP, 2002). Stormwater concentrations were developed based on sampling conducted citywide as part of the Inner Harbor Facility Planning Study (DEP, 1994), and sampling conducted citywide by DEP for the USEPA Harbor Estuary Program (HydroQual, 2005b).

Table 3-11. Sanitary and Stormwater Discharge Concentrations, Baseline Condition

Constituent	Sanitary Concentration(1)	Stormwater Concentration(2,3)
CBOD (mg/L)	110	15
TSS (mg/L)	110	15
Total Coliform Bacteria (MPN/100mL)	25×10^6	300,000
Fecal Coliform Bacteria (MPN/100mL) (4)	4×10^6	120,000
Enterococci (MPN/100mL) (4)	1×10^6	50,000

Notes: 1 - DEP, 2002
2 - DEP, 1994
3 - DEP, 2005
4 - Bacterial concentrations expresses as “most probable number” of cells per 100 mL.

3.5.3 Characterization of Pollutant Loads, Baseline Conditions

The majority of pollutant loads into Jamaica Bay are from the four DEP WWTPs (Table 3-12), their associated CSOs (Table 3-13), and stormwater outfalls (Table 3-14). Jamaica Bay receives a total of 70,998 MG of treated wastewater effluent annually, 99.5 percent of which originates from the three New York City WWTPs (Nassau County contributes the remaining 0.5 percent). WWTPs contribute approximately 99.7 percent of the total CBOD, and 98.7 percent of the nitrogen loading to Jamaica Bay.

Table 3-12. Annual WWTP Loadings to Jamaica Bay, Baseline Conditions

WWTP	Total Volume (MG)	CBOD (1,000 lbs)	TN (1,000 lbs)	Total Coliform (MPNx10^12)	Fecal Coliform (MPNx10^12)	Entero (MPNx10^12)
26th Ward	26,979	1,378	1,366	204	51	26
Jamaica	33,712	2,633	2,632	255	64	32
Rockaway	9,978	607	1,525	75	19	13
Nassau County	329	14	72	2	1	0
Totals	**70,998**	**4,632**	**5,595**	**536**	**135**	**71**

CSOs contribute approximately 86 percent of the total coliform loading, 80 percent of the fecal coliform loading, and 67 percent of the enterococci loading which is ultimately discharged into Jamaica Bay through the CSO tributaries. The largest CSO discharges to Jamaica Bay come from Bergen Basin, with approximately 41 percent of the volume.

Table 3-13. Annual CSO Loadings Discharged into Jamaica Bay, Baseline Conditions

Drainage Basin	Total Volume (MGD)	CBOD (lbs/day)	TN (lbs/day)	Total Coliform (MPNx10^12)	Fecal Coliform (MPNx10^12)	Entero (MPNx10^12)
Paerdegat	5.25	1,672	399	1,780	295	76
Fresh Creek	1.37	388	81	285	49	13
Hendrix Creek	0.1	18	4	13	2	0.6
Spring Creek	0.33	56	13	40	7	2
Bergen Basin	10.4	1,231	276	419	71	20
Thurston Basin	7.91	1,443	131	720	118	31
Totals	**25.36**	**4,808**	**904**	**3,257**	**542**	**143**

Stormwater discharges into Jamaica Bay from several locations as shown in the following table. It should be noted that the Rockaway CSO discharge is primarily stormwater, as evidenced by its pathogen loading.

Table 3-14. Annual Stormwater Loadings to Jamaica Bay, Baseline Conditions

Drainage Basin	Total Volume (MGD)	CBOD (lbs/day)	TN (lbs/day)	Total Coliform (MPNx10^12)	Fecal Coliform (MPNx10^12)	Entero (MPNx10^12)
Bergen Basin	2.02	150.6	35	11.5	2.7	1.2
East Mill Basin	0.53	39.2	9.1	5.9	2.4	1
Fresh Creek	0.84	62.6	14.6	9.5	3.8	1.6
Gerritsen Creek	0.46	34.2	8	5.2	2.1	0.9
Grassy Bay	0.46	34	7.9	2.6	0.6	0.3
Head of Jamaica Bay	1.85	138	32.1	10.5	2.5	1.1
Hendrix Creek	0.33	24.7	5.7	3.8	1.5	0.6
Mill Basin	1.39	103.7	24.1	15.8	6.3	2.6

Drainage Basin	Total Volume (MGD)	CBOD (lbs/day)	TN (lbs/day)	Total Coliform (MPNx10^{12})	Fecal Coliform (MPNx10^{12})	Entero (MPNx10^{12})
Nassau County	8.26	615.8	143.2	46.8	10.9	4.7
Paerdeget Basin	0.96	71.8	16.7	10.9	4.4	1.8
Rockaway	6.69	498.9	116	38	8.9	3.8
Sheepshead Bay	3.47	258.8	60.2	39.4	15.7	6.6
Shellbank Basin	0.92	68.9	16	5.2	1.2	0.5
Shellbank Creek	0.46	34.6	8.1	5.3	2.1	0.9
Spring Creek	0.48	36	8.4	3.4	1	0.4
Thurston Basin	4.8	357.7	83.2	2.7	6.4	2.7
Others	7.91	589.8	137.2	63.5	21	8.8
Totals	**41.83**	**3,119.3**	**725.5**	**280**	**93.5**	**39.5**

3.5.4 Effect of Urbanization to Discharge

The urbanization of the Jamaica Bay drainage area from a pastoral watershed to an urban sewershed is described in Section 2. The pastoral condition featured undeveloped uplands that provided infiltration of incident rainfall and contributed continuous freshwater inputs. Urbanization brought increased population, increased pollutants from sewage and industry, construction of sewer systems, and physical changes affecting the surface topography and imperviousness of the watershed. Increased impervious surface area generates more runoff that is less attenuated by infiltration processes. Accordingly, the sewer systems replaced natural overland runoff pathways with a conveyance system that routes the runoff directly to the waterbody – without the attenuation formerly provided by surrounding wetlands. As a result, more runoff is generated, and it is conveyed more quickly and directly to the waterbody. These changes also affect how pollutants are transported along with stormwater runoff as it is conveyed to the waterbody. Furthermore, the urbanized condition also results in additional sources of pollution from CSOs and industrial/commercial activities.

Urbanization of the watershed has altered its runoff yield tributary to Jamaica Bay by increasing its imperviousness. Imperviousness is a characteristic of the ground surface that reflects the percentage of incident rainfall that runs off the surface rather than is absorbed into the ground. While natural areas typically exhibit imperviousness of 10 to 15 percent, imperviousness in urban areas can be 70 percent or higher.

In a pastoral condition, runoff from a watershed typically reaches the receiving waters through a combination of overland surface flow and subsurface transport, typically with ponding and other opportunities for retention and infiltration. Tidal wetland areas previously surrounding Jamaica Bay would have further attenuated wet-weather discharges. The urbanization of the Jamaica Bay watershed reduced infiltration and natural subsurface transport and eliminated natural streams previously tributary to Jamaica Bay. Runoff is transported via roof leaders, street gutters, and catch basins into the combined and separate sewer system, which then discharges into Jamaica Bay via the CSO tributaries, since most of the wetlands have been eliminated. Urbanization has thus simultaneously decreased retention and absorption of runoff during transport and decreased the travel time for runoff to reach the waterbody. When combined with the increased runoff due to increased imperviousness of the watershed, the end result is increased peak discharge rates and higher total discharge volumes to the waterbody during wet weather.

Urbanization has also altered the pollutant character of wet-weather discharges from the watershed. The original rural landscape of forests, fields and wetlands represents pristine conditions with pollutant loadings resulting from natural processes (USEPA, 1997). These natural loadings, while having an impact on water quality in the receiving water, are insignificant compared to the urbanized-condition loadings from CSO and stormwater point sources.

Wet-weather discharges from urbanized areas are significantly higher in pollutant concentrations than natural runoff. These pollutants include coliform bacteria, oxygen-demanding materials, suspended and settleable solids, floatables, oil and grease, and other materials.

A summary of the hydrologic changes caused by urbanization in the Jamaica Bay watershed is presented in Table 3-15. The pre-urbanized condition is assumed circa 1900. The table demonstrates that the runoff yield for an average precipitation year, as calculated by the RAINMAN model, has increased from 2,761 MG of natural runoff to 21,241 MG discharged by combined and separate sewer systems to Jamaica Bay per year, an increase of 670 percent. Significantly larger discharges are now made into Jamaica Bay at higher rates since they are no longer attenuated, filtered, and mitigated by “natural” overland mechanisms.

Table 3-15. Effects of Urbanization on Watershed Yield

Watershed Characteristic	Pre-Urbanization	Urbanized (1)
Drainage Area (acres)	45,560 (2)	53,828
Adjacent Wetlands (acres)	9,356	340
Population (4)	223,500	1,523,000
Imperviousness (%)	10%	70%
Annual Runoff Yield (MG) (3)	2,761	21,241
Peak Storm Runoff Yield (MG) (3)	232	1,379

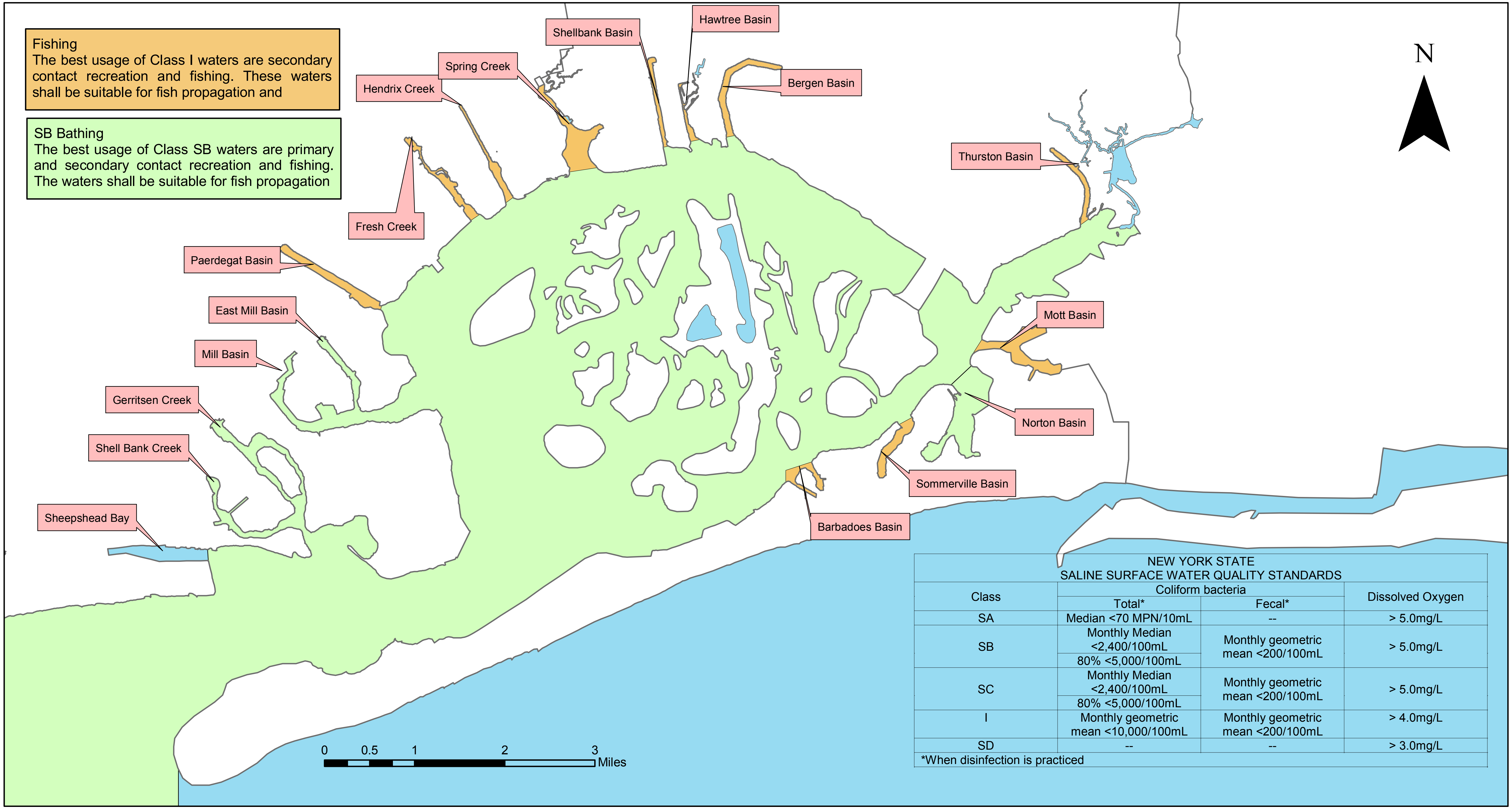
Notes: 1 - Existing condition
2 - Approximated from historical maps
3 - For an average precipitation year (JFK, 1988), including stormwater
4 - Pre-urbanized is estimated for year 1900; urbanized estimate based on Year 2000 U.S. Census

3.5.5 Toxic Discharge Potential

Early efforts to reduce the amount of toxic contaminants being discharged to the New York City open and tributary waters focused on industrial sources and metals. For industrial source control for separate and combined sewer systems, USEPA required approximately 1,500 municipalities nationwide to implement Industrial Pretreatment Programs (IPPs). The intent of the IPP is to control toxic discharges to public sewers that are tributary to sewage treatment plants by regulating Significant Industrial Users (SIU). If a proposed IPP is deemed acceptable, USEPA decrees the local municipality a “control authority.” The DEP has been a control authority since January 1987, and enforces the IPP through Chapter 19 of Title 15 of the Rules of the City of New York (Use of the Public Sewers), which specifies excluded and conditionally accepted toxic substances along with required BMPs for several common discharges such as photographic processing waste, grease from restaurants and other non-residential users, and perchloroethylene from dry cleaning. The DEP has been submitting annual reports on its activities since 1996. The 310 SIUs that were active citywide at the end of 2004 discharged an estimated average total mass of 38.2 pounds per day (lbs/day) of the following metals of concern: arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver and zinc.

As part of the IPP, the DEP analyzed the toxic metals contribution of sanitary flow to CSOs by measuring toxic metals concentrations in WWTP influent during dry weather in 1993. This program determined that of the 177 lbs/day of regulated metals being discharged by regulated industrial users only 2.6 lbs/day (1.5 percent) were bypassed to CSOs. Of the remaining 174.4 lbs, approximately 100 lbs ended up in biosolids, and the remainder was discharged through the WWTP effluent outfall. Recent data suggest even lower discharges. In 2003, the average mass of total metals discharged by all regulated industries to the New York City WWTPs was less than 39.1 lbs/day, which would translate into less than 1 lb/day bypassed to CSOs from year 2003 regulated industries if the mass balance calculated in 1993 is assumed to be maintained. A similarly developed projection was cited by the 1997 DEP report on meeting the nine minimum CSO control standards required by Federal CSO policy, in which DEP considered the impacts of discharges of toxic pollutants from SIUs tributary to CSOs (DEP, 1997). The report, audited and accepted by USEPA, includes evaluations of sewer system requirements and industrial user practices to minimize toxic discharges through CSOs. It was determined that most regulated industrial users (of which SIUs are a subset) were discharging relatively small quantities of toxic metals to the NYC sewer system.

Currently there are no SIUs located within the sewershed associated with combined sewer outfalls that discharge to Jamaica Bay. In addition, the DEC has not listed Jamaica Bay or its CSO tributaries as being impaired by toxic pollutants. As such, metals and toxic pollutants are not considered to be pollutants of concern for the development of this WBWS Facility Plan.



NEW YORK STATE
SALINE SURFACE WATER QUALITY STANDARDS

Class	Coliform bacteria		Dissolved Oxygen
	Total*	Fecal*	
SA	Median <70 MPN/10mL	--	> 5.0mg/L
SB	Monthly Median <2,400/100mL 80% <5,000/100mL	Monthly geometric mean <200/100mL	> 5.0mg/L
SC	Monthly Median <2,400/100mL 80% <5,000/100mL	Monthly geometric mean <200/100mL	> 5.0mg/L
I	Monthly geometric mean <10,000/100mL	Monthly geometric mean <200/100mL	> 4.0mg/L
SD	--	--	> 3.0mg/L

*When disinfection is practiced

NYC Environmental Protection

Jamaica Bay
DEC Waterbody Classifications

4.0 Waterbody Characteristics

Jamaica Bay is located on the south shore of western Long Island, New York and classified as an enclosed bay in the New York code (6 NYCRR Part 700.1(a) (12). Roughly semi-circular in shape, Jamaica Bay is approximately four miles wide, north to south, and eight miles long, east to west. Much of the area in the center of Jamaica Bay consists of narrow channels and tidal marsh islands that are exposed during low tides. Navigable channels, approximately 30 feet in depth, encircle most of the outer ring of Jamaica Bay, with navigable tributaries connecting to the main channel. Tidal exchange with the Atlantic Ocean is through Rockaway Inlet. The Jamaica Bay watershed includes portions of Brooklyn, Queens and Nassau County. Figure 4-1 illustrates the DEC waterbody classifications of Jamaica Bay and its tributaries and associated water quality standards.

The following report section describes the present-day physical and water quality characteristics of Jamaica Bay and its CSO tributaries, as well as their current uses.

4.1 CHARACTERIZATION METHODOLOGY

The DEP's comprehensive watershed-based approach to long-term CSO control planning follows the USEPA's guidance for monitoring and modeling (USEPA, 1999). The watershed approach "represents a holistic approach to understanding and addressing all surface water, ground water, and habitat stressors within a geographically defined area, instead of addressing individual pollutant sources in isolation" (USEPA, 1999). The guidance recommends identifying appropriate measures of success based on site-specific conditions to both characterize water quality conditions and measure the success of long-term control plans. The measures of success are recommended to be objective, measurable, and quantifiable indicators that illustrate trends and results over time. USEPA's recommended measures of success are administrative (programmatic) measures, end of pipe measures, receiving waterbody measures, and ecological, human health, and use measures. USEPA further states that collecting data and information on CSOs and CSO impacts provides an important opportunity to establish a solid understanding of the "baseline" conditions and to consider what information and data are necessary to evaluate and demonstrate the results of CSO control. USEPA acknowledges that since CSO controls must ultimately provide for the attainment of water quality standards, the analysis of CSO control alternatives should be tailored to the applicable standards such as those for dissolved oxygen and coliform bacteria. Since the CSO Control Policy recommends reviews and revision of water quality standards, as appropriate, investigations should reflect the site-specific wet weather impacts of CSOs. The waterbody/watershed assessment of Jamaica Bay and its CSO tributaries therefore required a compilation of existing data, identification of data gaps, collection of new data, and cooperation with field investigations being conducted by other agencies.

DEP has implemented its CSO facility planning projects consistent with this guidance and has developed the above noted categories of information on waterbodies such as the Jamaica Bay and its CSO tributaries. Waterbody/watershed characterization activities were conducted following the work plans and field sampling programs developed during the Use and Standards Attainability (U&SA) Project. These efforts yielded valuable information for characterizing the Jamaica Bay and its watershed as well as supporting mathematical modeling and engineering efforts. The following describes these activities.

4.1.1 Compilation of Existing Data

A comprehensive review of past and ongoing data collection efforts was conducted to identify programs focused on or including Jamaica Bay and nearby waterbodies. The DEP has conducted facility planning in Jamaica Bay since at least 1978, when the 208 Study identified the waterbody for CSO abatement. Facility planning has been ongoing since that time, resulting in a large body of pertinent data. Several other parallel projects by the DEP and others have also been conducted that further contribute to the data available (see Section 5.0). The DEP continues to conduct Citywide investigative programs yielding useful water quality data to address these limitations such as the City of New York Harbor Survey Program. Additional sources of data are available from other stakeholders in the New York Harbor, including the US Army Corps of Engineers. Modeling was based on 1988 data collected during the City-wide CSO Study, 1995-96 data collected during the Jamaica Bay Eutrophication Study, 2005 data collected during the CSO Long-term Control Plan (this project), and data from the ongoing City of New York Harbor Survey Program.

4.1.2 Biological and Habitat Assessment

The USEPA has for a long time indicated that water quality based planning should follow a watershed based approach. Such an approach considers all factors impacting water quality including both point and nonpoint (watershed) impacts on the waterbody. A key component of such watershed based planning is an assessment of the biological quality on the waterbody. Fish and aquatic life use evaluations require identifying regulatory issues (aquatic life protection and fish survival), selecting and applying the appropriate criteria, and determining the attainability of criteria and uses. According to guidance published by the Water Environment Research Foundation (Michael & Moore, 1997; Novotny et. al., 1997), biological assessments of use attainability should include "contemporaneous and comprehensive" field sampling and analysis of all ecosystem components. These components include phytoplankton, macrophytes, zooplankton, benthic invertebrates, fish, and wildlife. The relevant factors are dissolved oxygen, habitat (substrate composition, organic carbon deposition, sediment pore water chemistry), and toxicity.

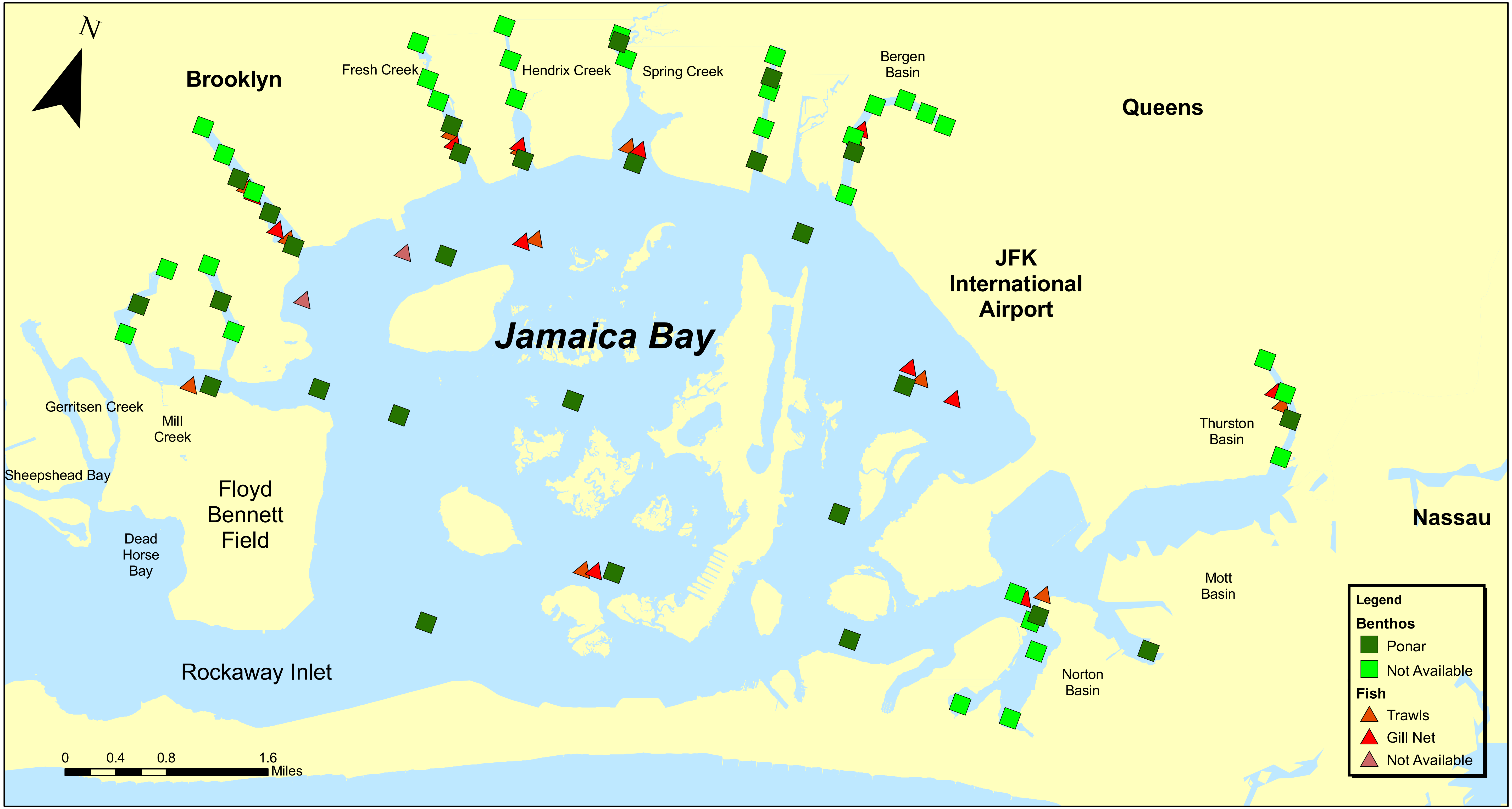
Biological components and factors were prioritized based on what was most in need of contemporary information relative to existing data or information expected to be generated by other ongoing studies, and/or, which biotic communities would provide the most information relative to the definition of use classifications and the applicability of particular water quality criteria and standards. The biotic communities selected for sampling included subtidal benthic invertebrates (which being largely sessile, have historically been used as indicators of environmental quality); epibenthic organisms colonizing standardized substrate arrays suspended in the water column (thus eliminating substrate type as a variable in assessing water quality); fish eggs and larvae (their presence being related to fish procreation); and juvenile and adult fish (their presence being a function of habitat preferences and/or dissolved oxygen tolerances).

The waterbody/watershed assessment conducted a biological Field Sampling and Analysis Program (FSAP) designed to fill ecosystem data gaps in the New York Harbor. DEP's FSAPs were designed and implemented for each element of the FSAP in conformance with USEPA's Quality Assurance Project Plan guidance (USEPA, 1998, 2001a, 2001b), its standard operation and procedure guidance (USEPA, 2001c), and in consultation with USEPA's Division of Environmental Science and Assessment in Edison, NJ. The FSAPs collected information to identify uses and use limitations within waterbodies assessing aquatic organisms and factors that contribute to use limitations (dissolved oxygen, substrate, habitat and toxicity). Some of these FSAPs were related to specific waterbodies; others to specific ecological communities or habitat variables throughout the harbor; and still others to trying to answer specific questions about habitat and/or water quality effects on aquatic life. Several FSAPs were conducted by the DEP during U&SA Project that included investigations of Jamaica Bay. Following review by the USEPA, DEC and other members of the Project Steering Committee, the Jamaica Bay FSAP was initiated in early Summer 2000. Figure 4-2 provides a composite map of the biological FSAP sampling station locations.

DEP conducted its Harbor-Wide Ichthyoplankton FSAP in 2001 to identify and characterize ichthyoplankton communities in the open waters and tributaries of New York Harbor (HydroQual, 2001b). Information developed by this FSAP identified what species are spawning, as well as where and when spawning may be occurring in New York City's waterbodies. The FSAP was executed on a harbor-wide basis to assure that evaluations would be performed at the same time and general water quality conditions for all waterbodies would be assessed during the same temporal period. Sampling was performed at 50 stations throughout New York Harbor, its tributaries, and at reference stations outside the harbor complex. The locations of the sampling stations are shown on Figure 4-3. One station was located in the Jamaica Bay watershed. Samples were collected using fine-mesh plankton nets with two replicate tows taken at 50 stations in March, May, and July 2001. In August 2001, the month where ichthyoplankton are most stressed due to high temperatures and low dissolved oxygen levels, 21 of the stations were re-sampled to evaluate ichthyoplankton during generally the worst case temperature and dissolved oxygen conditions.

The DEP conducted a Harbor-Wide Epibenthic Recruitment and Survival FSAP in 2001 to characterize the abundance and community structure of epibenthic organisms in the open waters and tributaries of New York Harbor (HydroQual, 2001c). The recruitment and survival of epibenthic communities on hard substrates was evaluated because these sessile organisms are good indicators of long-term water quality. This FSAP provided a good indication of both intra- and inter-waterbody variation in organism recruitment and community composition. Artificial substrate arrays were deployed at 37 stations throughout New York Harbor, its tributaries, and at reference stations outside the harbor complex. The locations of relevant sampling stations are shown on Figure 4-4. Three stations were located in Jamaica Bay. The findings of previous waterbody-specific FSAPs indicated that six months was sufficient time to characterize the peak times of recruitment, which are the spring and summer seasons. Therefore, arrays were deployed in April 2001 at two depths (where depth permitted) and retrieved in September 2001.

A special field investigation was conducted during the summer of 2002 to evaluate benthic substrate characteristics in New York Harbor tributaries (HydroQual, 2002). The goals of this FSAP were to assist in the assessment of physical habitat components on overall habitat suitability and water quality and to assist in the calibration of the water quality models as they compute bottom sediment concentrations of total organic carbon (TOC). Physical characteristics of benthic habitat directly and critically relate to the variety and abundance of the organisms living on the waterbody bottom. These benthic organisms represent a crucial component of the food web, and, therefore, the survival and propagation of fish. Samples were collected from 103 stations in New York Harbor tributaries using a petit Ponar® grab sampler in July 2002. The



NYC Environmental Protection

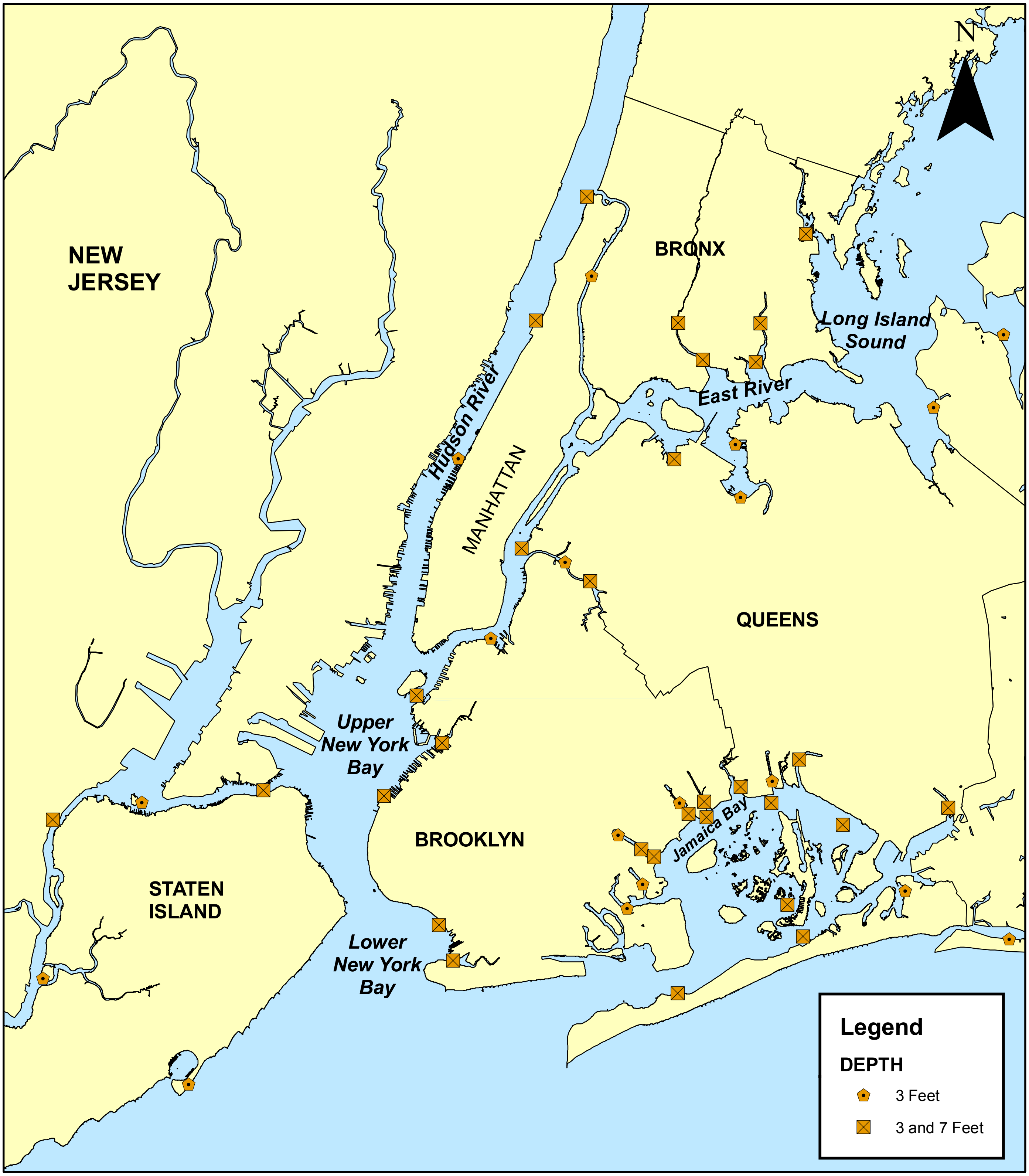
Jamaica Bay Sampling Stations
Benthos and Fish

NYC Environmental Protection

Jamaica Bay Sampling Stations
Icthyoplankton

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

Figure 4-3



Citywide Sampling Stations Epibenthos

locations of the sampling stations are shown on Figure 4-5. Three stations were located in Jamaica Bay. Two samples from each station were tested for TOC, grain size, and percent solids.

4.1.3 Other Data Gathering Programs

From 1975 through 1977, the City conducted a harbor-wide water quality study funded by a Federal grant under Section 208 of the Water Pollution Control Act Amendments of 1972. This study confirmed tributary waters in the New York Harbor were negatively affected by CSOs. In 1984 a City-wide CSO abatement program was developed that initially focused on establishing planning areas and defining how facility planning should be accomplished. The City was divided into eight individual project areas that together encompass the entire harbor area. Four open water project areas were developed (East River, Jamaica Bay, Inner Harbor and Outer Harbor), and four tributary project areas were defined (Flushing Bay, Paerdegat, Newtown Creek, and Jamaica tributaries). Samples were collected from sewer discharges at several locations that characterized dry and wet weather discharges. Receiving water sampling locations were established from receiving water modeling support. Physical measurements of tidal dynamics, current velocity, and bathymetry were made in addition to sample collection for chemical analysis. As part of the Jamaica Bay Water Quality Facility Plan, two dry weather and three wet weather surveys, paired with special studies, were conducted during 1986 to characterize water quality and sediment conditions and to identify sources of impairments (Hazen and Sawyer, 1991).

The DEP and its predecessor city agencies have been monitoring water quality in New York Harbor waters since 1909, and reporting results annually as part of the New York City Regional Harbor Survey. The stated purpose of the program was "to assess the effectiveness of New York City's various water pollution control programs and their combined impact on water quality" (DEP, 2000). Harbor Survey stations relevant to Jamaica Bay are shown on Figure 4-6.

Data has been collected by agencies and organizations throughout New York Harbor in addition to harbor monitoring and project-specific sampling programs conducted by the DEP. The USEPA Regional Environmental Monitoring and Assessment Program (REMAP) (Adams et. al., 1998) has evaluated sediment quality throughout New York Harbor, as has the agency's more recent five-year National Coastal Assessment (a.k.a. "Coastal 2000") program. The New York State Department of Transportation (TAMS, 1999) conducted studies of the biota of the East River at the Queensboro Bridge, while the New York City Public Development Corporation (EEA, 1991) studied the ecology of Wallabout Bay in the East River. The USACOE performed sediment profile imagery and benthic sampling in Jamaica Bay, Upper New York, Newark, Bowery, and Flushing Bays during June and October, 1995. In Upper New York Bay, the USACOE conducted a two-year study of flatfish distribution and abundance. The data from these programs are useful for comparing Jamaica Bay to similar waterbodies in the New York Harbor to ascertain its relative aquatic and ecological health.

A significant source of data on fish populations in the New York Harbor comes from the numerous studies associated with electric power generating station cooling water systems. Along with cooling water, intakes inadvertently withdraw planktonic biota and smaller fish incapable of escaping the pressure gradients generated by pumping. These organisms either pass through the cooling system (entrainment), or are trapped against the screens and other protective

NYC Environmental Protection

Benthic Substrate Characteristics Sampling Locations

barriers (impingement). Permit conditions at these facilities require entrainment and impingement sampling, providing an abundance of data on fish populations and other aquatic organisms. These data are biased towards younger life-stages (fish eggs and larvae) and smaller fish species, but can provide evidence of the viability of fish species in the waterbody. Local power plants include the East River plant in lower Manhattan; the Arthur Kill plant on Staten Island; and the Ravenswood, Astoria and Poletti plants on the Queens side of the East River. ENSR (1999) reported on the East River generating station, but the most recent summary of these data was produced by Sunset Energy Fleet LLC, in its Article X application to the New York State Public Service Commission, to build and operate a power plant in Gowanus Bay (Sunset Energy Fleet, 2002). Sunset Energy also collected and analyzed numerous samples of benthic infauna, and ichthyoplankton, in Gowanus Bay in 1999 and 2000. Again, these data are useful for comparative and baseline evaluations, but do not generally provide meaningful information on the effects of water pollution control efforts by the DEP.

4.1.4 Receiving Water Modeling

A set of mathematical models were developed and calibrated to describe relationships between CSO/storm loads discharged to Jamaica Bay and the water quality in the waterbody. The CSO model (Infoworks) was used to calculate the flows and loadings of pollutants that are fed to the receiving water models. The Jamaica Bay Eutrophication Model (JEM), a three dimensional, time variable hydrodynamic and water quality model containing a 28 state variable eutrophication model for computing nutrient forms and chlorophyll-a (algae) concentrations provided the basis of the water quality modeling analysis (HydroQual, 2002).

The hydrodynamic component of the JEM model uses input data and a set of equations that describe the movement of water to calculate the volume and velocity of water at any time and location. The water quality component of the JEM model uses the volume and velocity information, along with additional water quality input information and water quality kinetic equations, to calculate receiving water concentrations for different types of pollutants. The water quality model includes a sediment nutrient flux sub-model that calculates the decomposition of organic material within the sediment and the flux of inorganic material between the sediment and overlying water column. JEM was calibrated during the Jamaica Bay Eutrophication Study (HydroQual, 2002) and peer reviewed during a review by a Model Evaluation Group.

The North Channel Model (NCM) and Jamaica Bay Eutrophication Model – Bergen/Thurston (JEM-BT) are subsets of JEM and were used to analyze the tributaries of Jamaica Bay. The NCM was used to analyze Fresh Creek, Hendrix Creek, and Spring Creek. The NCM was originally calibrated to a 1988 water quality data set for the Fresh Creek CSO Facility Plan Project (HydroQual, 2003). This calibration was updated using water quality data collected during 2005 for this WB/WS Facility Plan. JEM-BT was used to analyze Bergen and Thurston Basins. The JEM-BT, originally calibrated to a 1993 water quality data set for the Jamaica Tributaries CSO Facility Planning Project (Hazen and Sawyer, 1996), was also updated with 2005 water quality data. This model is essentially the same as JEM, except that Bergen and Thurston Basins have a more refined segmentation in JEM-BT. Both NCM and JEM-BT use the same hydrodynamic modeling system and have the same receiving water kinetics as JEM, only the model segmentation differs between the models.

4.2 PHYSICAL WATERBODY CHARACTERISTICS

Defining Jamaica Bay and its CSO tributaries in terms of their physical characteristics and properties is critical to the development of accurate and predictive water quality models. Baseline information on bottom topography and contours in the study area was obtained from the National Oceanic and Atmospheric Administration (NOAA) navigational chart 12350 (1988) of Jamaica Bay and Rockaway Inlet. Temperature, salinity, bathymetric, tidal, and current data collected in conjunction with previous receiving water sampling programs provided useful information about the physical characteristics of Jamaica Bay and its CSO tributaries. Field observations of nuisance conditions such as odors, sediment mounds, and floating debris were made in order to assess qualitatively the aesthetic impact CSOs have on the study area.

4.2.1 Jamaica Bay

Jamaica Bay is a shallow bar-built embayment that connects with Lower New York Bay to the west through Rockaway Inlet. Jamaica Bay contains approximately 16,000 acres of surface waters and 3,000 acres of islands and marshes. The mean depth of the bay is approximately 13 feet, with maximum depths reaching 30 to 50 feet in navigation channels and sand borrow pit areas. Jamaica Bay lies at the southwestern tip of Long Island and is located primarily within the New York City boroughs of Brooklyn and Queens. A relatively small portion of the bay is located in the Town of Hempstead in Nassau County, New York.

Jamaica Bay is a brackish water estuary (a mixture of freshwater and seawater). Thus, the salinity of the Bay is intermediate between freshwater (less than one part per thousand) and sea water (34 parts per thousand). Salinity in Jamaica Bay generally varies from about 23 to 27 parts per thousand (DEP, 2007). Stratification of the water column can occur particularly following wet weather as the less dense stormwater overrides the denser saline waters in the Bay. Jamaica Bay has an average semidiurnal (two high and two low tides per day) tidal range of 5 feet. Tidal currents move sediment and other materials around the Bay and mix salt and freshwater. The sediment flushing time has increased 250 percent since the construction of JFK International Airport, from 10 days to 35 days (USACOE, 2004).

The Jamaica Bay estuary is only about half of its pre-colonial extent and the salt marsh wetlands that have been a defining ecological feature of the Bay are decreasing at an accelerated rate. Over the last 150 years, interior wetland islands and perimeter wetlands have been permanently lost as a result of extensive filling operations; shorelines have been hardened and bulk-headed to stabilize and protect existing residential communities and infrastructure; deep channels and sand borrow pit areas have been dredged altering bottom contours and affecting natural flows within the Bay; natural tributaries providing freshwater inputs and coarse sediment exchange with the Bay have essentially disappeared resulting in accumulations of silts and particulates from urban runoff. These activities have altered historic flow patterns in the Bay, eradicated natural habitat, impacted water quality, and modified the rich ecosystem that was present prior to the extensive urban development of the watershed.

4.2.2 CSO Tributaries

The CSO tributaries are either artificially created waterbodies or have been significantly altered by human activities. Freshwater inputs to the CSO tributaries are generally limited to flow from stormwater or CSO outfalls. Salinity ranges in the CSO tributaries are similar to those found in Jamaica Bay with water column stratification occurring after wet weather. Water temperatures in the CSO tributaries respond to seasonal changes in atmospheric conditions. Temperature differences between surface and bottom waters in the tributaries are generally less than 1 degree Celsius (Hazen and Sawyer, 1996).

Fresh Creek

Fresh Creek is approximately one mile long, ranging in width from 650 feet at its widest point to approximately 125 feet at its narrowest point. Depths at mean low water (MLW) range from 3 to 19 feet. Studies conducted by the USACOE (1997) recommended re-establishment of submerged aquatic vegetation (SAV) for fish and invertebrate habitat and enhancement of upland habitat for wildlife at Fresh Creek.

Hendrix Creek

Hendrix Creek has been greatly affected by channelization and filling (Blanchard, 1992). The width of the creek has been made a uniform 60 to 80 feet; and its depth (at low tide) reduced 2 to 5 feet. The 26th Ward WWTP occupies a large portion of the western shore. In addition, the Pennsylvania and Fountain Avenue landfills occupy the east and west shores near the mouth of the creek.

Spring Creek

Spring Creek is actually a tributary to Old Mill Creek which opens to Jamaica Bay. Ralph Creek is tributary to Spring Creek. In sequence of their original stream orders, Ralph Creek is the shortest and narrowest (2,100 feet long x 100 feet wide); Spring Creek is 3,800 feet long by an average width of 180 feet; and Old Mill Creek is a mile long and between 200 and 2,300 feet in width. Depths throughout the system range from 3 to 12 feet at MLW, and extensive areas of low and high marsh exist in Old Mill Creek up-stream from its junction with Spring Creek. However, the system as a whole has been altered to the point where freshwater input is wholly derived from CSO and storm sewer discharge. Spring and Ralph Creeks have retained some semblance of their original channel configuration. The Spring Creek Auxiliary WWTP overflows to the confluence of Spring Creek and Old Mill Creek. Upland habitat is dominated by plants characteristic of disturbed habitat (mugwort and common reed).

Bergen Basin

Bergen Basin is over a mile long with average width of 400 feet and average depth of 12.5 feet (MLW). Fuel storage facilities for JFK International Airport line its eastern shore. In Bergen Basin, fish and wildlife habitat is limited to a small area of intertidal flats and wetlands near the mouth on Grassy Bay.

Thurston Basin

Thurston Basin is located at the eastern-most end of Jamaica Bay. Thurston Basin is 5,000 feet long and 250 feet wide, ranging in depth at MLW from 3 feet at its head to 20 feet at its mouth. Undeveloped land surrounds Thurston Basin with JFK International Airport along its western shore and Rockaway Boulevard along its eastern shore.

4.2.3 Waterbody Access

Existing development within the Jamaica Bay watershed restricts access to significant areas of Jamaica Bay and it's CSO tributaries. The below is summary of the public's ability to access the waterbodies studied in this WB/WS Facility Plan Report.

Jamaica Bay

Obstacles to accessing Jamaica Bay include highways (including the Belt Parkway & Beach Channel Drive) that encircle the Bay, JFK International Airport, and former landfills. The primary way to access Jamaica Bay is through the Federal Gateway National Recreation Area (GNRA). The Jamaica Bay unit of the GNRA is over 12,000 acres and consists of the Jamaica Bay Wildlife Refuge, Breezy Point Tip, Canarsie Pier and Floyd Bennett Field. Additional access to Jamaica Bay is provided by City and state parks primarily reachable by residents in the western and southern neighborhoods of the watershed (DEP, 2007). There are boat marinas scattered throughout Jamaica Bay and, in the Broad Channel neighborhood, many of the homes located along the adjacent man-made canals have their own floating boat dock.

Fresh Creek

Fresh Creek is generally bounded on both sides by the Fresh Creek Park Preserve, a 100± acre park under the domain of NYC Department of Parks & Recreation. The public has access to Fresh Creek through walking paths in the preserve as well as through nearby recreation fields in Canarsie Park. There are no public boat ramps or marinas located in Fresh Creek. The NOAA nautical chart for Jamaica Bay indicates that the upper half of Fresh Creek – between the head end and the area parallel to Avenue M – is very shallow in depth.

Hendrix Creek

Public access to Hendrix Creek is very limited, due in part to the presence of the 26th Ward WWTP, the Pennsylvania and Fountain Avenue landfills and the nearby Gateway shopping center. There are no public boat ramps or marinas located in Hendrix Creek. The NOAA nautical chart for Jamaica Bay indicates that the area between the head end of Hendrix Creek and the Belt Parkway bridge is very shallow in depth.

Spring Creek

Access to Spring Creek is through walking paths in Spring Creek Park, an undeveloped/natural park run by the NYC Department of Parks & Recreation that is located on the east side of Spring Creek. Access to the west side of Spring Creek is restricted by the presence of the Fountain Avenue landfill. There are no public boat ramps or marinas located in

Spring Creek. The NOAA nautical chart for Jamaica Bay indicates that the narrow portion of Spring Creek – between the head end and the enlarged waterbody parallel to 163rd street – is very shallow in depth.

Bergen Basin

As a portion of Bergen Basin is located within the Safety and Security Zone of JFK Airport, the public is restricted from accessing most of Bergen Basin. The eastern side of the basin is isolated from a nearby residential development by railroad tracks and a fence line that runs down to the Jamaica Bay shoreline, while the eastern side of the basin is located entirely on JFK Airport property. Boaters can maneuver approximately halfway up Bergen Basin before encountering a boom that appears to delineate the Safety and Security Zone of JFK Airport. There are no public boat ramps or marinas located in Bergen Basin.

Thurston Basin

As a portion of Thurston Basin is located within the Safety and Security Zone of JFK Airport, the public is restricted from accessing most of Thurston Basin. Access to the eastern side of the basin is restricted by a fence along Rockaway Boulevard; however, there is a small residential development off of Rockaway Boulevard that terminates at the Thurston Basin/Head of Bay waterbody. The western side of the basin is located entirely on JFK Airport. Boaters can maneuver approximately halfway up Thurston Basin before encountering a boom that appears to delineate the Safety and Security Zone of JFK Airport. While there are no public boat ramps or marinas located in Thurston Basin, several of the homes in the aforementioned residential development have floating boat docks at/near the terminus of Thurston Basin.

4.3 CURRENT WATERBODY USES

4.3.1 Bathing Beaches

There are no bathing beaches within Jamaica Bay that are permitted by the New York City Department of Health and Mental Hygiene.

4.3.2 Other Uses

The land immediately surrounding Jamaica Bay is used mostly for recreational purposes, with some residential, municipal, commercial, and industrial uses. There are numerous individual parks along the shores of Jamaica Bay, as well as on islands in the bay, the majority of which are part of the GNRA, which is administered by the National Parks Service. The shores of Jamaica Bay in Brooklyn are entirely parkland. In Queens, the shoreline between Spring Creek and Shellbank Basin is parkland. The parks of Jamaica Bay provide numerous recreational opportunities such as fishing, golfing, swimming, horseback riding, boating, hiking, picnicking, and bird watching. The JFK International Airport, located between Bergen and Thurston Basins, comprises the single largest industrial use in Jamaica Bay. Commercial uses in Jamaica Bay include several marinas located along the shores and islands of the Bay.

Jamaica Bay also serves as an important ecological resource for populations of flora and fauna. The Bay has evolved over the last 25,000 years as a complex network of open water, salt marsh, grasslands, coastal woodlands, maritime shrublands, and brackish and freshwater wetland communities. The wildlife use of these systems is commensurate with this complex network of natural systems. These varied natural communities support 91 species of fish, 325 bird species and provide important habitat for many species of reptiles, amphibians, and small mammals. The Bay is a critical stopover area along the Eastern Flyway avian migration route.

4.4 POINT SOURCES AND LOADS

The majority of pollutant loads discharged to Jamaica Bay are believed to be from the following sources:

- There are five wastewater treatment facilities that discharge into Jamaica Bay:
  - DEP Coney Island WWTP – discharges into Rockaway Inlet.
  - DEP 26th Ward WWTP – discharges to the upper reach of Hendrix Creek.
  - DEP Jamaica WWTP – primarily discharges to Grassy Bay, also has a secondary discharge towards the head of Bergen Basin.
  - DEP Rockaway WWTP – discharges to Beach Channel.
  - Village of Cedarhurst WWTP – discharges to Mott Basin. An Inter-municipal Agreement (IMA) between the Village of Cedarhurst and Nassau County was executed in January 2008. The IMA calls for the diversion of flow from Cedarhurst to the County-owned Bay Park Sewage Treatment Plant to be completed by January 1, 2011. The diversion has not happened as of October 2011. . The Bay Park STP discharges into Reynolds Channel (which flows into Hempstead Bay).).
- JFK International Airport - At times, flow may be contaminated by deicing chemicals (during winter) and/or other contaminants. JFK discharges to Bergen Basin, Thurston Basin and directly to the Bay.
- Landfills - contaminants leaching from three former landfills, specifically the Edgemere Landfill off Rockaway Peninsula and the Fountain Avenue and Pennsylvania Avenue Landfills in Brooklyn, discharge to the Bay
- Industrial effluent discharges to Jamaica Bay are minimal compared to the above sources.

In 1996 DEC designated the eastern portion of Jamaica Bay and its tributaries located in Queens County as high priority waterbodies for TMDL development with their inclusion on the Section 303(d) List. The cause of the listing was nitrogen, oxygen demand, and pathogens. A TMDL for mercury was developed for these waterbodies in 1996. In 1998 Hendrix Creek and Bergen Basin were added to the DEC 303(d) list and designated as high priority waterbodies for TMDL development for pathogens and oxygen demand, respectively. In 2002, Hendrix Creek was newly listed for nitrogen and oxygen demand and Bergen Basin was newly listed for pathogens. The above referenced 303(d) listings remain in effect for the proposed final 2010 cycle. However, the proposed final 303(d) list also indicates that TMDL development for these waterbodies may be deferred as impairments are being addressed by a 2005 Order on Consent with New York City to develop and implement watershed and facility plans to address CSO discharges and bring New York City waters into compliance with the Clean Water Act.

4.5 CURRENT WATER QUALITY CONDITIONS

The open water region of Jamaica Bay(i.e., exclusive of the CSO tributaries) is designated as a Class SB waterbody by the DEC. Class SB waters shall be appropriate for primary and secondary contact activities (i.e. recreation and fishing) and suitable for fish propagation/survival. The CSO tributaries contiguous to the Bay are designated as Class I waterbodies. The water quality of Class I waters shall be suitable for secondary contact activities and fish propagation/survival. DEC water quality standards for these waters specify numerical dissolved oxygen and coliform requirements among other narrative standards. The numerical water quality standards for saline waters in New York State are summarized in Table 4-1.

Table 4-1. New York State Saline Surface Water Quality Standards

Class	Coliform Bacteria		Dissolved Oxygen
	Total	Fecal	
SA	Median <70 MPN/100 mL	--	>5.0 mg/L
SB	Monthly median <2,400/100 mL 80% <5,000/100 mL	Monthly geometric mean <200/100 mL	>5.0 mg/L
SC	Monthly medium <2,400/100 mL 80% <5,000/100 mL	Monthly geometric mean <200/100 mL	>5.0 mg/L
I	Monthly geometric mean <10,000/100 mL	Monthly geometric mean<2,000/100 Ml	>4.0 mg/L
SD	--	--	>3.0 mg/L

The concentration of DO in the water column is one of the universal indicators of overall water quality in aquatic systems. Sufficient levels of oxygen are needed for the survival of marine life and for preventing nuisance conditions such as hydrogen sulfide odors produced from the anaerobic decay of organic material in sediments. Oxygen concentrations in coastal waters depend on a variety of interrelated chemical, physical, and biological factors such as salinity, temperature, photosynthesis, and respiration.

Photosynthesis can play a major role in the DO content of a water body. Photosynthesis is the production of organic material with nutrients and light energy by either rooted aquatic plants or free floating, unicellular plants called phytoplankton. Oxygen is a byproduct of the photosynthetic process and when excessive amounts of phytoplankton are present in the water column (e.g. bloom conditions), DO levels may become supersaturated (>8.0 mg/L). The respiration of phytoplankton during dark periods consumes oxygen for the oxidation of organic compounds to provide energy for metabolic needs. Under bloom conditions, phytoplankton respiration can produce hypoxic conditions (DO < 3.0 mg/L) which can severely stress or kill aquatic organisms. Thus, when phytoplankton blooms exist, large diurnal fluctuations in DO concentrations can occur.

The oxidation of organic material by bacteria can also result in the depletion of DO. This biological process is the primary cause of low oxygen concentrations in polluted waters. Worst case conditions for the depletion of DO usually occur during the summer months when water temperatures rise. As water temperatures rise, oxygen solubilities decrease and the metabolic rates of bacteria increase requiring more oxygen for respiratory purposes. Consequently, bacteria may utilize existing oxygen faster than it can be replenished by either photosynthesis or diffusion from the atmosphere.

Hydrologic factors that may intensify low DO concentrations are stratification and stagnation. Stratification, due to temperature and salinity differences between surface and bottom waters, and stagnation, due to reduced flushing (from rain events), cause the water body to become less well mixed.

Coliform bacteria inhabit the intestines of humans as well as other warm blooded animals and are commonly used as indicators of unsanitary water conditions. Waters contaminated with fecal material will have high numbers of coliform bacteria which also indicates the presence of disease causing organisms. Coliform bacteria are measured as total and fecal organisms. The bacteria standards listed in Table 4-1 are only applicable when disinfection is practiced to protect the designated uses of the waterbody. When assessing water quality conditions, coliform concentrations that exceed state criteria reflect degraded water conditions.

4.5.1 Jamaica Bay Water Quality

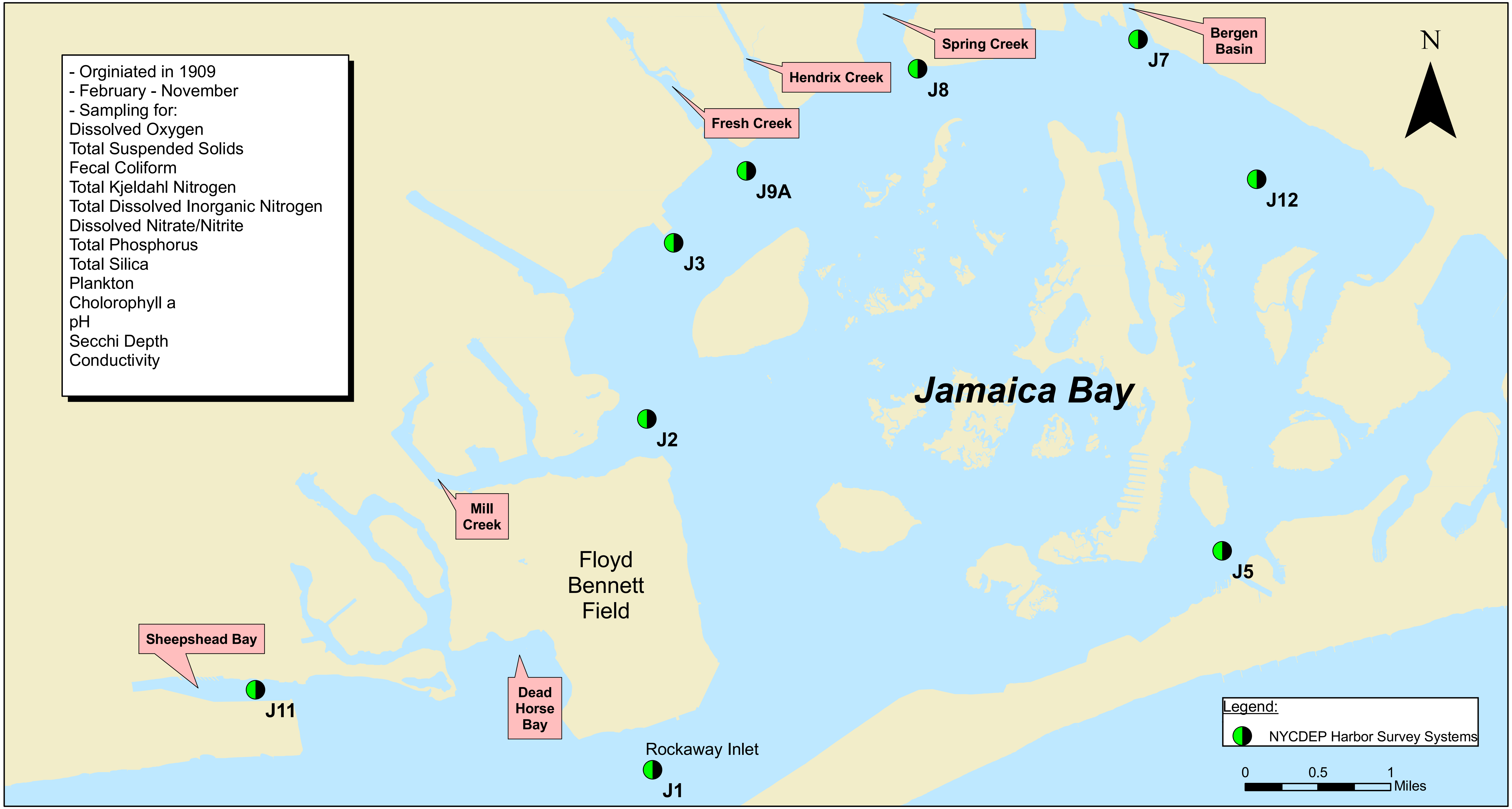
Data summaries for Jamaica Bay were obtained from the 2004 New York Harbor Water Quality Regional Summary report published by the DEP Marine Sciences Section and are presented below. The Harbor Survey sampling locations in Jamaica Bay are shown in Figure 4-6. Also presented are percent attainment data for DO and bacterial water quality criteria under baseline conditions in Jamaica Bay based on water quality model projections developed for the Jamaica Bay and CSO Tributaries Waterbody/Watershed Facility Plan.

Dissolved Oxygen Data

During the summer of 2004, the average DO concentration for surface and bottom waters surpassed the New York State standard of 5.0 mg/L for SB waters at all 9 Jamaica Bay sampling sites. However, individual measurements failed to attain the standard 21 times of 288 measurements. Several hypoxia events (DO < 3.0 mg/L) were recorded at the northeastern most stations J7 (Bergen Basin) and J12 (Grassy Bay).

Historical trends in DO concentrations in Jamaica Bay show average DO levels were well above the 5.0 mg/L standard as early as 1970. However, variability in DO concentrations is high within and between years and the gap between surface and bottom waters has been increasing since the 1980s. High surface DO levels are often due to supersaturated conditions attributable to algae blooms and eutrophic waters.

Table 4-2 summarizes the calculated percent annual attainment of dissolved oxygen for current Class SB criteria for Baseline conditions at a number of locations throughout Jamaica Bay along a north transect, a south transect, and at Rockaway Inlet (Figure 4-7). Both the North and South Transects begin at the same location in Rockaway Inlet near the lower New York Harbor. The North Transect parallels the north shore of the Bay. Locations near the mouth of Paerdegat Basin, Spring Creek, and Bergen Basin are included in Table 4-2. The transect goes

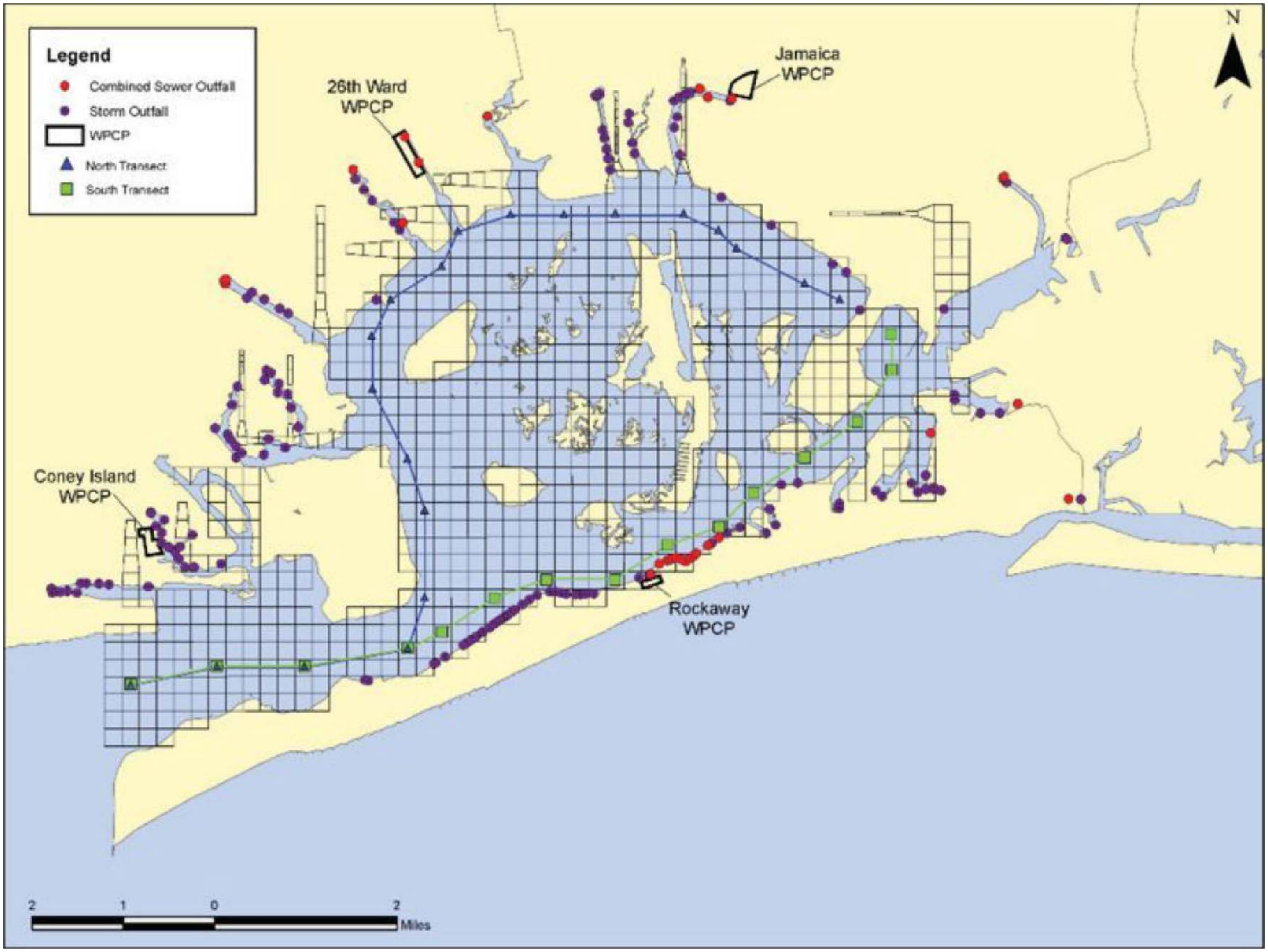


Environmental Protection

NYCDEP Harbor Survey Stations
Jamaica Bay

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

Figure 4-6



Jamaica Bay Water Quality Modeling
Transect Map

FIGURE 4-7

through Grassy Bay and ends near JFK Airport. The South Transect parallels the south shore of Jamaica Bay. Locations in Beach Channel, Grass Hassock Channel, and at Head of Bay (near the mouth of Thurston Basin) are included in Table 4-2.

Table 4-2. Baseline Annual Attainment for Class SB/SC Dissolved Oxygen Criteria for Design Year – Jamaica Bay

Location		Class SB/SC (≥ 5.0 mg/L) Annual Percent Attainment
North Transect	Paerdegat Basin	100
	Spring Creek	99
	Bergen Basin	97
	Grassy Bay & JFK	80
South Transect	Beach Channel	100
	Grass Hassock Channel	98
	Head of Bay	86
Rockaway Inlet		100

Dissolved oxygen criterion (less than 5.0 mg/L) attainment is close to 100 percent along the North Transect on an annual basis. Near the Grassy Bay/JFK Airport, annual attainment of the dissolved oxygen criterion is approximately 86 percent for Baseline conditions. The depression of dissolved oxygen in the eastern area of Jamaica Bay is related to a number of factors. The primary factors contributing to low dissolved oxygen in the eastern portion of Jamaica Bay are the eutrophic conditions in the bay resulting from nitrogen discharges from the Jamaica and 26th Ward WWTPs, carbon (BOD) discharges from theses WWTPs, and poor circulation. The poor circulation in the eastern portion of the bay is due to constricted channels in North Channel and Beach Channel as well as the depth of the borrow pits. CSOs and stormwater are relatively minor contributors to the DO deficit in the open waters of Jamaica Bay.

Total Coliform

Total coliform is no longer sampled as part of the Harbor Survey sampling program. Table 4-3 summarizes the projected percentage annual attainment of total coliform criteria for Class SB/SC primary contact recreation (monthly median less than 2,400 per 100 mL and 80% of values less than 5,000 per 100 mL). As shown, 100 percent annual attainment is calculated throughout Jamaica Bay under Baseline conditions. Additional Details are provided in the Hydraulic modeling report provided under separate cover. In addition, complete attainment of the Class SB/SC total coliform criteria is calculated during the recreation season. Jamaica Bay, therefore, meets the primary contact recreation, “swimmable” use goal of the CWA for the design year condition as measured by total coliform.

Table 4-3. Baseline Annual Attainment of Class SB/SC Total Coliform Criteria for Design Year – Jamaica Bay

Location		Class SB/SC – Annual	
		Median < 2,400 Percent Attainment	80th Percentile < 5,000 Percent Attainment
North Transect	Paerdegat Basin	100	100
	Spring Creek	100	100
	Bergen Basin	100	100
	Grassy Bay & JFK	100	100
South Transect	Beach Channel	100	100
	Grass Hassock Channel	100	100
	Head of Bay	100	100
Rockaway Inlet		100	100

Fecal Coliform

According to the New York Harbor Water Quality Regional Summary report, summer fecal coliform levels were well below 200 cells/100mL (SB) standard for all stations. Under wet weather conditions, the Bay experiences localized degradation. At these times, spikes in fecal coliform may temporarily exceed the SB standard of 200 cells/100mL for the entire northern portion of the bay (from Mill Basin to Bergen Basin). Mean fecal coliform levels in Jamaica Bay as a whole have been at or below the 200 cells/100mL standard for bathing over the past 20 years.

Table 4-4 summarizes the projected percentage annual and recreation season attainment of Class SB/SC primary contact recreation fecal coliform criteria (monthly geometric mean less than 200 per 100 mL). As shown, except for a small area of 92 percent attainment near Bergen Basin, attainment is expected annually throughout Jamaica Bay under Baseline conditions (). Complete attainment of the Class SB/SC fecal coliform criteria is also calculated during the recreation season. Jamaica Bay, therefore, meets the primary contact recreation, "swimmable" use goal of the CWA for the design year condition as measured by fecal coliform.

Table 4-4. Baseline Annual Attainment of Class SB/SC Fecal Coliform Criteria for Design Year – Jamaica Bay

Location		Class SB/SC – Annual	
		Monthly Geometric Mean < 200/100 mL Annual Percent Attainment	Monthly Geometric Mean < 200/100 mL Recreation Season Percent Attainment
North Transect	Paerdegat Basin	100	100
	Spring Creek	100	100
	Bergen Basin	92	100
	Grassy Bay & JFK	100	100
South Transect	Beach Channel	100	100
	Grass Hassock Channel	100	100
	Head of Bay	100	100
Rockaway Inlet		100	100

Enterococci

Table 4-5 summarizes the projected attainment of enterococci criteria which are applicable to Jamaica Bay for primary contact water use (geometric mean less than 35 per 100 mL). It is noted that the attainment values shown on Table 4-5 are for the three month period of June, July and August as the enterococci criteria were developed for the bathing season. The seasonal geometric mean enterococci criterion is expected to be fully attained under Baseline conditions. In addition to the enterococcus criteria, USEPA has defined a reference level of enterococci for infrequent use in coastal recreation waters (upper 95% confidence limit) of 501 per 100 mL. Under Baseline conditions, the infrequent reference level of 501 is exceeded approximately 10 percent of the time along the North Transect and 15 percent of the time in Head of Bay.

Table 4-5. Baseline Recreation Season Attainment of Class SB/SC Enterococci Criteria for Design Year – Jamaica Bay

Location		Class SB/SC – Annual	
		Monthly Geometric Mean < 35/100 mL Percent Attainment	Monthly Geometric Mean < 501/100 mL Percent Attainment
North Transect	Paerdegat Basin	100	92
	Spring Creek	100	92
	Bergen Basin	100	92
	Grassy Bay & JFK	100	100
South Transect	Beach Channel	100	100
	Grass Hassock Channel	100	100
	Head of Bay	100	83
Rockaway Inlet		100	100
Note: Attainment values shown are for the three month period of June, July and August as the enterococci criteria were developed for the bathing season			

Chlorophyll α

Of the four geographic Harbor Survey regions, Jamaica Bay continues to display the widest range of individual chlorophyll α measurements. Chlorophyll α values range from a high of 171 µg/L at Station J8 (Spring Creek) to a low of 1.4µg/L at Station J1 (Rockaway Inlet). All nine stations have summer averages above 20 µg/L. On average, chlorophyll α concentrations for the bay measured 39.6 µg/L. This is consistent with recent years, but well above levels that are indicative of enriched or eutrophic waters. High Chlorophyll α concentrations in Jamaica Bay are indicative of eutrophic conditions. The slow turnover of water within the bay allows for the development of large standing phytoplankton populations.

4.5.2 CSO Tributary Water Quality

Presented below are percent attainment data for DO and bacteria water quality criteria under Baseline conditions in the CSO tributaries of Jamaica Bay. These baseline water quality conditions are based on water quality model projections developed for the Jamaica Bay and CSO Tributaries Waterbody/Watershed Facility Plan.

Dissolved Oxygen

Table 4-6 summarizes the projected percentage annual attainment of dissolved oxygen for current DEC Class I criteria for Baseline conditions at the head end, mid-creek and mouth of each of the Jamaica Bay CSO Tributaries. Under Baseline conditions, annual attainment at the head of Bergen and Thurston Basins is calculated to be 72 percent and 63 percent, respectively. Attainment of dissolved oxygen criterion on an annual basis in Hendrix Creek and Fresh Creek is similar ranging from 57 percent at the head and 82 percent at the mouth of the creek under Baseline conditions. Annual dissolved oxygen criterion attainment in Spring Creek for Baseline conditions is 87 percent at the mouth, 93 percent at mid-creek, and 83 percent at the mouth.

Table 4-6. Baseline Annual Attainment of Class I Dissolved Oxygen Criteria for Design Year – Jamaica CSO Tributaries

Location		**Class I ($\geq$ 4.0mg/L) Annual Percent Attainment**
Fresh Creek	Head	57
	Mid-Creek	79
	Mouth	82
Hendrix Creek	Head	61
	Mid-Creek	70
	Mouth	82
Spring Creek	Head	87
	Mid-Creek	93
	Mouth	83
Bergen Basin	Head	72
	Mid-Creek	75
	Mouth	79
Thurston Basin	Head	63
	Mid-Creek	72
	Mouth	79

Total Coliform

Table 4-7 summarizes attainment of the Class I total coliform secondary contact recreation criterion (monthly geometric mean less than 10,000 per 100 mL) on an annual basis for Baseline conditions. Under Baseline conditions, Hendrix and Spring Creeks attain Class I total coliform criterion 100 percent of the time. For Fresh Creek, Bergen Basin, and Thurston Basin, annual attainment ranges from 67 percent to 92 percent at the head end. At the mouths of these tributaries, Baseline attainment is 100 percent. However, during the recreation season (June through August), 100 percent attainment of the Class I total coliform criterion is calculated for all of the tributaries under Baseline conditions.

Table 4-7. Baseline Annual Attainment of Class I Total Coliform Criterion for Design Year – Jamaica CSO Tributaries

Location		Class I (GM ≤ 10,000/ 100mL) Annual Percent Attainment
Fresh Creek	Head	75
	Mid-Creek	92
	Mouth	100
Hendrix Creek	Head	100
	Mid-Creek	100
	Mouth	100
Spring Creek	Head	100
	Mid-Creek	100
	Mouth	100
Bergen Basin	Head	67
	Mid-Creek	92
	Mouth	100
Thurston Basin	Head	92
	Mid-Creek	100
	Mouth	100

Fecal Coliform

Table 4-8 summarizes attainment of the Class I fecal coliform secondary contact recreation criterion (monthly geometric mean less than 2,000 per 100 mL) on an annual basis for the Baseline conditions. Under Baseline conditions for the design year, Hendrix Creek attains the Class I fecal coliform criterion 100 percent of the time. For the Baseline, attainment ranges from 75 percent to 92 percent at the head of Fresh Creek, Spring Creek, Bergen Basin, and Thurston Basin. At the mouths of these tributaries, Baseline attainment is 100 percent. However, during the recreation season (June through August), 100 percent attainment of the Class I total coliform criterion is calculated for all of the tributaries, except for the head end of Bergen Basin, under Baseline conditions.

Table 4-8. Baseline Annual Attainment of Class I Fecal Coliform Criterion for Design Year – Jamaica CSO Tributaries

Location		Class I (GM ≤ 2,000/100mL) Annual Percent Attainment
Fresh Creek	Head	75
	Mid-Creek	75
	Mouth	100
Hendrix Creek	Head	100
	Mid-Creek	100
	Mouth	100
Spring Creek	Head	92
	Mid-Creek	100
	Mouth	100
Bergen Basin	Head	67
	Mid-Creek	92

Location		Class I (GM ≤ 2,000/100mL) Annual Percent Attainment
	Mouth	100
Thurston Basin	Head	92
	Mid-Creek	100
	Mouth	100

4.6 BIOLOGY

Aquatic habitats within Jamaica Bay have been highly modified through a long history of physical changes including infilling of wetlands and salt marshes, dredging of navigation channels, and developments of commercial and residential areas within the watershed. Degraded water and sediment quality have resulted from treated and untreated sewer discharges, landfill leachate, and hydrographic modifications, which have reduced tidal water circulation. These changes represent constraints to Jamaica Bay in reaching its full potential to support a diverse aquatic life community and to provide a fishery resource for anglers.

Adverse physical effects on aquatic habitats interact with water and sediment quality to limit the diversity and productivity of aquatic systems. Water and sediment quality can be limiting to aquatic life when they are below thresholds for survival, growth, and reproduction. However, when these thresholds are reached or exceeded, physical habitat factors may continue to limit diversity and productivity. Improvements to water and sediment quality can enhance aquatic life use in degraded areas such as Jamaica Bay, but major irreversible changes to the watershed and the waterbody place limits on the extent of these enhancements. In addition, because Jamaica Bay is part of a much larger modified estuarine/marine system, which is a source of recruitment of aquatic life to Jamaica Bay, its ability to attain use standards is closely tied to overall ecological conditions in the NY/NJ Harbor estuary.

This section describes existing aquatic communities in Jamaica Bay “proper” (i.e., waters exclusive of the basins and creeks). This baseline information is considered in conjunction with technical literature on the water quality and habitat tolerances of aquatic organisms, long-term aquatic sampling data from NY/NJ Harbor, and expertise on the response of aquatic life to water quality and habitat restoration to provide the foundation for assessing the response of aquatic life to CSO treatment alternatives for Jamaica Bay.

4.6.1 Tidal Wetlands Habitat

Jamaica Bay is a shallow bar-built embayment measuring approximately eight miles long and four miles wide. While numerous wetlands exist within Jamaica Bay today, many others have been lost through a long history of physical modification to the bay and watershed. Wetlands have been lost due to dredging of shipping channels, digging of borrow pits for the construction of JFK International Airport, salt marsh infilling for garbage disposal, and parkway construction among numerous other factors. Changes to the distribution and size of wetlands within the bay would have been accompanied by changes in habitat utilization by invertebrates and fish and the role of the bay in the ecology of NY/NJ Harbor estuary. DEP (2002) reported that just 4,000 of the original 16,000 acres of wetlands present prior to colonial settlement exist today. Currently, wetlands represent approximately 20 percent of the entire bay. The information contained here is based on a review of United States Fish and Wildlife Service

National Wetland Inventory (NWI) wetland maps (Figure 4-8). While NWI mapping can be used to determine the general locations of wetlands, field verification is needed to determine their actual presence and location. Therefore, a margin of error is inherent in the boundaries presented in NWI mapping. Cowardin et al. (1979) developed the classification scheme used for these wetlands.

Currently, there are 317 designated marine, estuarine, palustrine, or lacustrine wetlands designated for Jamaica Bay (exclusive of subtidal wetlands). These wetlands, which span Jamaica Bay proper as well as the basins and creeks, total 766 acres (Table 4-9, Figure 4-8). Approximately 713 acres (93 percent) of these wetlands are designated as estuarine and intertidal, the vast majority of which are centrally located within Jamaica Bay proper. The largest of these estuarine, intertidal wetlands are further categorized as either flat or emergent and irregularly exposed or regularly flooded. Marine wetlands account for 5 percent of the wetlands designated for Jamaica Bay while palustrine and lacustrine wetlands amount to 1.0 percent and 0.6 percent, respectively. All tidal wetlands are regulated by DEC. There are no New York State regulated freshwater wetlands (> 12.4 acres) adjoining Jamaica Bay.

Table 4-9. Current Wetland Designations for Jamaica Bay (based on United States Fish and Wildlife Service National Wetland Inventory Wetland Maps)

Wetland Classification	Acres	Description
E2FLM	273	[E] Estuarine, [2] Intertidal, [FL] Flat (obs), [M] Irregularly Exposed
E2FLN	183.8	[E] Estuarine, [2] Intertidal, [FL] Flat (obs), [N] Regularly Flooded
E2EM5N	164.1	[E] Estuarine, [2] Intertidal, [EM] Emergent, [5] Mesohaline, [N] Regularly Exposed
E2EM5P	80.3	[E] Estuarine, [2] Intertidal, [EM] Emergent, [5] Mesohaline, [P] Irregularly Flooded
M2BBP	28.9	[M] Marine, [2] Intertidal, [BB] Beach/Bar (obs), [P] Irregularly Flooded
M2BBN	7.1	[M] Marine, [2] Intertidal, [BB] Beach/Bar (obs), [N] Regularly Flooded
E2SBM	6.6	[E] Estuarine, [2] Intertidal, [SB] Streambed, [M] Irregularly Exposed
PEM5A	5.1	[P] Palustrine, [EM] Emergent, [5] Mesohaline, [A] Temporarily Flooded
L1UBH	4.6	[L] Lacustrine, [1] Limnetic, [UB] Unconsolidated Bottom, [H] Permanently Flooded
E2EM1P	3.6	[E] Estuarine, [2] Intertidal, [EM] Emergent, [1] Persistent, [P] Irregularly Flooded
M2FLM	2.2	[M] Marine, [2] Intertidal, [FL] Flat (obs), [M] Irregularly Exposed
PEM1A	1	[P] Palustrine, [EM] Emergent, [1] Persistent, [A] Temporarily Flooded
PFLA	0.9	[P] Palustrine, [FL] Flat (obs), [A] Temporarily Flooded
PSS1/EM5C	0.8	[P] Palustrine, [SS] Scrub-Shrub, [1] Broad-Leaved Deciduous / [EM] Emergent, [5] Mesohaline, [C] Seasonally Flooded
PEM/UBF	0.8	[P] Palustrine, [EM] Emergent / , [UB] Unconsolidated Bottom, [F] Semi-permanently Flooded
E2EM5Pd	0.5	[E] Estuarine, [2] Intertidal, [EM] Emergent, [5] Mesohaline, [P] Irregularly Flooded, [d] Partially Drained/Ditched
PEME	0.5	[P] Palustrine, [EM] Emergent, [E] Seasonally Flooded/Saturated
E2BBP	0.4	[E] Estuarine, [2] Intertidal, [BB] Beach/Bar (obs), [P] Irregularly Flooded
PEM1C	0.4	[P] Palustrine, [EM] Emergent, [1] Persistent, [C] Seasonally Flooded
PEM1E	0.3	[P] Palustrine, [EM] Emergent, [1] Persistent, [E] Seasonally Flooded/Saturated
PUBZ	0.3	[P] Palustrine, [UB] Unconsolidated Bottom, [Z] Intermittently Exposed/Permanent
E2SS1/EM5P	0.3	[E] Estuarine, [2] Intertidal, [SS] Scrub-Shrub, [1] Broad-Leaved Deciduous / [EM] Emergent, [5] Mesohaline, [P] Irregularly Flooded
PUBZh	0.2	[P] Palustrine, [UB] Unconsolidated Bottom, [Z] Intermittently Exposed/Permanent, [h] Diked/Impounded

Wetland Classification	Acres	Description
PUBF	0.04	[P] Palustrine, [UB] Unconsolidated Bottom, [F] Semi-permanently Flooded
Total	766	

The U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) characterizes the shoreline area of Fresh Creek as predominantly estuarine subtidal unconsolidated bottom excavated wetland (E1UBLx). Several portions of Fresh Creek shoreline (one along the northwest side and one along the central east side) are characterized as estuarine intertidal emergent mesohaline irregularly flooded partially drained/ditched wetlands (E2EM5Pd). The eastern and western shoreline along the mouth of Fresh Creek is characterized as estuarine intertidal flat irregularly exposed wetland (E2FLM). An area just northwest of Interstate 907 and to the west of Fresh Creek, is characterized as a freshwater wetland. More specifically, the two portions consist of a palustrine emergent persistent temporarily flooded wetland (PEM1A) and a palustrine unconsolidated bottom semi-permanently flooded wetland (PUBF) (Cowardin et al. 1979).

Qualitative field identification of the Fresh Creek wetlands indicate that the shorelines south of Interstate 907, along the mouth of Fresh Creek, are dominated by mugwort *(Artemisia vulgaris*) and common reed on the eastern shoreline, and spike grass, saltmarsh cordgrass, and common reed, on the western shoreline (JABERRT 2002). The western shoreline of Fresh Creek, just north of Interstate 907, is predominantly mugwort, common reed, and secondary woodland habitat (Tree of heaven - *Ailanthus altissima*, black cherry, and mugwort). Further north along the same shoreline, the dominant species becomes spike grass and saltmarsh cordgrass. The eastern shoreline composed of various habitats including; mugwort, spike grass, common reed, saltmarsh cordgrass, and secondary woodland. Moreover, several rare, threatened and endangered plants have been identified in this area. Among these are saltmarsh aster (*Aster tenuifolius*) and seaside goldenrod (*Solidago sempervirens mexicana*) (JABERRT 2002).

The U.S. Fish and Wildlife Service's NWI characterizes the shoreline area of Hendrix Creek predominantly as an estuarine subtidal unconsolidated bottom subtidal wetland (E1UBL). A freshwater wetland identified adjacent to the Hendrix Creek on the western side, north of Interstate 907, is characterized as a palustrine emergent mesohaline temporarily flooded wetland (PEM5A) (Cowardin et al. 1979).

The U.S. Fish and Wildlife Service's NWI characterizes the shoreline and open water areas of Spring Creek as predominantly an estuarine intertidal flat irregularly exposed wetland (E2FLM). North of Interstate 907, an area of Spring Creek is characterized as an estuarine intertidal emergent mesohaline irregularly flooded wetland (E2EM5P) and an estuarine intertidal emergent mesohaline regularly exposed wetland (E2EM5N). To the east of Spring Creek several areas of freshwater wetlands have been designated. These are characterized as palustrine emergent mesohaline temporarily flooded wetlands (PEM5A). No other freshwater wetlands are designated adjacent to Spring Creek (Cowardin et al. 1979).

Qualitative field identification of the Spring Creek wetlands, indicate that portions of the shoreline are dominated by many vegetation types, including mugwort (Artemisia vulgaris), saltmarsh cordgrass, common reed, spike grass, and secondary woodland (JABERRT 2002). The western shoreline, just north of Interstate 907 of Fresh Creek is predominantly inhabited by

Environmental Protection

Jamaica Bay NWI Wetlands

Jamaica Bay and CSO Tributaries Waterbody/ Watershed Facility Plan

Figure 4-8

mugwort, common reed, and secondary woodland habitat (White mulberry - *Morus alba*, Winged sumac - *Rhus copallina*, Tree of heaven - *Ailanthus altissima*, black cherry, and mugwort). The area south of Interstate 907, designated as Old Mill Creek, is dominated by spike grass, common reed, and saltmarsh cordgrass (JABERRT 2002). The freshwater wetlands adjacent to Spring Creek are dominated by common reed.

The U.S. Fish and Wildlife Service's NWI characterizes the shoreline areas of Bergen Basin as predominantly estuarine subtidal unconsolidated bottom subtidal wetlands (E1UBL). The eastern portion of the mouth opening of Bergen Basin is characterized as an estuarine intertidal flat regularly flooded wetland (E2FLN), whereas the western portion of the mouth of Bergen Basin is characterized as estuarine intertidal flat irregularly exposed wetland (E2FLM) (Cowardin et al. 1979).

Qualitative field identification of the Bergen Basin wetlands, indicate that the classification of intertidal marsh, designated by the DEC, is accurate (JABERRT 2002). The western shoreline of Bergen Basin is dominated by the invasive, opportunistic species, common reed (Phragmites australis) with sparse patches of salt marsh cordgrass. The area adjacent and to the west of the shoreline is composed of various habitats including; mugwort (*Artemisia vulgaris*), marsh elder, bayberry thicket (*Myrica pensylvanica*), silverhair (*Corynephorus canescens*), and Japanese knotweed thicket (*Polygonum cuspidatum*). Several rare, threatended and endangered plants have been identified in this area. Among these are saltmarsh aster (*Aster tenuifolius*), five-angled dodder (*Cuscuta pentagona*), Schweinitz's flatsedge (*Cyperus schweinitzii*), and ohio spiderwort (*Tradescantia ohiensis*). No freshwater wetlands were identified adjacent to Bergen Basin.

The U.S. Fish and Wildlife Service's NWI characterizes the shoreline areas of Thurston Bain as predominantly estuarine subtidal unconsolidated bottom subtidal wetlands (E1UBL). Several shoreline areas of Thurston Basin (two along the eastern side near the mouth and one along the western side of the mouth) are characterized as estuarine intertidal flat regularly flooded wetlands (E2FLN). An adjacent wetland located across Rockaway Boulevard is characterized as an estuarine intertidal emergent mesohaline/hyperhaline irregularly flooded partially drained/ditched wetland (E2EM5/1Pd) (Cowardin et al. 1979).

Adjacent to Thurston Basin on the western side are small patches of freshwater wetlands. These are designated as palustrine emergent mesohaline temporarily flooded wetlands (PEM5A).

4.6.2 Benthic Invertebrates

Marine and estuarine benthic communities generally consist of a wide variety of small aquatic invertebrates, such as worms, mollusks and crustaceans, which live burrowed into or in contact with bottom sediments. These benthic organisms are prey species to many higher trophic level organisms and thus cycle nutrients from the sediment and water column up through food webs. Suspension feeders filter particles out of the water column and deposit feeders consume particles on or in the sediment. The sediment is modified by the benthos through bioturbation and formation of fecal pellets (Wildish and Kristmanson, 1997). Grain size, chemistry, and physical properties of the sediment are the primary factors determining which organisms inhabit a given area of the substrate. Because benthic organisms are closely associated with the sediment and have limited mobility, the benthic community structure reflects local water and sediment quality. Benthic inventories have been conducted in Jamaica Bay as part of the Jamaica Bay FSAP; (HydroQual 2001a). In early August 2001, benthic samples were collected at 10 stations (Figure 4-2) throughout Jamaica Bay proper using a Ponar® Grab. One sediment sample per station was also taken for analysis of sediment grain size and TOC content.

Thirty four taxa, at a combined density of 42,770 organisms per square meter (m2) (Ponar® Grab samples [0.025m2] were scaled upward to calculate number/m2) were collected in Jamaica Bay (Table 4-10). Thirty-three of these taxa were distributed among Annelida, Arthropoda and Mollusca. A single Cnidaria was also collected. Of these four phyla, annelids were collected in the highest density. The polychaete mud worm Streblospio benedicti dominated the collections. This mud worm is common along the entire Atlantic coast including the NY/NJ harbor estuary and is relatively tolerant of high levels of sediment organics (Reish 1979). Another family of polycheate worm, Capitellidae, was also collected in high numbers. Many species of Capitellidae, commonly known as "lugworms," are also considered indicators of anthropogenic, organically enriched sediments. Together these two polychaete worm taxa accounted for 59 percent of the infaunal community by number. A number of other polychaete worms were collected, although in lesser abundance. The presence of an abundance of polychaete worms in Jamaica Bay suggests that overly enriched sediments may exist within this system (Gosner 1978, Weiss 1995).

Table 4-10. Abundance (number/m^2) of Benthic Organisms Collected from Jamaica Bay

Phylum	Lowest Practical	Density (Number/meter^2)
Annelida	*Capitellidae*	7,790
	Haploscolopos rubustus	50
	Tharx	1,360
	Polychaeta	340
	Streblodpio benedicti	17,290
	Spionidae	2,540
	Aricidea	220
	Nereis	90
	Phyllodocidae	480
	Glycera	30
	Polydora	1,190
Arthropoda	*Ampelisca*	4,380
	Crangon septemspinosa	20
	Amphipoda	230
	Elasmopus laevis	10
	Microdeutopus	170
	Ericthonius	60
	Lysianopsis alba	60
	Trichophoxus epistomus	50
	Corophium	2,170
	Palaemonetes	20
	Cyathura polita	50
Mollusca	*Nucula proxima*	70
	Arcidae	20
	Crepidula fornicata	50

Phylum	Lowest Practical	Density (Number/meter^2)
	Pagurus	200
	Ovalipes ocellatus	10
	Xanthidae	440
	Mercenaria mercenaria	50
	Gastropoda	10
	Mya arenaria	110
	Nassarius	140
	Nassarius obsoletus	2,760
Cnidaraia	*Anemone*	90
Unidentified		220
		34
	Total	42,700

Arthropoda collections were dominated by Ampelisca and Corophium while Mollusca collections were dominated by *Nassarius obsoletus*. Both Ampelisca and Corophium are amphipods. Amphipods are general indicators of good environmental quality because they have limited mobility and are susceptible to pollution. *Nassarius obsoletus*, the eastern mud snail, is not generally known as an indicator of environmental conditions.

Overall, the benthic community in Jamaica Bay is abundant and moderately diverse. Polychaete worms were the dominant organisms, comprising over 70 percent of the individuals in the community. The high proportion of pollution tolerant organisms indicates degraded benthic habitat quality in Jamaica Bay. The presence of Ampelisca and Corophium, on the other hand, suggest that pollution levels are within thresholds, which can support organisms of limited mobility. These sampling results may also reflect variability in benthic habitat quality over the very large area that was sampled.

The benthic community structure in Jamaica Bay is generally similar to that described in studies of the effects of organic pollution on the benthos. In areas of high levels of organic enrichment benthic communities are composed of a few small, rapidly breeding, short-lived species with high genetic variability (Pearson and Rosenberg 1978). The Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational Scientific and Cultural Organization suggested that stress to the benthic community would be greatest in sediment with TOC greater than 3 percent (Hyland *et al*. 2000). Four of the ten sampling locations in Jamaica Bay had sediment TOC greater than 3 percent suggesting a moderately stressed benthic community exists in Jamaica Bay.

In the tributaries of Jamaica Bay, the number of benthic species generally increases from the head end to the mouth changes in TOC and percent solids of the sediment within the tributaries. The highest percentages of TOC and the lowest percentages of solids, are found at the head ends of the tributaries. These sediments have a high water content and a characteristic strong "rotten egg" odor and are often referred to as "black mayonnaise". Tributary sediment changes from this low-solids form at the head to that of a more stable substrate at the mouth with a corresponding increase in abundance of benthic organisms. The highest numbers of taxa per tributary (as defined in this study), were 21 and 29 (PAER03 and FRSH02, respectively), and sampling data for both 2000 (JAMBB01) and 2001 (JAMBB02-11) revealed that numbers of taxa were no higher than this in Jamaica Bay. The lowest number of taxa per tributary was found in PAER01. Numbers of taxa in the bay ranged from 3 (Grassy Bay) to 17-19 (several stations, stretching from Norton Basin and Grass Hassock Channel, through Pumpkin Patch Channel), and the types of taxa were generally similar to those of the tributary mouths. Species considered useful as indicators of pollution (*Capitella capitata*, and *Streblospio benedicti*) comprised the highest percentage species found in the tributaries. Few, if any, pollution sensitive taxa or individuals were found at any of the stations sampled in 2000 (PAERB02 had two individual polychaetes worms - *Clymenella torquata*; and PAERB03 had two individual hard clams - *Mercenaria mercenaria*).

4.6.3 Epibenthic Communities

Epibenthos live on or move over the substrate surface. Epibenthic organisms include sessile suspension feeders (mussels and barnacles), free swimming crustaceans (amphipods, shrimp, and blue crabs) and tube-dwelling polychaete worms found around the base of attached organisms. Epibenthic organisms require hard substrate, as they cannot attach to substrates composed of soft mud and fine sands (Dean and Bellis 1975). In general, the main factors that limit the distribution of epibenthic communities are the amount of available hard substrate for settlement, species interactions, and water exchange rates. In Jamaica Bay, pier piles and bulkheads provide the majority of underwater substrates that can support epibenthic communities. The epibenthic communities living on underwater structures affect the ecology of the near-shore zone. Suspension feeding organisms continuously filter large volumes of water, removing seston (particulate matter that is in suspension in the water) and releasing organic particles to the sediment. This flux of organic particles (from feeding and feces) enriches the benthic community living in the sediment below piers and bulkheads (Zappala 2001).

The recruitment and survival of epibenthic communities on hard substrates in Jamaica Bay was evaluated because these assemblages reflect the average water quality conditions of the area over an extended period of time (Day et al. 1989). The Jamaica Bay proper epibenthic community was studied as part of the Harbor-wide Epibenthic Recruitment and Survival FSAP (HydroQual, 2001a) by suspending 8-inch x 8-inch multi-plate arrays in the upper and lower water column at six stations (Figure 4-4). Epibenthic arrays were deployed in June, July and October of 2000 and January, March and June of 2001. Plates were retrieved in October 2000 and January, April, June and September of 2001, resulting in exposure times of 3, 6, 9, and 12 months. Upon retrieval, the arrays were inspected and weighed and motile organisms clinging to or stuck in the arrays (i.e., crabs and fish) were counted and identified. Importantly, sampling was not consistent across sampling stations, depth strata, and exposure durations. The large number of missing samples (evident in Tables 4-11 and 4-12) limits the extent to which this assessment can be used to characterize the open water areas of Jamaica Bay.

Table 4-11. Total Number of Taxa Collected from Suspended Multi-Plate Arrays (Top and Bottom) Placed in Jamaica Bay

Station	1		2		3		4		5		6
Length of Deployment	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Bottom
3 months (Jan-Apr)	5	4									
3 months (Mar-Jun)	9	4	4	7	6	6	4	7	5	7	

Station	1		2		3		4		5		6
3 months (Jun-Sep)			10	8	9	7	9	8	8	10	5
3 months (Jul-Oct)	5	7									
3 months (Oct-Jan)	6	6									
6 months (Mar-Sep)			11	12	6	7	9	11	11	7	
6 months (Jul-Jan)	9	10									
9 months (Jul-Apr)	10	10									
12 months (Jun-Jun)	9	9									

Note:
Empty cells indicate no data available (e.g., no sampling or plate was lost). Compiled from the HydroQual database.

Table 4-12. Total Weight (g) of All Organisms Collected from Suspended Multi-Plate Arrays (Top and Bottom) Placed in Jamaica Bay

Station	1		2		3		4		5		6
Length of Deployment	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Bottom
3 months (Jan-Apr)	1.4	6.7									
3 months (Mar-Jun)	11.3	23.34	120.6	74.1	4.8	10.7	38.6	10.0	35.6	22.7	
3 months (Jun-Sep)			32.3	43.4	128.8	203.9	16.5	5.4	88.6	51.3	0.5
3 months (Jul-Oct)	51.9	79.9									
3 months (Oct-Jan)	22.7	19.7									
6 months (Mar-Sep)			66.3	41.9	525.3	389.9	7.7	15.3	114.8	89.9	
6 months (Jul-Jan)	96.8	51.7									
9 months (Jul-Apr)	69.0	74.5									
12 months (Jun-Jun)	20.9	67.2									

Note:
Empty cells indicate no data available (e.g., no sampling or plate was lost). Compiled from the HydroQual database.

In Jamaica Bay, 43 taxa were identified on the epibenthic arrays (Table 4-13), including Annelida, Arthropoda, Bryozoa, Chlorophyta, Chordata, Cnidaria, Mollusca, and Porifera. The average weight of epibenthic organisms on top plates was slightly higher than that on the bottom plates while the opposite was true for taxa richness. The individual taxa collected in the highest total weight included the ivory barnacle (Balanus eberneus), the golden star tunicate (Botryllus schlosseri), the blue mussel (Mytilus edulis), and the cnidarians Tubularia and Campanularia.

Table 4-13. Total Weight of Epibenthic Organisms Collected from Suspended Multi-Plate Arrays (Top and Bottom) Placed in Jamaica Bay

Phylum	Lowest Taxanomic Level	Average Weight (G)*	
		Top	Bottom
Annelida	*Amphitrite ornata*	0.1	0.2
	Calcareous worm tubes	43.8	27.7
	Eumida sanguinea	0.2	0.3
	Hydroides dianthus	1.0	0.8
	Nereis	0.0	0.1
	Nereis succinea	1.2	1.6
	Polynoidae	0.1	0.1
	Sabella microphthalma	2.2	1.1
	Sabellaria vulgaris	0.0	0.1

Phylum	**Lowest Taxanomic Level**	**Average Weight (G)***	
		Top	**Bottom**
Arthropoda	Caprellidae	12.5	10.3
	Dyspanopeus sayi	3.1	1.1
	Gammarus oceanicus	0.3	0.3
	Jassa falcata	0.0	0.1
	Jassa marmorata	0.7	0.1
	Leptocheirus pinguis	0.1	0.2
	Palaemonetes pugio	0.0	0.4
	Palaemonetes vulgaris	0.1	0.3
	Panopeus herbstii	1.6	2.5
	Pleustidae	0.0	0.1
	Rhithropanopeus harrisii	0.0	0.1
	Stenothoidae	0.0	0.1
	Xanthidae	0.7	0.0
Bryozoa	*Bugula*	9.5	17.1
	Membranipora tenuis	1.1	0.4
Chlorophyta	*Ulva lactuca*	0.3	0.0
Chordata	*Botryllus schlosseri*	110.2	88.5
	Molgula manhattensis	5.8	4.3
	Tautogolabrus adspersus	7.0	0.0
Cnidaria	*Bougainvillia*	0.3	0.0
	Campanularia	58.6	15.3
	Diadumene lineata	2.5	0.7
	Hydroida	25.3	34.6
	Tubularia	65.3	40.4
Mollusca	*Balanus eburneus*	160.1	135.3
	Crepidula convexa	0.0	0.1
	Crepidula fornicata	1.7	1.2
	Crepidula plana	0.5	0.5
	Mercinaria mercinaria	0.1	0.0
	Mya arenaria	0.3	0.1
	Mytilus edulis	22.3	83.7
	Onchidorididae	0.2	0.2
	Urosalpinx cinerea	0.4	1.5
Porifera	*Suberites ficus*	0.3	0.1
Unidentified	Unidentified	0.1	0.1
Taxa Count**/Sum (g)	43	540	472

Taxa richness across the stations sampled within each deployment period were generally similar. There was however, a slight tendency for top plates to have higher taxa richness than bottom plates for the 3 month deployment period and a tendency for bottom plates to have higher taxa richness for the longer deployment periods. In terms of the total weight of organisms present on the plates there was more variability among stations and among deployment periods. For example, the weight of organisms at both the top and bottom plates at station 3 were higher than at the other stations in the March through September 6-month and June through September 3-month deployment periods. Interestingly Station 3 organism weights for the March through June 3-month deployment were generally lower than at the other stations.

Overall, total weight was generally highest for the six- and nine-months deployment periods.

Typically, epibenthic communities in the NY/NJ Harbor exhibit a vertical distribution on pier piles and bulkheads (Zappala 2001). This vertical distribution coincides with changes in water level, salinity and DO associated with the tides and salinity stratification. The epibenthic community in Jamaica Bay that developed on test plates did not exhibit a specific vertical distribution. The lack of a clear vertical distribution in Jamaica Bay suggests that the entire water column is being used as habitat for epibenthic organisms and that low DO levels do not limit epibenthic organism growth in the lower water column. Dissolved oxygen is likely not limiting colonization and growth of epibenthos in open water areas of the bay.

The epibenthic communities of the Jamaica tributaries were studied as well (HydroQual, 2002). Most of the taxa found in the tributaries are tolerant of organic enrichment and/or low DO (even barnacles, which are also found in very clean waters). A notable exception is the Say mud crab (Dyspanopeus sayi) which in its larval stage is intolerant of low DO and was a driving force in the derivation of new federal water quality criteria for DO (USEPA 2001). Adult Say crabs were found living in and on substrate arrays placed throughout the harbor in June 2001 including the Jamaica tributaries and many other waterbodies which experience low DO from late spring through early fall. Larval D. sayi were also found in ichthyoplankton samples taken throughout Jamaica Bay (including Grassy Bay), in Mill Basin and Fresh Creek, during July 2001; all areas with documented hypoxic conditions (HydroQual 2002). These results suggest that the Say crab larval survival and growth may be less sensitive to low DO in nature than the laboratory results used by USEPA, although interpretation of plankton data is complicated by possible tidal transport of larvae among waterbodies. Regardless, the presence of epibenthic larvae sensitive to low DO conditions in waterbodies known to experience those same conditions suggests that full attainment of stringent DO standards 100 percent of the time is not necessary to ensure survival and recruitment of important epibenthic species.

The plates placed at the mouth of the Jamaica Bay tributaries, where tidal flushing is greatest, indicate a relatively high diversity of epibenthic species use. The results of the artificial substrate study at the head of Paerdegat Basin, however, indicate that poor water quality limits epibenthic recruitment and survival, but (like the subtidal benthic community) marine life begins to return within about 2,000 feet of the head of the basin. It is therefore expected that an increase in epibenthic biomass and diversity could occur at the head of Paerdegat Basin and other Jamaica Bay tributaries with reductions in CSO pollutant loadings if suitable substrate habitat is available. Reductions in solids loading would reduce TOC and improve light penetration in the water column, leading to increased DO levels on an average basis, and fewer incidences of hypoxia in the lower half of the water column.

4.6.4 Phytoplankton

West-Valle et al. (1992) reported on the physical, biological and chemical characteristics of Jamaica Bay. This report includes a summary of the findings of the studies of Peterson and Dam (1987), and Cosper et al. (1989). These studies were conducted in the same locations within Jamaica Bay and its tributaries, but at different times of the year. They measured the abundance of phytoplankton and primary productivity, along with other variables such as salinity, temperature, oxygen and nutrients. Peterson and Dam (1987) characterized the taxonomic composition of the high salinity, well-mixed outer part of Jamaica Bay as being similar to that found in coastal waters, whereas, the lower-salinity, partially-stratified inner bay area was characterized by species such as cryptomonads and dinoflagellates. Spring blooms were found to be dominated by large diatoms and summer blooms were dominated by small diatoms and flagellates. Cosper *et al*. (1989) suggested that although the bay may experience eutrophic conditions at certain times of the year, the phytoplankton communities are similar to nearby embayments with less eutrophic conditions.

EEA conducted a biological productivity study during 1995 and 1996 for the DEP that included phytoplankton sampling in Jamaica Bay (EEA 1998). Phytoplankton samples were collected monthly from August 1995 to July 1996 and collected twice monthly during September and October 1995 and March and April 1996, at 5 different stations (Grassy Bay, Barren Island, The Raunt, North Channel, and Grassy Hassock) for a total of 80 samples. Results of this study indicate that Jamaica Bay had an average phytoplankton density of 17.8 x 106 cells/L with peak densities occurring during January and March 1996, having average densities of 35.5 x 106 cells/L and 35.4 x 106 cells/L, respectively. A total of 83 different species of phytoplankton were identified, with a majority of the species being classified as diatoms. The most abundant phytoplankton species found was the diatom, *Skeletonema costatum*, which accounted for 21 percent of all species present. Densities of phytoplankton ranged from, 0.372 x 106 cells/L, to 68.6 x 106 cells/L with the lowest and highest densities found at the Barren Island station and at the Raunt station, respectively. At the station nearest to Thurston Basin (Grassy Hassock), 56 different species were observed, including, euglenids (*Eutreptia viridis* and *Euglena spp*.), diatoms (*Leptocylindrus minimus* and *Thalassiosira gravida*), *Cryptomonas spp*., and unidentified centric diatom spp. (< 10µm long) (EEA 1998).

The DEP has conducted annual New York/New Jersey Harbor Water Quality Surveys since the 1970s. These surveys include limited phytoplankton sampling. However, they do provide an estimate for the amount of chlorophyll-α in the water column. Chlorophyll-a, the pigment that allows plants—including algae—to convert sunlight into organic compounds in the process of photosynthesis, is the predominant pigment found in algae and cyanobacteria, and its abundance is a good indicator of the amount of phytoplankton in the water column. Overall, the chlorophyll-α level in Jamaica Bay fell significantly below ten-year monthly averages in 2003. Averages in June and September were 36.5 and 13.2 µg/L (parts per billion) respectively, compared with ten-year means of 48.7 and 30.2 µg/L. Lower surface water temperatures in 2003 relative to 2002 and abnormally high rainfall amounts may explain this decrease. Lower water temperatures will slow algae growth and high rainfall levels may have led to faster flushing and lower residence time in Jamaica Bay. Additionally, August 2003 was a particularly poor month for water clarity, during which time monthly Secchi depth averaged 2.89 feet, compared to ten-year monthly means of 4.11±0.89 feet (DEP 2003).

4.6.5 Zooplankton

Peterson and Dam (1989), as summarized by West Valle *et al.* (1992), reported that zooplankton populations in Jamaica Bay were dominated by adult and juvenile species of copepod. The dominant species found in Jamaica Bay during the fall and spring samplings were the calanoid copepods; *Acartia tons, Acartia hudsonica* and *Paracalanus parvus*. The summer sampling was dominated by the cyclopoid copepod, *Oithona similis*. The study suggested that although Jamaica Bay may experience eutrophic conditions at certain times of the year, the phytoplankton communities are similar to nearby embayments with less eutrophic conditions (Cosper *et al.* 1989).

As part of the biological productivity study conducted by EEA for DEP (EEA 1998), micro-zooplankton and macro-zooplankton were sampled monthly from August 1995 through July 1996 and bi-weekly in September and October, 1995 and March and April, 1996 at five different stations (Grassy Bay, Barren Island, The Raunt, North Channel, and Grassy Hassock) for a total of 80 micro-zooplankton samples and 80 macro-zooplankton samples. Overall, a total of 31species of zooplankton were observed, with copepods being the most dominant and abundant species. The most abundant individual copepod species, which accounted for 39.5 percent of all organisms collected, was *Acartia hudsonica*, followed by *Eurytermora spp.*, *Temora longicornis*, *Acartia tonsa*, and *Centropages spp.*, along with barnacle larvae (Infraclass: Cirripedia). At the station nearest to Thurston Basin, Grassy Hassock, macro-zooplankton abundances macro-zooplankton densities (measured by no. organisms/ 100m3) peaked in the months of February, March and June, with a mean density of approximately 260,173/ $100m^3$, 254,617/ $100m^3$, and 215,760/ $100m^3$, respectively. The dominant species observed during the February and March peaks include; *Eurytemora spp.*, *A. hudsonica*, *A. tonsa*, and *Cirripedia nauplii* (EEA 1998). In June however, the dominant species identified were of non-copepod taxa, in particular, decapods and gastropods.

Although zooplankton sampling was not included in the 2000 and 2001 USA FSAP, the ichthyoplankton sampling nets frequently became clogged with copepods and other common zooplankton taxa such as cladocerans, hydromedusae and decapod larvae. Of note, Say mud crab larvae were found in ichthyoplankton samples collected in Fresh Creek, Paerdegat Basin and Mill Basin, as well as two Jamaica Bay stations. No species were recorded specifically in Hendrix Creek.

4.6.6 Icthyoplankton

Because the issue of fish propagation is integral to defining use classifications and attainment of associated water quality standards and criteria, ichthyoplankton sampling was conducted to identify any fish species spawning in Jamaica Bay or using its waters during the planktonic larval stage. Ichthyoplankton sampling was conducted at two to five stations in Jamaica Bay proper during 2001 and 2002 (HydroQual 2001, 2002) (Figure 4-3). Sampling was conducted at stations 1 through 5 in March, May, and July 2001, stations 1 and 2 in August 2001, and stations 1, 6 and 7 in March, April, June and July 2002. March through June were chosen based on spawning of a variety of important species and July and August were chosen to observe activity during anticipated worst case DO conditions.

A total of 29 unique taxa were collected in Jamaica Bay during 2001 and 2002 ichthyoplankton sampling (Table 4-14). True gobies (likely comprised seaboard gobies and naked gobies) dominated the catches with a large contribution of larvae. Herrings (likely comprised of Atlantic menhaden and Atlantic herring) were second and bay anchovy were third with large contributions of eggs. The ichthyoplankton community composition found in Jamaica Bay varied over the months sampled (Table 4-15). The total number of taxa collected increase from three in April to 13 in July and dropped to four in August. Clupeids (herrings and menhaden) were present during four of the six months sampled (March and May through July). A number of other species were present during three of the six months sampled: American sand lance (March through May), bay anchovy (May, July and August), true gobies (June through August), winter flounder (March through May), windowpane (May through July), northern pipefish (June through August), and tautog (May through July). The remaining species were collected during a single month (e.g., American eel and silver perch) and in some cases two months (e.g., anchovies and blennies).

Table 4-14. Number of Fish Eggs and Larvae Collected from Jamaica Bay

Common Name	Lowest Practical Taxon	Total Eggs and Larvae Collected
True gobies	Gobiidae	16,740
Herrings	Clupeidae	13,638
Bay anchovy	*Anchoa mitchilli*	7,124
Unidentified damaged	Unidentified damaged	7,066
Windowpane	*Scophthalmus aquosus*	3,792
Tautog	*Tautoga onitis*	3,612
Unidentified	Unidentified	2,846
Winter flounder	*Pseudopleuronectes americanus*	2,545
Anchovies	*Anchoa*	2,304
Atlantic menhaden	*Brevoortia tyrannus*	1,988
North American sea robin	*Prionotus*	1,986
Cunner	*Tautogolabrus adspersus*	1,545
Scup	*Stenotomus chrysops*	1,108
Northern pipefish	*Syngnathus fuscus*	1,078
Blennies	Blenniidae	330
Myoxocephalus	*Myoxocephalus*	148
Wrasses	Labridae	88
Spotted seahorse	*Hippocampus erectus*	88
American sand lance	*Ammodytes americanus*	56
Seaboard goby	*Gobiosoma ginsburgi*	28
Butterfish	*Peprilus triacanthus*	22
Atlantic silverside	*Menidia menidia*	18
Rock gunnel	*Pholis gunnellus*	12
Silver perch	*Bairdiella chrysoura*	8
Weakfish	*Cynoscion regalis*	8
Feather blenny	*Hypsoblennius hentzi*	4
Fourbeard rockling	*Enchelyopus cimbrius*	2
American eel	*Anguilla rostrata*	2
Atlantic herring	*Clupea harengus harengus*	2
Number of Taxa*		22
Total Collected		68,188

*Does not include “Unidentified” and “Unidentified damaged”; taxonomic families are not counted when one or more species from that family was collected (e.g., “Wrasses” are not counted if either of both of cunner and tautog were collected)

Table 4-15. Seasonal Distribution of Fish Eggs (eP and Larvae (L) Collected in Jamaica Bay

Common Name	Lowest Practical Taxon	March	April	May	June	July	August
American sand lance	*Ammodytes americanus*	E,L	E,L	L			
Anchovies	*Anchoa*				L	L	
Bay anchovy	*Anchoa mitchelli*			E		E	L
American eel	*Anguilla rostrata*	L					
Silver perch	*Bairdiella chrysoura*				L		
Blennies	Blenniidae				L	L	
Atlantic menhaden	*Brevoortia tyrannus*	L		E	L	L	
Atlantic herring	*Clupea harengus harengus*	L					
Herrings	Clupeidae	L		E,L	L	E,L	
Weakfish	*Cynoscion regalis*				L		
Fourbeard rockling	*Enchelyopus cimbrius*	E					
True gobies	Gobiidae				L	L	L
Seaboard goby	*Gobiosoma ginsburgi*					L	
Spotted seahorse	*Hippocampus erectus*				L	L	
Feather blenny	*Hypsoblennius hentzi*					L	L
Wrasses	Labridae			E		E	
Atlantic silverside	*Mendidia menidia*			L		L	
Myoxocephalus	*Myoxocephalus*	L	L				
Fourspot flounder	*Paralichthys oblongus*					L	
Butterfish	*Peprilus triacanthus*					L	
Rock gunnel	*Pholis gunnellus*	L					
North American sea robins	*Prionotus*			E		E	
Winter flounder	*Pseudopleuronectes americanus*	E,L	L	L			
Windowpane	*Scophthalmus aquosus*			E,L	L	E	
Scup	*Stenotomus chrysops*			E			
Northern pipefish	*Syngnathus fuscus*				L	L	L
Tautog	*Tautoga onitis*			E,L	L	E,L	
Cunner	*Tautogolabrus adspersus*			E,L		E	
Unidentified	Unidentified/Unidentified Damaged	E,L	L	E,L	L	E,L	L
Number of Taxa*		8	3	10	10	13	4

* Does not include "Unidentified"; taxonomic families are not counted when one or more species from that family was collected (e.g., "Wrasses" are not counted if either of both of cunner and tautog were collected.)

The presence of these life stages is generally consistent with what is known about each species' spawning activity. The large reduction in number of taxa present from July to August is likely attributable to the development of these organisms into older life stages. However, the fact that DO levels are typically lowest during August may be playing a role in the reduction in species richness over these months. Similarly, the presence of eggs and larvae of numerous species in May and July suggests that DO levels during these months of typically low DO are sufficient to sustain these organisms.

Ichthyoplankton are planktonic and generally drift with prevailing currents. Therefore, the location of the spawning, which produced these early life stages, is uncertain. Spawning may occur in Jamaica Bay proper, in the adjoining basins and creeks, or in ocean waters, with eggs and larvae transported into Jamaica Bay by the tides. Because the duration of the egg stage is short (about two days after fertilization) compared to the larval stage (2-3 months depending on species) there is a relatively higher degree of confidence that an egg found in Jamaica Bay was spawned there. The majority of the eggs collected in Jamaica Bay were of pelagic species such as herrings and bay anchovy. Structure and bottom oriented species including tautog; windowpane and sea robin also contributed large numbers of eggs.

The abundance and diversity of a fish community is dependent on several factors (DEP 2004):

- spawning season;
- proximity to spawning areas;
- type of eggs and larvae (demersal or pelagic); and
- adult life stage habitat requirements.

The spawning season of a fish species will determine if water quality is a limiting factor in the potential survivability of the eggs and larvae. For example, winter flounder spawn in the winter and larvae are present in the spring, when hypoxia is infrequent. Based on spring DO levels in Jamaica Bay, winter flounder eggs and larvae would be able to survive there.

Bay anchovy spawn in the summer, when DO levels are at their lowest, but their eggs and larvae are found in surface waters. In May and July, bay anchovy eggs were present in Jamaica Bay while larvae were present in August. Anchovy larvae could be exposed to low DO conditions with their duration of exposure dependent upon the location of adult spawning and egg and larval dispersal by tidal currents.

The development of the ichthyoplankton community is affected by the type of habitat present for juvenile and adult fish, the differences in habitat diversity, relative habitat quality and the type of bottom substrate. Based on the results of the FSAP, the eggs and larvae of both pelagic and structure, and bottom oriented species such as gobies, herrings, bay anchovy, windowpane, tautog, and winter flounder dominated the ichthyoplankton community found in Jamaica Bay.

The FSAP data from March 2001 are noteworthy in that they demonstrate the overall dominance of the winter flounder larvae at most stations and that more winter flounder larvae are found in open waterbodies like Jamaica Bay than in the tributaries. An analysis of variance revealed that the concentrations of eggs and larvae were significantly higher in open waterbodies of Jamaica Bay than in the tributaries on a total basis during both March and May 2001 (Hydroqual 2002). However, the FSAP data also indicate that many species of fish use the tributaries of Jamaica Bay as spawning or foraging habitat, albeit at lower densities than in the open waters of the bay, even though the tributaries may not be compliant with DO standards for a Class I Waterbody during certain times of the year. Therefore, improvements to DO in the tributaries through CSO pollutant load reductions and proposed habitat restoration initiatives

(USACOE, 1997) could increase the use of tributaries by fish for spawning and foraging purposes.

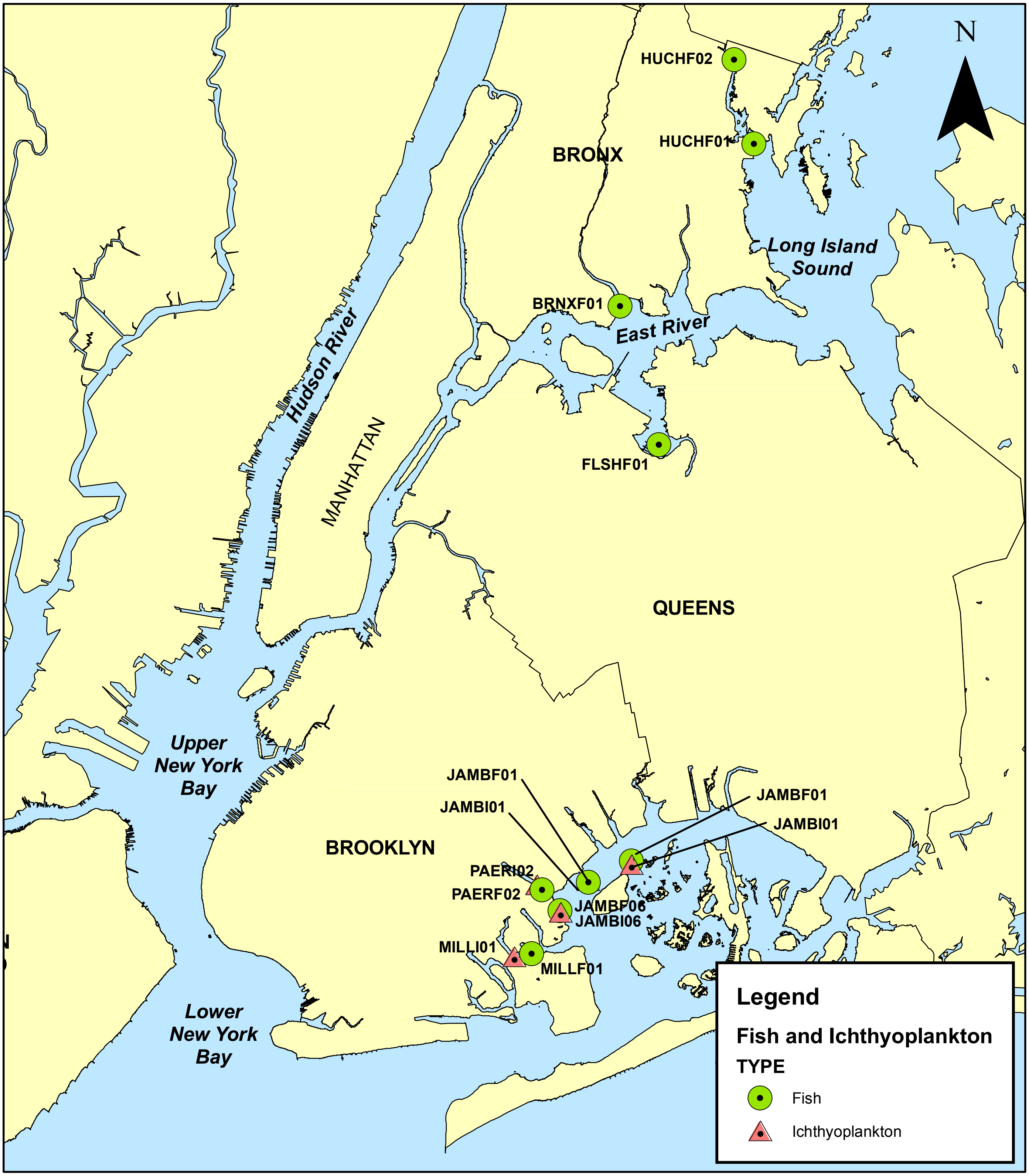
4.6.7 Juvenile and Adult Fish

Jamaica Bay continues to be a significant nursery ground for commercially and recreationally important fish such as the winter flounder (*Pseudopleuronectes americanus*) and striped bass (*Morone saxatilis*). Of all the finfish species the majority caught in Jamaica Bay were juveniles. The most abundant finfish caught seining was the juvenile Atlantic silverside (*Menidia menidia*), comprising 61 percent of all species (JABERRT 2002). This fish species consistently remains one of the most abundant juvenile fish in the Jamaica Bay and also throughout the Middle Atlantic Bight. Species of the family Cyprinodontidae including the striped killifish (*Fundulus majalis*), spotfin killifish (*Fundulus luciae*) and the mummichog (*Fundulus heteroclitus*), comprising 25 percent of the species, were the second most prevalent of all species. The third most prevalent species collected through seining techniques was the Atlantic menhaden (Brevoortia tyrannus) with 4 percent, and the forth was the striped mullet (Mugil cephalus) and the winter flounder, both comprising 1 percent (JABERRT 2002).

Fish are motile organisms that can choose which habitats they enter and utilize. As such, their presence or absence can be used to evaluate water quality. The fish community in Jamaica Bay proper was sampled in July and August 2001 and March, April, June, and July of 2002 under the FSAP program (HydroQual 2001a; Figure 4-9). Summer months are represented because this is the time of year when bottom water DO concentrations are at their lowest. Sampling was conducted with an otter trawl to catch bottom-oriented species and a gill net suspended in the water column to capture pelagic species at stations 1 through 5 during 2001 and stations 1, 6, and 7 in 2002.

Under the FSAP sampling program, a total of 27 taxa were collected from Jamaica Bay. Bay anchovy dominated the catch accounting for 34 percent of the total catch. Weakfish were the second most abundant species accounting for 10 percent of the total catch. Weakfish are generally associated with structure while bay anchovy are pelagic. Demersal species, such as winter flounder and summer flounder were also collected in relatively high numbers, suggesting that juvenile and adult fishes are using the entire water column in Jamaica Bay as habitat. Catch composition in 2001 and 2002 was very different. For example, no bay anchovy were collected in 2001 sampling. Overall, fewer species and individuals were collected in 2001 relative to 2002. This could have been due to the difference in stations sampled as well as the months sampled between the two years. July 2002 sampling produced the highest individual catches of bay anchovy, butterfish, blueback herring, weakfish, and scup of all months sampled. March 2002 produced the single largest catch of Atlantic silverside. August 2001 sampling, where DO levels would be expected to be at or near their annual low, collected relatively small numbers of pipefish, Atlantic silverside, and summer flounder. The fact that the single largest catches of adult and juvenile fish were collected during the month of July, when DO is typically near its lowest, suggests that DO is not limiting use of Jamaica Bay by fishes during most of the year. Collection of both pelagic and benthic fishes in Jamaica Bay during August 2001 also suggests that DO levels stay within which those that can support a fish community year round.

Very few fish were caught from the Jamaica Bay tributaries during the July and August 2001 FSAP sampling indicating that fish generally avoid the tributaries during periods of low



NYC Environmental Protection

Jamaica Bay Supplemental Sampling Stations, Icthyoplankton and Fish

DO. However, results of the JABERRT sampling effort conducted monthly during 2002 show that fish do in fact utilize the tributaries during most times of the year (Table 4-16). It is likely that fish utilize the tributaries opportunistically when DO concentrations are favorable and they avoid the tributaries when DO concentrations are suboptimal. Therefore, improvements to DO in the tributaries through CSO pollutant load reductions and proposed habitat restoration initiatives (USACOE, 1997) could increase the use of tributaries by fish for spawning and foraging purposes.

Table 4-16. Seine and Trawl Catch Data (Abundance) for Jamaica Tributaries (JABERRT 2002)

Common Name	Species Name	Fresh Creek		Spring Creek		Bergen Basin		Dubos Point (Thurston Basin)	
		Seine	Trawl	Seine	Trawl	Seine	Trawl	Seine	Trawl
Atlantic Silversides	*Menidia menidia*	843		506	3	3087	2	610	
Striped Killifish	*Fundulus majalis*	692		6		1392		8	
Atlantic Croaker	*Micropogonias undulatus*	15							
Striped Bass	*Morone saxatilis*	12				1			
Alewife	*Alosa pseudoharengus*	6							1
Winter Flounder	*Pseudopleuronectes americanus*	4	2	4	28	1	19	6	12
Spot	*Leiostomus xanthurus*	1							
Atlantic Menhaden	*Brevoortia tyrannus*	1		212		24		3	
Bluefish	*Pomatomas saltatrix*			13				3	
Crevalle Jack	*Caranx hippos*	1							
Windowpane flounder	*Scophthalmus aquosus*		9						5
Summer Flounder	*Paralichthys dentatus*		7	1	11		5		4
Tautog	*Tautoga onitis*		3	1			2		
Northern Pufferfish	*Phoeroides maculatus*			1					
Red Hake	*Urophycis chuss*				4		4		
Striped Sea Robin	*Prionotus evolans*				3				
Weakfish	*Cynoscion regalis*			2					
Northern Pipefish	*Syngnathus fuscus*			1	1	2		1	
Lined Seahorse	*Hippocampus erectus*			1					
Striped Mullet	*Mugil cephalus*					1			
Striped Searobin	*Prionotus evolans*								2
Black Sea Bass	*Centropristis striata*								3
Oyster Toadfish	*Tautoga onitis*								2

4.7 SENSITIVE AREAS

4.7.1 CSO Policy Requirements

Federal CSO Policy requires that the long-term CSO control plan give the highest priority to controlling overflows to sensitive areas. For such areas, the CSO Policy indicates the LTCP should:

- Prohibit new or significantly increased overflows;
- Eliminate or relocate overflows that discharge to sensitive areas if physically possible, economically achievable, and as protective as additional treatment or provide a level of treatment for remaining overflows adequate to meet standards; and
- Provide reassessments in each permit term based on changes in technology, economics, or other circumstances for those locations not eliminated or relocated (USEPA, 1994).

The policy defines sensitive areas as:

- Waters designated as Outstanding National Resource Waters (ONRW);
- National Marine Sanctuaries;
- Public drinking water intakes;
- Waters designated as protected areas for public water supply intakes;
- Shellfish beds;
- Waters with threatened or endangered species and their habitat;
- Water with primary contact recreation; and
- Additional areas determined by the Permitting Authority (i.e., DEC)

The last item in the list was derived from the policy statement that the final determination should be the prerogative of the NPDES Permitting Authority. The Natural Resources Division of the DEC was consulted during the development of the assessment approach, and provided additional sensitive areas for CSO abatement prioritization based on local environmental issues. Their response listed the following: Jamaica Bay; Bird Conservation Areas; Hudson River Park; ‘important tributaries’ such as the Bronx River in the Bronx, and Mill, Richmond, Old Place, and Main Creeks in Staten Island; the Raritan Bay shellfish harvest area; waterbodies targeted for regional watershed management plans (Newtown Creek and Gowanus Canal).

4.7.2 Assessment

An assessment was performed to identify areas within Jamaica Bay that may be candidates for consideration as sensitive areas. The assessment was limited to a review of relevant regulatory designations, publicly available information accessed through Freedom of Information Act (FOIA) requests, and direct communication with the permitting authority.

Table 4-17 summarizes the sensitive areas assessment in Jamaica Bay.

Table 4-17. Sensitive Areas in Jamaica Bay

Designation	Present
Outstanding National Resource Waters	No
National Marine Sanctuaries	No
Threatened or Endangered Species	No
Primary Contact Recreation	Yes
Public Water Supply Intake	No
Public Water Supply Protected Areas	No
Shellfish Bed	No
Areas Determined by DEC	No

The DEC recommended that Jamaica Bay CSOs with the highest discharges of floatables and settleable solids be given priority in the LTCP. This recommendation was based on Jamaica Bay's ecological significance in an otherwise urban environment. The Jamaica Bay complex provides important habitat to fish and wildlife and is one of the largest open spaces in the City of New York. The Bay is used year-round for boating, fishing, and other recreational purposes, and is therefore sensitive to floatables and other aesthetic issues. The identification of the highest solids and floatables discharges will be addressed under the Jamaica Bay and CSO Tributaries LTCP.

The presence of threatened or endangered species in Jamaica Bay and its tributaries was determined based on FOIA letter requests sent to each of the agencies that maintain databases regarding the presence of threatened or endangered species within the waterbody. The New York Natural Heritage Program maintains a comprehensive database on the status and location of State-designated rare species. The National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Services (USFWS) respectively maintain the federal lists of marine and non-marine threatened or endangered species in accordance with the Endangered Species Act of 1973. The responses from these agencies were then filtered to exclude non water-dependent species, unverified historical records older than 40 years, and species that were not identified immediately within or adjacent to the waterbody.

Although NMFS listed three species of threatened or endangered sea turtles that may be seasonally present in Jamaica Bay there is no designated critical habitat in the area, and NMFS presumes that any sea turtles found in Jamaica Bay are there based on accessibility rather than on habitat or on direct observation. Because there is no specific information on the presence of these threatened or endangered marine animal species, there are no sensitive areas in Jamaica Bay on this basis.

There are no sensitive areas of the remaining categories based on the following information:

- There are no ONRW waters, National Marine Sanctuaries, or public water supplies in or near the waters of New York Harbor;
- There are no designated shellfishing areas within Jamaica Bay or its tributaries;

NO TEXT ON THIS PAGE

5.0 Waterbody Improvement Projects

New York City is served primarily by a combined sewer system. Approximately 70 percent of the City is comprised of combined sewers totaling 4,800 miles within the five boroughs. The sewer system drains some 200,000 acres and serves a population of approximately 8 million New Yorkers. Approximately 460 outfalls are permitted to discharge during wet-weather through CSOs to the receiving waters of the New York Harbor complex. These discharges result in localized water-quality problems such as periodically high levels of coliform bacteria, nuisance levels of floatables, depressed DO, and, in some cases, sediment mounds and unpleasant odors.

The City of New York is committed to its role as an environmental steward of the New York Harbor and began addressing the issue of CSO discharges in the 1950s. To date, DEP has spent or committed over $2.1 billion in its Citywide CSO abatement program. As a result of this and other ongoing programs, water quality has improved dramatically over the past 30 years (DEP Harbor Survey Annual Reports). Implementation of many of these solutions within the current DEP 10-year capital plan will continue that trend as DEP continues to address CSO-related water quality issues through its Citywide CSO Floatables program, pump station and collection system improvements, and the ongoing analysis and implementation of CSO abatement solutions. The following sections present the history of DEP CSO abatement and describe the current and ongoing programs in detail.

5.1 CSO PROGRAMS 1950 TO 1992

Early CSO assessment programs began in the 1950s and culminated with the Spring Creek Auxiliary WWTP, a 12-million gallon CSO retention facility, constructed on a tributary to Jamaica Bay. Completed in 1972, this project was one of the first such facilities constructed in the United States. Shortly thereafter, New York City was designated by the USEPA to conduct an Area-Wide Wastewater Management Plan authorized by Section 208 of the then recently enacted CWA. This plan, completed in 1979, identified a number of urban tributary waterways in need of CSO abatement throughout the City. During the period from the mid-1970s through the mid-1980s New York City's resources were devoted to the construction of wastewater treatment plant upgrades.

In 1983, DEP re-invigorated its CSO facility-planning program in accordance with DEC-issued SPDES permits for its WWTPs with a project in Flushing Bay and Creek. In 1985, a Citywide CSO Assessment was undertaken which assessed the existing CSO problem and established the framework for additional facility planning. From this program, the City was divided into eight areas, which together cover the entire harbor area. Four area-wide projects were developed (East River, Jamaica Bay, Inner Harbor and Outer Harbor) and four tributary project areas were defined (Flushing Bay, Paerdegat Basin, Newtown Creek, and the Jamaica tributaries). Detailed CSO Facility Planning Projects were conducted in each of these areas in the 1980s and early 1990s and resulted in a series of detailed, area-specific plans.

In 1989, DEP initiated the Citywide Floatables Study in response to a series of medical waste and floating material wash-ups and resulting bathing beach closures in New York and New

Jersey in the late 1980s. This comprehensive investigation determined that medical wastes were a small component of the full spectrum of material found in metropolitan area waters and beach wash-ups and that the likely source of the medical wastes was illegal dumping. The study also found that, aside from natural materials and wood from decaying piers and vessels, the primary component of the floatable material is street litter in surface runoff that is discharged to area waters via CSOs and storm sewers. The Floatables Control Program is discussed in Section 5.4.

5.2 CITYWIDE CSO ABATEMENT ORDERS (1992, 1996, 2005, 2008, 2009, 2011)

In 1992, DEC and DEP entered into the original CSO Administrative Consent Order (1992 ACO). As a goal, the 1992 ACO required DEP to develop and implement a CSO abatement program to effectively address the contravention of water quality standards for coliforms, DO, and floatables attributable to CSOs. The 1992 ACO contained compliance schedules for the planning, design and construction of the numerous CSO projects in the eight CSO planning areas. The 1992 ACO was modified in 1996 to add a program for catch basin cleaning, construction, and repair to further control floatables.

The Flushing Bay and Paerdegat Basin CSO Retention Tanks were included in the 1992 ACO. In addition, two parallel tracks were identified for CSO planning purposes. Track 1 addressed DO (aquatic life protection) and coliform bacteria (recreation) issues. Track 2 addressed floatables, settleable solids and other water use impairment issues. The 1992 ACO also provided for an Interim Floatables Containment Program to be implemented consisting of a booming and skimming program in confined tributaries, skimming in the open waters of the harbor, and an inventory of street catch basins where floatable materials enter the sewer systems. Open waters are defined as the Inner and Outer Harbors as well as Jamaica Bay.

In accordance with the 1992 ACO, DEP continued to implement its work for CSO abatement through the facility-planning phase into the preliminary engineering phase. Work proceeded on the planning and design of eight CSO retention tanks located on confined and highly urbanized tributaries throughout the City. The number of planned retention tank facilities was reduced from eight to six during the CSO facility planning phase. The Interim Floatables Containment Program was fully developed and implemented. The Corona Avenue Vortex Facility (CAVF) pilot project for the floatables and settleable solids control was designed and implemented. The City's 141,000 catch basins were inventoried and a re-hooding program for floatables containment was implemented and substantially completed. Reconstruction and re-hooding of the remaining basins were completed in 2009.

For CSOs discharging to the open waters of the Inner and Outer Harbors areas, efforts were directed to the design of sewer system improvements and wastewater treatment plant modifications to increase the capture of combined sewage for processing at the plants. For the Jamaica Tributaries, efforts focused on correction of illegal connections to the sewer system and evaluation of sewer separation as control alternatives. For Coney Island Creek, attention was directed to corrections of illegal connections and other sewer system/pumping station improvements. These efforts and the combination of the preliminary engineering design phase work at six retention tank sites resulted in amendments to some of the original CSO Facility Plans included in the 1992 ACO and the development of additional CSO Facility Plans in 1999.

DEP and DEC negotiated a new Consent Order that was signed January 14, 2005 that superseded the 1992 Order and its 1996 Modifications with the intent to bring all DEP CSO-related matters into compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The new Order, noticed by DEC in September 2004, contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for Citywide long-term CSO control in accordance with USEPA CSO Control Policy. DEP and DEC also entered into a separate Memorandum of Understanding to facilitate water quality standards reviews in accordance with the CSO Control Policy. The 2005 Consent Order was modified in 2008 and 2009. Table 5-1 presents the design and construction milestone dates for capital projects in the 2005 CSO Consent Order as updated.

Table 5-1. 2005 CSO Consent Order Milestone Dates for Capital Projects

Planning Area	Project	Design Completion	Construction Completion
Alley Creek	Outfall & Sewer System Improvements	Mar 2002	Dec 2006
	CSO Retention Facility	Dec 2005	Mar 2011
Outer Harbor	Regulator Improvements – Fixed Orifices	Apr 2005	Jul 2008
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	Port Richmond Throttling Facility	Aug 2005	Nov 2009 as modified
	In-Line Storage (Deleted per 2008 CSO Consent Order)	Nov 2006	Deleted
Inner Harbor	Regulator Improvements – Fixed Orifices	Sep 2002	Apr 2006
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	In-Line Storage	Nov 2006	Aug 2010
	Gowanus Flushing Tunnel Modernization	-	Sep 2014
	Gowanus Pumping Station Reconstruction	-	Sep 2014
	Dredging Gowanus Canal	Dec 2010	See Note 2
Paerdegat Basin	Influent Channel	Mar 1997	Feb 2002
	Foundations and Substructures	Aug 2001	Dec 2009
	Structures and Equipment	Nov 2004	May 2011
	Dredging Paerdegat Basin	See Note 2	See Note 3
Flushing Bay/Creek	CS4-1 Reroute & Construct Effluent Channel	Sep 1994	Jun 1996
	CS4-2 Relocate Ball fields	Sep 1994	Aug 1995
	CS4-3 Storage Tank	Sep 1996	Aug 2001
	CS4-4 Mechanical Structures	Feb 2000	Sep 2009
	CS4-5 Tide Gates	Nov 1999	Apr 2002
	CD-8 Manual Sluice Gates	May 2003	Jun 2005
	Tallman Island WWTP 2xDDWF	Dec 2010	Jul 2015
Jamaica Tributaries	Meadowmere & Warnerville DWO Abatement	May 2005	Jul 2009 as modified
	Expansion of Jamaica WWTP Wet Weather Capacity	Jun 2011	Jun 2015
	Destratification Facility	Dec 2007	Mar 2012
	Laurelton & Springfield Stormwater Buildout Drainage Plan	May 2008	-
	Regulator Automation	Nov 2006	Jun 2010
Coney Island Creek	Avenue V Pumping Station Upgrade	Jan 2005	Apr 2011
	Avenue V Force Main	Sep 2006	Jun 2012
Newtown Creek	Aeration Zone I	Dec 2004	Dec 2008
	Aeration Zone II	Jun 2010	Jun 2014
	Relief Sewer/Regulator Modification	Jun 2009	Jun 2014
	Throttling Facility	Jun 2008	Dec 2012
	CSO Storage Facility	Nov 2014	Dec 2022
Westchester Creek	Phase 1 (Influent Sewers)	Jun 2010	Jun 2015
	CSO Storage Facility	-	Dec 2022

Planning Area	Project	Design Completion	Construction Completion
Bronx River	Floatables Control	Jul 2008	Jun 2012
Hutchinson River	Phase I of Storage Facility	Jun 2010	Jun 2015
	Future Phases	-	Dec 2023
Jamaica Bay	Spring Creek AWWTP Upgrade	Feb 2002	Apr 2007
	26th Ward Drainage Area Sewer Cleaning & Evaluation	Jun 2007	Jun 2010
	Hendrix Creek Dredging	Jun 2007	Feb 2012
	26th Ward Wet Weather Expansion	Jun 2010	Dec 2015
	Rockaway WWTP 2xDDWF	-	Dec 2017
Notes: 1) DEP and DEC are negotiating replacing some of the existing mandates with more cost effective CSO controls that will attain equivalent water quality benefits 2) Dredging must be completed with 5 years of final permit issuance. 3) Design Completion = Permit + 18 months; Construction Completion = Permit + 60 months.			

DEP and DEC identified numerous modifications to the CSO Consent Order, including integration of green infrasturcute and substitution of more cost-effective grey infrastructure, and agreed to fixed dates for submittal of the Long-Term Control Plans. A summary of the capital project revisions is included in Table 5-2.

Table 5-2. 2011 CSO Consent Order Milestone Modifications

Planning Area	Project	Milestone Type	Proposed Modification
Alley Creek	CSO Retention Facility	Existing	Date
Outer Harbor	Regulator Improvements – Automation	Existing	Date
	Port Richmond Throttling Facility	Existing	Date
Inner Harbor	Regulator Improvements – Automation	Existing	Date
	Dredging Gowanus Canal	Existing	Date
Flushing Bay/Creek	CS4-4 Mechanical Structures	Existing	Date
	Divert Low Lying Sewers/Raise Weirs	New	Add
	Regulator Modifications	New	Add
	Dredging	New	Add
	Flushing Interceptor	New	Add
Jamaica Tributaries	Meadowmere & Warnerville DWO Abatement	Existing	Date
	Expansion of Jamaica WWTP Wet Weather Capacity	Existing	Eliminate
	Destratification Facility	Existing	Date
	Regulator Automation	Existing	Date
	48 Inch Parallel Interceptor	New	Add
	Bending Weirs	New	Add
Coney Is Creek	Avenue V Pumping Station Upgrade	Existing	Date
Newtown Creek	Zone II Aeration	Existing	Modify
	Relief Sewer/Regulator Modification	Existing	Eliminate
	CSO Storage Facility	Existing	Eliminate
	Bending Weirs / Floatable Controls.	New	Add
Westchester Creek	Phase 1 (Influent Sewers)	Existing	Eliminate
	CSO Storage Facility	Existing	Eliminate
Hutchinson River	Phase I of Storage Facility	Existing	Eliminate
	Future Phases	Existing	Eliminate
Jamaica Bay	26th Ward Wet Weather Expansion	Existing	Eliminate
	High Level Sewer Separation	New	Add
	26th Ward Wet Weather Stabilization	New	Add
	Green Infrastructure Demo in 26th Ward Drainage Basin.	New	Add

This Order was noticed by DEC in the October 12, 2011 ENB, with a public meeting schedule for November 9, 2011. The Public Comment Period concludes November 18, 2011. In addition to the changes noted in Table 5-2, there are also commitments for city-wide green infrastructure implementation, civil penalties, and Environmental Benefit Projects totaling $5.15 million for green infrastructure demonstration projects in the Bronx River and Newtown Creek drainage basins and water quality sampling.

5.3 BEST MANAGEMENT PRACTICES (BMPS)

The SPDES permits for all 14 WWTP in New York City require the DEP to report annually on the progress of 14 BMPs related to CSOs. The BMPs are equivalent to the Nine Minimum Controls (NMCs) required under the USEPA National Combined Sewer Overflow policy, which were developed by the USEPA to represent best management practices that would serve as technology based CSO controls. They were intended to be determined on a best professional judgment basis by the NPDES permitting authority and to be the best available technology based controls that could be implemented within two years by permittees. USEPA developed two guidance manuals that embodied the underlying intent of the NMCs (USEPA 1995b, 1995c) for permit writers and municipalities, offering suggested language for SPDES permits and programmatic controls that may accomplish the goals of the NMCs.

A list of BMPs excerpted directly from the most recent SPDES permits follows, along with brief summaries of each BMP and their respective relationships to the federal NMCs. In general, the BMPs address operation and maintenance procedures, maximum use of existing systems and facilities, and related planning efforts to maximize capture of CSO and reduce contaminants in the combined sewer system, thereby reducing water quality impacts. Through the CSO BMP Annual Reports, which were initiated in 2004 for the reporting year 2003, DEP provides brief descriptions of the Citywide programs and any notable WWTP drainage area specific projects that address each BMP.

5.3.1 CSO Maintenance and Inspection Program

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). Through regularly scheduled inspection of the CSOs and the performance of required repair, cleaning, and maintenance, dry weather overflows and leakage can be prevented and maximization of flow to the WWTP can be ensured. Specific components of this BMP include:

- Inspection and maintenance of CSO tide gates;
- Telemetering of regulators;
- Reporting of regulator telemetry results;
- Recording and reporting of rain events that cause dry weather overflows; and
- DEC review of inspection program reports.

DEP reports on the status of the Citywide program components and highlights specific maintenance projects, such as the Enhanced Beach Protection Program, where additional inspections of infrastructure in proximity to sensitive beach areas were performed. Table 5-3 lists all of the maintenance performed on regulators within the Jamaica Bay service area in the 2010 calendar year.

Table 5-3. CSO Maintenance and Inspection Programs in Jamaica Bay, 26th Ward, and Rockaway (2010)

Regulator	Description of Work(1)
Jamaica Bay	
J-01	Greased fittings, removed debris, exercised gates, scraped gate.
J-02	Removed debris
J-03	Responded to alarm for possible bypass all ok, removed debris, corrected problem involving float on wrong side of weir board.
J-04	Cleared debris
J-08	Cleared debris from diversion
J-09	Cleared debris from diversion
J-11	Exercised gates, removed debris
J-14	Exercised gates, greased all fittings, pulled and scraped gates, made necessary adjustments to all gates, full entry to clear blockage, removed debris.
26th Ward	
26W-1	Greased all fittings, exercised gates, hosed down chamber, scrapped seals, pulled flappers, scrapped sides of flappers PM one gate.
26W-2	Greased all fittings, removed arm for repair, scrapped gates, remove debris, PM on two front left gates, wiped seals.
26W-3	Removed grease, exercised gates, removed debris, scrapped seals.
Rockaway	
R-1	Exercised gates, greased fittings
R-2	Removed blockage, greased fittings, exercised gates.
R-D-5	Cleared partial blockage, checked new duck bills.
R-D-6	Exercised gates, checked new duck bills, cleared debris from diversion.
R-D-7	Exercised gates, checked new duck bills
R-D-9	Cleared partial blockage, cleared debris from diversions
R-D-10	Cleared partial blockage, cleared debris from diversion
R-D-11	Removed debris from diversion
R-D-12	Exercised gates and greased fittings.
(1) As listed in the SPDES Permit for the 14 Wastewater Treatment Plants, CY2010 CSO BMP Annual Report Attachment A, 2010	

5.3.2 Maximum Use of Collection System for Storage

This BMP addresses NMC 2 (Maximum Use of the Collection System for Storage) and requires the performance of cleaning and flushing to remove and prevent solids deposition within the collection system as well as an evaluation of hydraulic capacity so that regulators and weirs can be adjusted to maximize the use of system capacity for CSO storage and thereby reduce the amount of overflow. DEP provides general information describing the status of Citywide SCADA, regulators, tide gates, interceptors, and collection system cleaning in the CSO BMP Annual Report. See Table 5-3 for details on maintenance performed in 2010 at regulators within the Jamaica Bay drainage area.

In 2010, a total of 281,141 linear feet (832 pipe segments) of intercepting sewers were insepected in 26th Ward, Bowery Bay, Coney Island, Jamaica, North River, Oakwood Beach, Port Richmond, Red Hook, Rockaway, Tallman Island, and Wards Island drainage areas. This inspected length represents 38.9% of the total citywide interceptor system to be inspected. A breakdown of the Jamaica Bay drainage area is shows in Table 5-4 below.

Table 5-4. Interceptor Cleaning in Jamaica Bay, 26th Ward, and Rockaway (2010)

Description	Size (in)	Inspected Length (ft)
26th Ward	60	8,764
Rockaway	30 to 66	13,194
Jamaica Plant	36 to 96	9,064
East Interceptor	N/A	N/A

5.3.3 Maximize Flow to WWTP

This BMP addresses NMC 4 (Maximizing Flow to the Publicly Owned Treatment Works) and reiterates the WWTP operating targets established by the SPDES permits with regard to the ability of the WWTP to receive and treat minimum flows during wet weather. The collection systems are required to deliver and the WWTPs are required to accept the following flows for the associated levels of treatment:

- Receipt of flow through the headworks of the WWTP: 2xDDWF;
- Primary treatment capacity: 2xDDWF; and
- Secondary treatment capacity: 1.5xDDWF.

The BMP also refers to the establishment of collection system control points in the system's Wet Weather Operating Plan as required in BMP #4, and requires the creation of a capital compliance schedule within six months of the DEC approval of the Wet Weather Operating Plan should any physical limitations in flow delivery be detected.

In addition to describing WWTP upgrades and efforts underway to ensure appropriate flows to all 14 WWTPs, the BMP Annual Report provides analysis of the largest 10 storms of the year and WWTP flow results for each of these storms at least during the peak portions of the events.

A summary of each plant's performance during the top ten storm events is summarized in Table 5-5 below. In this table, "Permitted Capacity" represents (except as noted) the design wet weather capacity of the WWTP, typically equal to twice the design dry weather flow (2xDDWF). "Reported Capacity" respresents the capacity reported by a plant during the top ten storms and is based on the number of processing units in service at the plant and is in accordance with the plant's approved WWOP. "Sustained Flow" represents the flow rate maintained at the WWTP during the top ten storms. Each of the above parameters is computed at each WWTP for each of the top ten storms. Table 5-5 presents the maximum and the average of all sustained and peak flows at each WWTP.

Table 5-5. WWTP 2010 Performance

Plant	Permitted Capacity[1] (MGD)	Top-Ten Storm Maximum: Reported Capacity[2]	Top-Ten Storm Maximum: Sustained Flow[3]	Top-Ten Storm Maximum: Peak Flow[4]	Top-Ten Storm Average: Reported Capacity[5]	Top-Ten Storm Average: Sustained Flow[6]	Top-Ten Storm Average: Peak Flow[7]
Jamaica Bay	200	163	173	190	150-163	156	168
26th Ward	170	127.5	133	138	127.5	128	133
Rockaway	90	90	46	54	60-90	35	41

(1) **Permitted Capacity** represents the design wet-weather capacity of the WWTP, except as noted. The design wet-weather capacity is typically equal to two times design dry-weather flow (2xDDWF). The design capacity is applicable when all process units are in service. Construction and repair activities can temporarily reduce capacity.
(2) **Maximum Reported Capacity** represents the single largest WWTP capacity reported by the WWTP for any of the top ten storms. Capacities reported by the WWTP are based on the process units in service during each storm and area in accordance with each WWTP's approved wet-weather operating plan. Process units may be taken out of service during construction for upgrades mandated by Consent Orders or for other reasons such as emergency repairs. If all process units are in service during a storm, the reported capacity equals the design capacity.
(3) **Maximum Sustained Flow** is the largest wet-weather "sustained flow" that occurred during any of the top ten storms. Sustained flows represent the average hourly WWTP flow during WWTP throttling periods, or for events with no throttling, the average hourly flow over at least 3 hours including the peak wet-weather flow.
(4) **Maximum Peak Flow** represents the highest hourly flow observed during the top ten storms.
(5) **Average Reported Capacity** represents the average of the capacities reported by the WWTP for all top ten storms. Capacities reported by the WWTP are based on the process units in service during each storm and are in accordance with each WWTP's approved wet-weather operating plan. Process units may be taken out of service during construct for upgrades mandated by Consent Orders or for other reason such as emergency repairs. If all process units are in service during a storm, the reported capacity equals the design capacity.
(6) **Average Sustained Flow** represents the average of the largest, multi-hour flows that occurred during each of the top ten storm periods. Sustained flows represent the average hourly WWTP flow during WWTP-throttling periods or, for events with no throttling, the average hourly flow over at least 3 hours including the peak wet-weather flow.
(7) **Average Peak Flow** represents the average of the highest hourly flows observed during each of the top ten storms.

5.3.4 Wet Weather Operating Plan

In order to maximize treatment during wet weather events, WWOPs are required for each WWTP drainage area. Each WWOP should be written in accordance with the DEC publication entitled *Wet Weather Operations and Wet Weather Operating Plan Development for Wastewater Treatment Plants*, and should contain the following components:

- Unit process operating procedures;
- CSO retention/treatment facility operating procedures, if relevant for that drainage area; and
- Process control procedures and set points to maintain the stability and efficiency of biological nutrient removal (BNR) processes, if required.

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 4 (Maximizing Flow to the Publicly Owned Treatment Works). The DEP provides a schedule of plan submittal dates as part of the

BMP Annual Report. The submittal dates listed in the CY2011 CSO BMP Annual Report for facilities in Jamaica Bay are provided in Table 5-6.

Table 5-6. Jamaica Bay Wet Weather Operating Plans

Facility	Original Submissions to DEC	Most Recent Revision Submitted to DEC*	DEC Approval Status*
Jamaica	April 2005	Jun 2007	Approved Sep 2007
26th Ward	July 2003	Jul 2010	Approval Pending
Rockaway	April 2005	Dec 2007	Approved Mar 2008
*as of October 2011			

5.3.5 Prohibition of Dry Weather Overflow

This BMP addresses NMC 5 (Elimination of CSOs During Dry Weather) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls) and requires that any dry weather flow event be promptly abated and reported to DEC within 24 hours. A written report must follow within 14 days and contain information per SPDES permit requirements. The status of the shoreline survey, the Dry Weather Discharge Investigation report, and a summary of the total bypasses from the treatment and collection system are provided in the CSO BMP Annual Report.

5.3.6 Industrial Pretreatment

This BMP addresses three NMCs: NMC 3 (Review and Modification of Pretreatment Requirements to Determine Whether Nondomestic Sources are Contributing to CSO Impacts); NMC 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs); and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). By regulating the discharges of toxic pollutants from unregulated, relocated, or new SIUs tributary to CSOs, this BMP addresses the maximization of persistent toxics treatment from industrial sources upstream of CSOs. Specific components of this BMP include:

- Consideration of CSOs in the calculation of local limits for indirect discharges of toxic pollutants;
- Scheduled discharge during conditions of non-CSO, if appropriate for batch discharges of industrial wastewater;
- Analysis of system capacity to maximize delivery of industrial wastewater to the WWTP, especially for continuous discharges;
- Exclusion of non-contact cooling water from the combined sewer system and permitting of direct discharges of cooling water; and
- Prioritization of industrial waste containing toxic pollutants for capture and treatment by the POTW over residential/commercial service areas.

The CSO BMP Annual Report addresses the components of the industrial pretreatment BMP through a description of the Citywide program.

5.3.7 Control of Floatable and Settleable Solids

This BMP addresses NMC 6 (Control of Solid and Floatable Material in CSOs), NMC 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs), and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls) by requiring the implementation of four practices to eliminate or minimize the discharge of floating solids, oil and grease, or solids of sewage origin which cause deposition in receiving waters, i.e.:

- Catch Basin Repair and Maintenance: This practice includes inspection and maintenance schedules to ensure proper operation of basins;
- Catch Basin Retrofitting: By upgrading basins with obsolete designs to contemporary designs with appropriate street litter capture capability, this program is intended to increase the control of floatable and settleable solids, Citywide;
- Booming, Skimming and Netting: This practice establishes the implementation of floatables containment systems within the receiving waterbody associated with applicable CSO outfalls. Requirements for system inspection, service, and maintenance are established, as well; and
- Institutional, Regulatory, and Public Education - A one-time report must be submitted examining the institutional, regulatory, and public education programs in place Citywide to reduce the generation of floatable litter. The report must also include recommendations for alternative City programs and an implementation schedule that will reduce the water quality impacts of street and toilet litter.

The CSO BMP Annual Report provides summary information regarding the status of the catch basin and booming, skimming, and netting programs Citywide.

Several catch basin cleaning and hooding activities took place in the Jamaica Bay service area in 2010 as described in the CY2010 CSO BMP Annual Report. For the calander year 2010, 20,703 catch basins were inpected at an approximate monthly average of 1,725 in Queens. DEP also cleaned 14,956 catch basins in Queens in 2010. In 2010, hoods were replaced at 82 of the catch basins within the Jamaica Bay drainage area.

As part of its floatables plan, the DEP maintains floatables containment booms in Jamaica Bay. The DEP has these facilities inspected and serviced after significant rainstorms. Table 5-7 summarizes the quantity of floatables retrieved from the Jamaica Bay containment facilities in 2010, as reported in the CY2010 CSO BMP Annual Report.

Table 5-7. Floatable Material Collected in Jamaica Bay (2010)

Month of Year	Jamaica Bay
January	0.0
February	14.0
March	45.0
April	0.0
May	0.0
June	0.0
July	0.0

Month of Year	Jamaica Bay
August	7.0
September	3.0
October	0.0
November	0.0
December	0.0
Total	**69.0**

5.3.8 Combined Sewer System Replacement

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls), requiring all combined sewer replacements to be approved by the New York State Department of Health (NYSDOH) and to be specified within the DEP Master Plan for Sewage and Drainage. Whenever possible, separate sanitary and storm sewers should be used to replace combined sewers. The CSO BMP Annual Report describes the general, Citywide plan and addresses specific projects occurring in the reporting year. In the Rockaway drainage area, the sewer system is undergoing major modifications. Storm Sewer build-out is being done in conformance with the Master Plan for Sewers and Drainage, DEP, 1985. Exhibit 2 of the CY2010 CSO BMP Annual Report shows status of all sewer projects in Rockaway WPCP drainage area.

5.3.9 Combined Sewer/Extension

In order to minimize storm water entering the combined sewer system, this BMP requires combined sewer extensions to be accomplished using separate sewers whenever possible. If separate sewers must be extended from combined sewers, analysis must occur to ensure that the sewage system and treatment plant are able to convey and treat the increased dry weather flows with minimal impact on receiving water quality.

This CSO BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and a brief status report is provided in CY2010 CSO BMP Annual Report, although no combined sewer extension projects were completed in 2010.

5.3.10 Sewer Connection and Extension Prohibitions

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and prohibits sewer connections and extensions that would exacerbate recurrent instances of either sewer back-up or manhole overflows. Wastewater connections to the combined sewer system downstream of the last regulator or diversion chamber are also prohibited. The CSO BMP Annual Report contains a brief status report for this BMP and provides details pertaining to chronic sewer back-up and manhole overflow notifications submitted to DEC when necessary.

For the calendar year 2010, no letter of notification was received from DEC concerning chronic sewer backups or manhole overflows which would prohibit additional sewer connections or sewer extensions.

5.3.11 Septage and Hauled Waste

The discharge or release of septage or hauled waste upstream of a CSO (i.e., scavenger waste) is prohibited under this BMP. Scavenger wastes may only be discharged at designated manholes that never drain into a CSO, and only with a valid permit. This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls). The CSO BMP Annual Report summarizes the three scavenger waste acceptance facilities controlled by DEP, all of which are downstream of CSO regulators, and the regulations governing discharge of such material at the facilities.

The septage and hauled waste program continued unchanged according to the 2011 Annual BMP Report issued on March 31, 2011.

5.3.12 Control of Run-off

This BMP addresses NMC 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs) by requiring all sewer certifications for new development to follow DEP rules and regulations, to be consistent with the DEP Master Plan for Sewers and Drainage, and to be permitted by DEP. This BMP ensures that only allowable flow is discharged into the combined or storm sewer system. The CSO BMP Annual Report refers to the DEP permit regulations required of new development and sewer connections.

5.3.13 Public Notification

This BMP requires easy-to-read identification signage to be placed at or near CSO outfalls with contact information for DEP to allow the public to report observed dry weather overflows. All signage information and appearance must comply with the Discharge Notification Requirements listed in the SPDES permit. This BMP also requires that a system be in place to determine the nature and duration of an overflow event, and that potential users of the receiving waters are notified of any resulting, potentially harmful conditions. The BMP does allow the New York City Department of Health and Mental Hygiene (NYCDHMH) to implement and manage the notification program.

BMP No. 13 addresses NMC 8 (Public Notification) as well as NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). DEP provides the status of the CSO signage program in the CSO BMP Annual Report and lists those former CSO outfalls that no longer require signs. In 2010, DEP changed the design of the outfall signs at the recommendation of the Floatables Citizens Advisory Committee which requested that we include specific information about the water quality at these locations. The new design has the approval of NYS DEC, the Arts Commission and Parks Department, as well as Community Boards in the five boroughs. Recommendations were made to include warnings about recreational activities such as swimming, boating and fishing at the outfall locations. The new design emphasizes the word “Caution” in order to alert the public to the fact that the location is a point of release of wastewater into surface water during wet weather. The signs also provide graphics of non-recommended activities. DEP replaced all the signs that were installed in 2003 with the newly designed CSO signs; see Appendix 10 of the

2010 Annual BMP Report for the list of installed CSO sign locations. In addition, descriptions of new educational signage and public education-related partnerships are described. The NYCDHMH CSO public notification program is also summarized.

5.3.14 Annual Report

This BMP requires an annual report summarizing implementation of the BMPs, including lists of all existing documentation of implementation of the BMPs, be submitted by April 1st of each year. This BMP addresses all nine minimum controls. As of October 2011, the most recent BMP Annual Report submitted was for calendar year 2010.

5.4 CITYWIDE CSO PLAN FOR FLOATABLES ABATEMENT

In the late 1980s, New York City initiated the Citywide Floatables Study, a multi-year investigation of floatables in New York Harbor (HydroQual, 1993, 1995a). In addition to examining floatables characteristics, this study investigated potential sources of floatables, floatables circulation and beach-deposition patterns throughout the Harbor, and potential structural and non-structural alternatives for floatables control. Findings of the study showed that the primary source of floatables (other than natural sources) in the Harbor was urban street litter carried into waterways along with rainfall runoff.

DEP developed a floatables abatement plan (Floatables Plan) for the CSO areas of New York City in June 1997 (HydroQual, 1997). The Floatables Plan was updated in 2005 (HydroQual, 2005b) to reflect the completion of some proposed action elements and the addition of a monitoring program, as well as changes appurtenant to SPDES permits and modifications of regional WB/WS Facility Plans and CSO Facility Plans. The DEC approved the updated Floatables Plan on March 17, 2006.

The objectives of the Floatables Plan are to provide substantial control of floatables discharges from CSOs throughout the City and to provide for compliance with appropriate DEC and IEC requirements pertaining to floatables.

5.4.1 Program Description

The Citywide CSO Floatables Plan consists of the following action elements:

- Monitor Citywide street litter levels and inform the New York City Department of Sanitation (DSNY) and/or the New York City Mayor's Office of Operations when changes in litter levels at or in City policies would potentially result in increased discharges of CSO floatables;
- Continue the three-year cycle to inspect catch basins Citywide for missing hoods and to replace missing hoods to prevent floatables from entering the sewer system. In addition, proceed with the retrofit, repair, or reconstruction of catch basins requiring extensive repairs or reconstruction to accommodate a hood;
- Maximize collection system storage and capacity;
- Maximize wet-weather flow capture at WWTPs;

- Capture floatables at wet-weather CSO storage/treatment facilities;
- Capture floatables at end-of-pipe and in-water facilities, including the Interim Floatables Containment Program (IFCP) booms and nets.
- Continue the Illegal Dumping Notification Program (IDNP) in which DEP field personnel report any observed evidence of illegal shoreline dumping to the Sanitation Police section of DSNY, who have the authority to arrest dumpers who, if convicted, are responsible for proper disposal of the material;
- Engage in public outreach programs to increase public awareness of the consequences of littering and the importance of conserving water;
- As new floatables-control technologies emerge, continue to investigate their applicability, performance, and cost-effectiveness in New York City;
- Provide support to DEC to review and revise water-quality standards to provide for achievable goals; and
- Develop a floatables-monitoring program to track floatables levels in the Harbor and inform decisions to address both short- and long-term floatables-control requirements.

Overall, implementation of the Floatables Plan is expected to control approximately 96 percent of the floatable litter generated in New York City. The Floatables Plan is a living program that will undergo various changes over time in response to ongoing assessment of the program itself as well as changing facility plans associated with other ongoing programs. A key component of the Floatables Plan is self-assessment, including a new Floatables Monitoring Program to evaluate the effectiveness of Plan elements and to provide for actions to address both short- and long-term floatables-control requirements (see Section 8). Evidence of increasing floatables levels that impede uses could require the addition of new floatables controls, expansion of BMPs, and modifications of WB/WS Facility Plans and/or drainage-basin specific LTCPs, as appropriate.

5.4.2 Pilot Floatables Monitoring Program

In late 2006, work commenced to develop the Floatables Monitoring Program to track floatables levels in New York Harbor (HydroQual, 2007a). This pilot work which was performed to develop a monitoring procedure and an associated visual floatables rating system based on a five-point scale (very poor, poor, fair, good, very good), involved observations at a number of different sites. At each site, observations were made for up to three categories: on the shoreline, in the water near the shoreline; and in the water away from the shoreline.

5.4.3 Interim Floatable Controls in Jamaica Bay

There are booms installed in Hendrix Creek, near the 26th Ward Off-Loading Facility. The volume of floatables contained from this location is provided in Table 5-7 above.

5.4.4 Shoreline Cleanup Pilot Program

As part of the Environmental Benefits Projects (EBP) program established under the Long Island Sound (LIS) Consent Judgment, DEP has implemented a beach clean-up program to clean up shorelines in areas where floatables are known to occur due to CSO overflows and stormwater discharges as well as careless behavior and illegal dumping. This project was undertaken in connection with the settlement of an enforcement action taken by New York State and the DEC for violations of New York State law and DEC regulations. DEP has conducted cleanups at several areas deemed to benefit from these efforts including:

- Coney Island Creek, Brooklyn
- Kaiser Park, Brooklyn
- Sheepshead Bay (Kingsborough Community College), Brooklyn
- Cryders Lane (Little Bay Park), Queens
- Flushing Bay, Queens
- Owls Head, Brooklyn

These cleanup efforts will consist of two primary methods of cleanup.

- Workboat Assisted Cleanup - Mechanical Cleanup – Where debris is caught up in riprap on the shoreline, a high-pressure pump will be used to spray water onto the shoreline to dislodge and flush debris and floatables from the riprap back into the. A containment boom placed in the water around the site will allow a skimmer vessel to collect the material for proper disposal.
- Workboat Assisted Cleanup – At a few locations where the shoreline is not readily accessible from the land side a small workboat with an operator and crewmembers collects debris by hand or with nets and other tools. The debris will be placed onto the workboat for transport to a skimmer boat for ultimate disposal.
- Manual Cleanup – At some locations simply raking and hand cleaning will provide the most efficient cleanup method. Debris will then be removed and placed into plastic garbage bags, containers, or dumpsters and then loaded onto a pickup truck for proper disposal.

On average, DEP will generally be performing three cleanups per site each year for a four-year period at each of the above locations. Pending the outcome of this program, as well as the findings of the floatables monitoring program, an evaluation will be made of how the DEP will proceed in the future.

5.5 LONG-TERM CSO CONTROL PLANNING (LTCP) PROJECT

In June 2004, DEP authorized the LTCP Project. This work integrates all Track I and Track II CSO Facility Planning Projects and the Comprehensive Citywide Floatables Abatement Plan, incorporates on-going USA Project work in the remaining waterbodies, and develops WB/WS Facility Plan reports and the LTCP for each waterbody area. The LTCP Project monitors and assures compliance with applicable Administrative Consent Orders. This document is a work product of the LTCP Project.

5.6 JAMAICA BAY COMBINED SEWER OVERFLOW ABATEMENT FACILITY PLANNING PROJECTS

The Jamaica Bay and CSO Tributaries planning area was originally divided into Jamaica Bay, Jamaica Tributaries, and Paerdegat Basin (addressed under the separate Paerdegat Basin LTCP, June 2006)., which collectively cover the entirety of the waters of Jamaica Bay. . While these earlier CSO Facility Planning Projects recommended various CSO abatement elements, follow-up planning efforts have both eliminated some of the original recommended actions and advanced others. The results of those activities and decisions have led to a short list of CSO control related actions listed in Appendix A of the 2005 CSO Consent Order.

The original Jamaica Bay Combined Sewer Overflow Facility Planning Project (O'Brien & Gere, 1993) addressed CSOs in the 26th Ward WWTP drainage area, specifically the CSO discharges to Fresh Creek, Hendrix Creek, Spring Creek, and the open waters of Jamaica Bay. The facility plan recommended cleaning of sewers in the 26th Ward drainage area, interim dredging of the head-end of Hendrix Creek, and expansion of the wet weather capacity of the 26th Ward WWTP by 50 MGD. In addition to the facility plan recommendations, projects developed under other programs were added to the Jamaica Bay CSO planning area, including the upgrade of the existing Spring Creek Auxiliary WPCP, and the design of flow upgrades and construction of all necessary facilities to ensure that the Rockaway WWTP is capable of delivering accepting, and treating influent at or above twice the plant’s design flow during any storm event.

The Jamaica Tributaries CSO Facility Planning Project (Hazen and Sawyer, 1996, 2003) area included the Jamaica WWTP sewershed and the tributaries that receive wet weather discharges from the associated collection system (Bergen Basin, Thurston Basin, Shellbank Basin, and Hawtree Basin). The recommendations of this planning effort included the following:

- Construction of a new pumping station, force main, and sanitary sewer collection system for the Meadowmere & Warnerville sections of southeast Queens as a means of DWO Abatement
- Expansion of Wet Weather Capacity of Jamaica WWTP by 50 MGD
- Installation of a permanent diffused-air bubble mixing system in Shellbank Basin to destabilize temperature stratification during the summer season, thus mitigating odor and marine life kills.
- A drainage plan for 7,000 acres in southeast Queens served by the Laurelton and Springfield Boulevard sewers to identify the necessary capital sewer projects to alleviate flooding and convert the CSO area to a high-level storm sewer system. A description of the project is provided in section 5.6.1 below.
- Automation of key regulators contributing the largest flows to the treatment plants, J-2, J-3, and J-14 in the Jamaica WWTP drainage area.

5.6.1 Laurelton and Springfield Boulevard Storm Sewer Buildout

A drainage plan for 7,000 acres in southeast Queens is being developed to address flooding and to construct high-level storm sewers in a 1,450 acre CSO drainage area tributary to Thurston Basin. The drainage plan identifies the necessary capital sewer projects to alleviate flooding and convert the aforementioned CSO area to a high-level storm sewer system. Some sections of southeast Queens were developed faster than the DEP was able to fully construct the storm and sanitary sewer system. As such, the area has a mixture of combined sewers, separate sewers, areas where storm sewers interconnect with combined sewers and areas with inadequate sewers. In fact, the DEP has constructed hundreds of seepage basins in the area to provide some level of relief to the communities until storm sewers could be properly constructed. DEP has always intended to fully build-out the storm sewers in the area to prevent both street and basement flooding in the area. HLSS conversion would involve the construction of a storm drainage system that would convey wet weather flow from drainage inlets directly to Thurston Basin. While the existing combined sewer system would primarily convey sanitary flow after the construction of the HLSS, some storm water flow (roof drains, sump pumps, etc.) would continue to be conveyed for treatment at the Jamaica WWTP. Due to the extent of the project in multiple phases over a number of years, the cost for the storm sewer buildout is still to be determined.

5.7 COMPREHENSIVE JAMAICA BAY WATER QUALITY PLAN

The Jamaica Bay Combined Sewer Overflow Facility Planning Project (O'Brien & Gere, 1993) concluded that in “regard to dissolved oxygen, the bay-wide impact of CSO discharges upon dissolved oxygen deficit is not appreciable and one hundred percent removal of CSO discharges would not allow the open bay waters to meet the Class SB standard for dissolved oxygen one hundred percent of the time.” This project also determined that algae and phytoplankton are the main sources and sinks of the dissolved oxygen in the open bay.

In 1994, the DEP commenced the Jamaica Bay Eutrophication Study. The study found that most of the nitrogen entering the Bay that stimulates algal production, and in turn causes the eutrophication that depresses dissolved oxygen below water quality standards (95 percent), comes from the four WPCPs that discharge to the Bay.

In 2003, the NYCEP merged the ongoing water quality planning efforts of the Jamaica Eutrophication Project, the Use and Standards Attainment Project, the Citywide Advanced Wastewater Treatment Program, and the Long Outfall Project for purposes of developing a comprehensive report to evaluate and, as necessary, reduce the impacts of nitrogen discharges to the Bay and improve dissolved oxygen levels within the open waters of the Bay.

Extensive evaluations were undertaken of the open waters of Jamaica Bay to characterize water quality and biological resources. Wastewater and other inputs were monitored and extensive peer-reviewed water quality modeling was performed to establish the causal relationship between WPCP inputs and resulting water quality. A wide range of treatment alternatives were evaluated, from non-treatment alternatives, such as outfall relocation, to the current limits of technology in nitrogen removal at the WPCPs. Additionally, extensive sampling and monitoring of the pelagic and benthic ecosystems within the open waters of Jamaica Bay were and continue to be performed to characterize current conditions and improvements that might be expected as a result of reducing the total nitrogen load discharged to the open waters of the Bay.

In view of the complexities of Jamaica Bay's ecosystem and the historical human-caused alterations of the watershed, receiving waters, and bathymetry, the Comprehensive Report recommended a phased approach for adaptive management of needed environmental improvements. The approach would consist of cost-effective treatment reductions for nitrogen, and continued ecosystem evaluation and post-construction ecosystem monitoring in order to assess the effectiveness of controls.

Of the various treatment and non-treatment alternatives that were evaluated, the report recommended the most readily implementable option from a control and regulatory approval standpoint: nitrogen reduction by advanced wastewater treatment. Modeling and engineering analysis indicated that, of the four Jamaica Bay WPCPs, the most positive effect on water quality would be realized through nitrogen reductions at 26th Ward and Jamaica. It was recommended that the DEP complete implementation of Contract 12 nitrogen load reduction at the 26th Ward WPCP as currently planned, and obtain approval for design and construction of level 2 Biological Nitrogen Removal (BNR) at the Jamaica WPCP.

5.8 JAMAICA BAY WATERSHED PROTECTION PLAN

On June 30, 2005, the New York City Council passed Local Law 71 to require the development of a watershed protection plan for the watershed/sewershed of Jamaica Bay. On July 20, 2005, the Mayor signed the legislation into law. Incorporated in the law was a requirement that the plan be completed by September 2006. That date has since been extended to October 2007 to allow incorporation of the findings of other studies currently underway as described below.

This legislation requires that the DEP create a watershed protection plan for the watershed/sewershed of Jamaica Bay, and establish an advisory committee. There are a number of existing plans developed or being developed with respect to Jamaica Bay, each focused on a particular area or issue: CSOs, marsh loss, habitat restoration, eutrophication, nitrogen discharges, and others. It is the intent of the legislation that the watershed protection plan establishes "the initial pathway towards restoring and maintaining the water quality and ecological integrity of the Bay by comprehensively assessing threats to the Bay and coordinating environmental remediation and protection in a focused and cost-effective manner. " Therefore, the information, findings, conclusions and recommendations of prior listed plans will be examined and incorporated, as necessary, into the Jamaica Bay Watershed Protection Plan.

Additionally, this plan will include elements that address previously unaddressed issues, new issues, and emerging issues not specifically addressed or covered in any of the previous plans or actions. These elements include stream bank protection, stream buffers, other BMPs, enforcement, access and use restrictions, freshwater ponds, urban runoff management, expansion of community use and participation, and other topics appropriate to Jamaica Bay. The watershed protection plan emphasizes making the maximum use of existing information, while retaining a commitment to continued analysis and study in areas where information may not be complete at this time (e.g., bioaccumulation and restoration of submerged aquatic vegetation). In short, the watershed protection plan will:

- Address the requirements of Local Law No. 71 with respect to the preparation of a Watershed Protection Plan for Jamaica Bay;
- Compile a baseline of information that describes and characterizes the Jamaica Bay watershed;
- Inventory existing environmental quality issues in the Jamaica Bay watershed;
- Describe potential management strategies that may be feasible for implementation;
- Assemble information regarding watershed protection activities that have been performed, are being performed, are being planned, and/or have been recommended for the Jamaica Bay watershed, both by the various governmental jurisdiction with authority over portions of the watershed, and by non-governmental organizations (NGOs);
- Present recommendations for restoring and protecting desired uses of Jamaica Bay and its watershed, including measures to address threats to the aquatic environment; and
- Identify steps and key milestones for the implementation of the Watershed Protection Plan for Jamaica Bay and its watershed.

5.9 NYC GREEN INFRASTRUCTURE PLAN

On September 28, 2010, Mayor Bloomberg and DEP Commissioner Cas Holloway unveiled the NYC Green Infrastructure Plan which presents a “green strategy” for CSO drainage areas that includes cost-effective grey infrastructure strategies, reduced flows to the WWTP, and 10 percent capture of impervious surfaces with green infrastructure. The green infrastructure component of the plan builds upon and reinforces strong support for green approaches to address water quality concerns. A key goal of the NYC Green Infrastructure Plan is to manage the first inch of runoff from 10 percent of the impervious surfaces in combined sewer watersheds through detention and infiltration source controls over the next 20 years.

The *NYC Green Infrastructure Plan* builds upon and extends the commitments made previously in Mayor Bloomberg’s PlaNYC to create a livable and sustainable New York City and, specific to water quality, open up 90 percent of the City’s waterways for recreation. PlaNYC included initiatives to promote green infrastructure implementation, including the formation of an Interagency BMP Task Force, development of pilot projects for promising strategies, and providing incentives for green roofs toward these goals.

The Sustainable Stormwater Management Plan (SSMP) released in December 2008 was developed as a result of the Interagency BMP Task Force’s efforts to identify promising BMPs for New York City. The SSMP provided a framework for testing, assessing, and implementing pilot installations to control stormwater at its source as well as strategies to promote innovative and cost-effective source controls and secure funding for future implementation. A key conclusion of the SSMP was that green infrastructure is feasible in some areas and could be more cost-effective than certain large infrastructure projects such as CSO storage tunnels.

Based on the evaluations completed for the development of the *NYC Green Infrastructure Plan*, preventing one inch of precipitation from becoming runoff that surges into the sewers over 10 percent of each combined sewer watershed's impervious area will reduce CSOs by approximately 1.5 billion gallons per year. Green infrastructure technologies currently in use and being piloted throughout the City include green roofs, blue roofs, enhanced tree pits, bioinfiltration, vegetated swales, pocket wetlands, and porous and permeable pavements. The monitoring data collected from the pilots will improve our understanding of performance, costs and maintenance requirements under New York City's environmental conditions, and our modeling methods and assumptions will continue to be refined based on this information. Table 5-8 summarizes the opportunities available to achieve the 10 percent goal Citywide.

Table 5-8. Citywide Green Infrastructure Opportunities, Strategies, and Technologies

Land Use	% of Citywide Combined Sewer Watershed Areas	Potential Strategies and Technologies
New development and redevelopment	5.0%	- Stormwater performance standard for new and expanded development - Rooftop detention; green roofs; subsurface detention and infiltration
Streets and sidewalks	26.6%	- Integrate stormwater management into capital program in partnership with DOT, DDC, and DPR - Enlist Business Improvement Districts and other community partners - Create performance standard for sidewalk reconstruction - Swales; street trees; Greenstreets; permeable pavement
Multi-family residential complexes	3.4%	- Integrate stormwater management into capital program in partnership with NYCHA and HPD - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels or cisterns; rain gardens; swales; street trees; Greenstreets; permeable pavement
Parking lots	0.5%	- Sewer charge for stormwater - DCP zoning amendments - Continue demonstration projects in partnership with MTA and DOT - Swales; permeable pavement; engineered wetlands
Parks	11.6%	- Partner with DPR to integrate green infrastructure into capital program - Continue demonstration projects in partnership with DPR - Swales; permeable pavement; engineered wetlands
Schools	1.9%	- Integrate stormwater management into capital program in partnership with DOE - Rooftop detention; green roofs; subsurface detention and infiltration
Vacant lots	1.9%	- Grant programs - Potential sewer charge for stormwater - Rain gardens; green gardens
Other public properties	1.1%	- Integrate stormwater management into capital programs - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels; permeable pavement
Other existing development	48.0%	- Green roof tax credit - Sewer charges for stormwater - Continue demonstration projects and data collection - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels or cisterns; rain gardens; swales; street trees; Greenstreets; permeable pavement

To begin implementation, the City has already created a Green Infrastructure Task Force to design and build stormwater controls into planned roadway reconstructions and other publicly funded projects. In addition, the City recognizes that partnerships with numerous community and civic groups and other stakeholders will be necessary to build and maintain green infrastructure throughout the City. DEP will provide resources and technical support so that communities can propose, build, and maintain green infrastructure projects.

Over the next year, the City will take on a number of other concrete steps to begin early implementation of the *NYC Green Infrastructure Plan* such as demonstrating green infrastructure installations on a variety of land uses (see Table 5-9); launching a comprehensive program to increase optimization of the existing system; piloting sewer charges for stormwater for stand-alone parking lots; refining DEP models by including new impervious cover data and extending predictions to ambient water quality; identifying alternative funding for additional elements of the plan; and replacing all CSO outfall signs to reduce potential exposure.

Table 5-9. DEP Retrofit Demonstration Projects

Green Infrastructure Pilot	Location	Type	Status	Construction Completion
Rain Barrel give-away program	Jamaica Bay	1,000 rain barrels	Completed	2008-2009
5 tree pits/5 swales*	Jamaica Bay	Tree pits and streetside swales in the right-of-way	Completed	Fall 2010
MTA constructed wetland/parking lot*	Jamaica Bay	Biofiltration	In Construction	Spring 2011
Blue roof/green roof comparison*	Jamaica Bay	Blue/green roofs	Completed	August 2010
DEP rooftop detention	Newtown Creek	Various Blue roof technologies	Design	Fall 2010
High Density residential retrofit	Bronx River	Variety of on-site BMPs at a New York City Housing Authority development	In Construction	Spring 2011
DOT parking lots*	Jamaica Bay	Detention/bioinfiltration/porous pavement	Design	Spring 2011
North/South Conduit	Jamaica Bay	Detention/bioinfiltration in roadway median	In construction	Spring 2011
Shoelace Park	Bronx River	Detention/bioinfiltration	Redesign underway	Spring 2011

* This project was undertaken in connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State Law and DEC Regulations.

5.10 DEP ENVIRONMENTAL BENEFIT PROJECTS

In connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State law and DEC regulations, DEP submitted a Nitrogen Consent Judgment Environmental Benefit Project (EBP) Plan to DEC in January 2007 that proposed a stormwater pilot study in the Jamaica Bay drainage area. This project will use Nitrogen Consent Judgment EBP funds to conduct a three year pilot study program to implement and monitor several stormwater treatment technologies and volume reduction stormwater BMPs for potential application within the Jamaica Bay watershed. The goals of Jamaica Bay Watershed Stormwater Pilot Project include documenting the quality of New York City stormwater and refining the specific capture rates and treatment efficiencies that may be expected locally. Once this information has been gathered, effective stormwater strategies would be developed for potential future applications.

The project is expected to cost approximately $1.75 million and will include infiltration swales for street-side and parking lot applications, parking lot curb water capture systems, enhanced tree pits, and a commercial green roof and a blue roof comparison installation (see Table 5-9. The EBP is being conducted through an innovative collaborative effort between DEP and the Gaia Institute. DEP entered into a contract with the Gaia Institute to complete the pilot study. The Gaia Institute is a 501(c)3 not-for-profit corporation, located on City Island in the Bronx, that explores how human activities can be attenuated to increase ecological productivity, biodiversity, environmental quality, and economic well being.

In connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State law and DEC regulations, DEP also submitted a CSO EBP Work Plan in March 2008 (approved by the DEC in April 2008) that is expected to partially mitigate the impacts of stormwater and CSO discharges in the New York Harbor Estuary through stormwater BMP implementation. Practices such as bio-infiltration swales, enlarged street tree pits with underground water storage, constructed wetlands, and others would be evaluated. The CSO EBP Work Plan proposes pilots in the Bronx River, Flushing Bay and Creek, and Gowanus Canal watersheds using the $4 million which has been placed in an EBP Fund.

6.0 Public Participation and Agency Interaction

Establishing early communication with both the general public, regulatory agencies, and other stakeholders is important to the successful development of the long-term CSO control planning approach (USEPA, 1995a), and is one of the nine minimum elements of a long-term control plan enumerated in federal CSO policy. Permittees are expected to meet early and frequently with water quality standards authorities, permitting authorities, and USEPA regional offices throughout the process to facilitate such coordinated efforts as water quality standards review and scoping data, modeling, and monitoring requirements to support the long-term control plan. DEP has a well-established commitment to stakeholder involvement in the planning and development of capital projects though the formation and support of advisory committees, information sharing at public meetings, and providing opportunity for comment regarding any capital improvement. The following sections describe the public participation and agency interaction programs integral to the development of the Jamaica Bay and CSO Tributaries WB/WS Facility Plan.

6.1 HARBOR-WIDE STEERING COMMITTEE

The DEP convened a Harbor-Wide Government Steering Committee to ensure overall program coordination and integration of management planning and implementation activities by holding quarterly meetings, exploring regulatory issues, prioritizing planning and goals, developing strategies, reviewing and approving assessment-related work plans and coordinating actions. A Steering Committee was comprised of city, state, interstate, and federal stakeholders representing regulatory, planning, and public concerns in the New York Harbor watershed. The Citizens Advisory Committee on Water Quality (CAC), which reviews and comments on DEP water quality improvement programs, is represented on the Steering Committee and separately monitors and comments on the progress of CSO projects, among other DEP activities.

Federal government members of the Harbor-Wide Government Steering Committee included representatives of the USEPA, USACOE and the National Park Service. USEPA Region 2 was represented by its Deputy Director and its Water Quality Standards Coordinator. The USACE was represented by its Chief of the Technical Support Section, Planning Division, and New York District. The National Park Service member was a representative of its Division of Natural Resources at the Gateway National Recreational Area.

The State of New York was represented by the central and regional offices of the DEC. The Central Office of DEC in Albany was represented by its Associate Director of the Division of Water, the Director of the Bureau of Water Assessment and Management Branch of the Division of Water, and the Director of the Bureau of Water Compliance in the Division of Water. The Region II office of the DEC was represented by the Regional Engineer for the Region II Water Division.

Several departments of the City of New York were represented on the Harbor-Wide Government Steering Committee. The Deputy Commissioner of the Bureau of Engineering Design and Construction and its Director of Planning and Capital Budget represented the DEP. The Department of City Planning was represented by its Director of Waterfront/Open Space.

The New York City Department of Parks and Recreation was directed by the Chief of its Natural Resources Group.

Public interests were represented on the Steering Committee by the General Counsel of Environmental Defense at the New York headquarters and the Real Estate Board of New York. These two members also co-chaired the Citizens Advisory Committee on Water Quality. Interstate interests were represented by the Executive Director and Chief Engineer of IEC. The IEC is a joint agency of the states of New York, New Jersey, and Connecticut. The IEC was established in 1936 under a Compact between New York and New Jersey and approved by Congress. The State of Connecticut joined the IEC in 1941. The mandates of the IEC are governed by the Tri State Compact, Statutes, and the IEC's Water Quality Regulations. Its responsibilities and programs include activities in areas such as air pollution, resource recovery facilities and toxics; however, the IEC's continuing emphasis is on water quality, an area in which the IEC is a regulatory and enforcement agency. The IEC's area of jurisdiction runs west from Port Jefferson and New Haven on Long Island Sound, from Bear Mountain on the Hudson River down to Sandy Hook, New Jersey (including Upper and Lower New York Bays, Newark Bay, Arthur Kill and Kill Van Kull), the Atlantic Ocean east to Fire Island Inlet on the southern shore of Long Island, and the waters abutting all five boroughs of New York City.

The Steering Committee was responsible for reviewing the methodology and findings of DEP water quality-related projects, and to offer recommendations for improvement. The Steering Committee reviewed and approved the waterbody work plan developed by the USA Project (HydroQual, 2001a), and was fully briefed on the on-going assessments and analyses for each waterbody. Among the recommendations provided by the Steering Committee was the investigation of cost-effective engineering alternatives that improve water quality conditions to remove harbor waters from the State of New York 303(d) list, to pursue ecosystem water quality restoration actions with USACOE, and to coordinate use attainment evaluations with the DEC. Representatives of the DEC reported that its agency was awaiting the results of the DEP watershed/waterbody assessment before completing the 303(d) evaluation.

6.2 JAMAICA TRIBUTARIES CSO FACILITY PLANNING PROJECT PUBLIC PARTICIPATION PROGRAM

The New York City Department of Environmental Protection (DEP), Bureau of Wastewater Pollution Control conducted the Jamaica Tributary Combined Sewer Overflow (CSO) Facility Planning project to establish a cost effective and environmentally sound program for achieving compliance with water quality standards, eliminating problems that are attributable to CSO discharges and improving water quality within four tributaries to Jamaica Bay: Shellbank, Hawtree, Bergen and Thurston Basins. From November 1995 to May 1996 public participation activities were conducted in conjunction with the Jamaica Tributaries CSO Facility Planning Project

As part of the project, a public participation effort was undertaken to provide a solid foundation for informed citizen input to agency decision-making. The effort was directed toward the six Queens Community Boards (8, 9, 10, 11, 12 and 13) which lie entirely, or in part, within the project study area that consisted of the drainage area of the Jamaica Water Pollution Control Plant.

In January and February 1996, Community Board public hearings were held to introduce the project to the affected Community Boards. In March and April 1996, DEP returned to the Community Boards to present the alternative solutions that were being considered to achieve the goals of the project. In June 1996, a third round of public hearings was conducted by the DEP to present the draft facility plan.

6.2.1 Interactional Activities

An on-going program of community interaction was implemented as the principal means of fostering substantive public involvement. The public participation program consisted of an introductory meeting with the Queens Borough Engineer and community liaison personnel from the Queens County Borough Presidents office and representatives from the Community Boards of the affected area; and public hearings with the individual community boards at milestones in the project development.

An introductory meeting was held on Tuesday, November 14, 1995 at Queens Borough Hall to familiarize the Borough Engineer and the affected Community Boards about the Jamaica Tributary CSO Facility Planning Project. In addition to introducing the project, DEP sought recommendations from the participants on how to present the project to the individual community board members, organizations and concerned citizens within the project area. Also, at this meeting, the DEP presented the Jamaica Bay Comprehensive Watershed Management Plan. Invited to the meeting were the Chairpersons, Environmental Committee chairpersons and the district managers from Queens community Boards Nos. 8, 9, 10, 11, 12 and 13, as well as the Borough Engineer and the Queens Borough President’s community liaison representative. Representatives from Community Boards number 8, 10, 12 and 13, plus the Borough Engineer and the Borough Community Liaison representative attended.

The question and comment period that followed the presentation highlighted concerns about the differences between the waterbodies that have CSO discharges and those that do not, the various water quality impairments associated with CSOs, and the process for selecting the final alternative solutions.

Because the water quality issues and the remedial solutions had the potential to affect each of the Community Boards, participants at this meeting recommended that DEP present the project to each of the Community Boards at their regular monthly meeting.

Community Board public hearings were made in January and February 1996 as part of the regular monthly meeting of Community Board Nos. 8, 10, 12 and 13. The goal of the presentations was to inform the Board members, local residents and businesses, civic groups and representatives of local elected officials of the project and to receive comments. DEP also requested information on related problems that individuals might be experiencing.

Each of the hearings began with an overview of the project followed by technical presentations on the CSO project. In the discussion period that followed, participants were given the opportunity to ask questions and provide comments on the Jamaica Tributary CSO Facility Planning project. DEP also distributed forms to submit written comments and questions if they were unable to get their question addressed during the hearing.

A second series of community board public hearings were held in March and April 1996 to present the alternative solutions under consideration for achieving compliance with water quality standards and eliminating problems that are attributable to CSO discharges, and to receive comments and input from the community on the alternatives under consideration.

The technical portion of the presentations focused on the alternative CSO abatement technologies under consideration, with an overview of the projects scope and status, the dominant impacts to water quality from CSOs. Possible CSO control alternatives, and the process for screening (analyzing and evaluating) alternatives were also presented. The potential abatement alternatives included: Maximizing Flow to the Existing Treatment Plant, Expanding Wet Weather Capacity at the Existing Treatment Plant, CSO Storage, CSO Treatment, Aeration, Sewer Separation, Dredging and Basin Flushing were also discussed.

In the question and answer periods that followed, hearing participants focused on a number of issues and concerns, including the cost of the project and how it is being funded, methodology of selecting alternatives (both how it is done and community involvement in selection), project schedule, and siting of facilities.

DEP also presented the Jamaica Tributary CSO Facility Planning project to approximately 25 community residents at a meeting of the Springfield/Rosedale Community Action Association meeting on May 2, 1996 in Springfield Gardens. The scope of the project was reviewed and potential alternative solutions were presented.

In the question and answer period, participants presented concerns about storm sewer and basement flooding, and the degree that the Carson Street sewer project will have on alleviating flooding.

6.2.2 Informational Activities

An essential element of the public participation program was the development of written and graphic materials to present project information to the public in a clear and comprehensive manner. Materials were designed to facilitate public understanding of the need for and scope of the project, review the range of alternatives under consideration, and present potential community and environmental impacts. The principal means of disseminating project information to the community was through the distribution of executive summaries and responsiveness summaries, which detailed issues and concerns raised at the Community Board public hearings. Other materials developed as part of the project included hearing/meeting handouts and a project glossary. All informational materials were available at the public hearings and from the Office of Community Outreach at DEP.

A project data base and mailing list was developed by DEP and used for the distribution of information materials to interested and affected constituencies. Lists from each Community Board were obtained and used in mailing notices of hearings. In addition, the individual Community Boards mailed notices of the hearings. The project database list include names of businesses, representatives from civic organizations, public officials, Community Boards, government agencies and authorities, the media and other interested individuals and organizations.

6.3 JAMAICA BAY WATERSHED PROTECTION PLAN

The Jamaica Bay Watershed Protection Plan, created by Local Law 71, provided a framework for public participation activities. Local Law 71 provided mechanisms of public involvement through the establishment of an Advisory Committee and public education programs. During the public participation process three sets of meetings were held: introductory public meetings, public meetings to present recommendations, and public workshops.

6.3.1 Introductory Public Meetings

Introductory meetings were held on January 11, 2006 and February 9, 2006 to introduce members of the Advisory Committee to the public and discuss the goals of the Jamaica Bay Watershed Protection Plan. Each meeting included an open house that provided visual displays detailing project information. After a brief presentation on the background of the project, representatives from both the DEP and Advisory Committee were available to informally discuss the project and answer questions.

6.3.2 Public Meetings to Present Recommendations

A second series of public meetings was held to discuss project status and draft recommendations. These meetings were scheduled to provide opportunities to receive public comments for the continued development of the Jamaica Bay Watershed Protection Plan before submission of the Advisory Committee's final recommendations.

6.3.3 Public Workshop

On December 7, 2006, a public workshop was held. The objective of this workshop was to present to the public the potential management strategies presently under consideration and to solicit additional potential strategies from the public. The DEP invited individuals from public and private organizations active in the protection of Jamaica Bay, along with members of academic institutions who have performed research on the Bay.

Specific details on these meetings and the Jamaica Bay Watershed Protection Plan public participation program can be found in the Jamaica Bay Watershed Protection Plan, Volume 1 (DEP, 2007).

6.4 PUBLIC OPINION SURVEY

The DEP conducted a telephone survey in order to assess and measure the use of waterbodies in New York City, and obtain feedback from New York City residents about their attitudes towards the water resources in their community and elsewhere. Surveys addressed city-wide issues as well as those for local waterbodies. Survey results were analyzed discreetly and summarized to provide additional public insight into the public's waterbody uses and goals in addition to those identified via other public participation programs run by DEP.

Survey interviews were conducted using Computer Assisted Telephone Interviews (CATI) among residents of the five New York City boroughs that were 18 years of age or older.

Residents were asked about specific waterways depending on their zip code. A total of 7,424 interviews with New York City residents were conducted during these telephone surveys, and a total of 8,031 primary waterway responses were recorded. Questionnaire development involved a pre-test prior to the full field application of the survey to ensure that the survey covered all relevant issues and it was presented in a way that would be clear to respondents. The pre-test was conducted via a series of five focus groups representing residents of each of the five New York City boroughs. Final presentation of results involved editing, cleaning, and weighting collected data. The weights were applied to the data to correct for unequal probability of household selection due to households with more than one telephone number, and different numbers of individuals available to be interviewed at different households. Post-stratification weighting was also applied for each waterbody to balance the sample data to 2000 U.S. Census population data that takes into account household composition, age, gender, and race/ethnicity. The survey data then was projected to actual population counts from the 2000 U.S. Census so that areas could easily be combined to yield an appropriate weighted sample for all five boroughs of New York City.

The telephone survey included a minimum of 300 interviews for each of 26 watersheds within the scope of the USA Project. The survey was analyzed to quantify the extent of existing uses of the waterbody and riparian areas, and to record interest in future uses. Elements of the survey focused on awareness of the waterbody, uses of the waterbody and riparian areas, recreational activities involving these areas and how enjoyable these activities were, reasons why residents do not partake in recreational activities in or around the waterbody, overall perceptions of New York City waterbodies, and what improvements have been recognized or are desired.

6.4.1 Waterbody Awareness

Approximately 86 percent of Jamaica Bay area residents that participated in the survey were aware of the Bay, and 26 percent could identify Jamaica Bay as their primary waterbody without any prompting or aid in their response. Nineteen percent of all area residents (unaided) who participated in the survey recognized Jamaica Bay as the waterway closest to their home. Only two waterways, the Hudson River and East River, were cited on an unaided basis by larger proportions of New York City residents.

6.4.2 Water and Riparian Uses

Approximately 21 percent of Jamaica Bay area residents that participated in the survey visit waterbodies in their community or elsewhere in New York City on a regular basis and 39 percent occasionally visit waterbodies - the remaining percentage of Jamaica Bay residents rarely or never visit waterbodies in New York City. This percentage is similar to New York City residents in general, where 60 percent of whom visit city waterbodies either regularly or occasionally. Thirty five percent of area residents have visited Jamaica Bay at some point, and 24 percent have done so in the prior twelve months. Among those area residents who are aware of Jamaica Bay but have never visited the Bay, the majority (56 percent) responded that there was no particular reason, 16 percent cited waterbody conditions, and 12 percent cited riparian conditions. In addition, 18 percent of area residents have participated in land activities at Jamaica Bay.

6.4.3 Improvements Noted

Forty-eight percent of area residents responded that they have noticed improvements to New York City waterways, although only 8 percent noticed improvements in Jamaica Bay specifically. This response is generally consistent with other New York City residents interviewed during the telephone survey. Water quality, appearance, and color were the most frequently mentioned improvements by respondents. Other improvements cited were cleaner and better waterways and improved availability of park benches.

Given the option of choosing one waterway for improvement, only 3 percent of Jamaica Bay residents chose their primary waterway for improvement, which is substantially below the median of 15 percent of city-wide respondents. Of the area residents who were aware that Jamaica Bay was their primary waterbody, 34 percent cited water quality appearance or odor as the most important aspect to be improved. Another 11 percent cited improvements to cleanliness, sanitation, or maintenance as desirable, compared to a city-wide median of 12 percent.

In general, 39 percent of the New York City residents with similar attitudes towards improvements to their primary waterbody responded that they would be willing to pay for those improvements, and 22 percent responded that they would not be willing to pay for anything.

6.5 ADMINISTRATIVE CONSENT ORDER

The 2005 CSO Consent Order was published for public comments on September 8, 2004, as part of the overall responsiveness effort on behalf of DEC. The public comment period, originally limited to 30 days, was extended twice to November 15, 2004, to allow for additional commentary. Comments were received from public agencies, elected officials, private and non-profit organizations, and private individuals. In total, DEC received in excess of 600 official comments via letter, facsimile, or email during the comment period. All comments received were reviewed and evaluated, then categorized by thematic elements deemed similar in nature by DEC. Each set of similar comments received a specific, focused response. Many of the comments received, although differing in detail, contained thematic elements similar in nature regarding DEC and DEP efforts toward CSO abatement, water quality issues, standards, and regulatory requirements.

None of the comments received changed the terms of the Order, but the volume of commentary was interpreted by DEC to indicate: "NYC citizenry places CSO abatement as a high ongoing priority" (DEC, 2005). The terms of the Order offer numerous opportunities for public participation and input for future CSO abatement measures and regulatory decisions, such as the requirement to comply with federal CSO policy with regard to public participation during LTCP development.

6.6 SPDES PERMITTING AUTHORITY

Any facilities built as a part of this WB/WS Facility Plan would require modification to the 26th Ward, Jamaica, Coney Island, and Rockaway WWTP SPDES permits and, as such, would be subject to a formal public review process.

6.7 WB/WS FACILITY PLAN STAKEHOLDER MEETINGS

A Local Stakeholder Team was convened under the WB/WS Facility Plan comprised of representatives of the Community Boards, local community organizations, involved citizens, and waterbody users with the goal of informing the planning process of community knowledge, experience, and expectations for the waterbody. Four documented Jamaica Bay Stakeholder Team meetings were held as part of the WB/WS Facility Plan development: June 22, 2006; September 14, 2006; January 11, 2007; and June 7, 2007. Notes of each meeting were recorded, made available via a website or distributed upon request, and published to provide a public record of the proceedings. All meetings were convened at the Ryan Visitor's Center in Floyd Bennett Field. The four meetings are broadly summarized below within the context of long-term CSO control planning; full meeting summary notes are included in Appendix A.

The first Jamaica Bay Stakeholder team meeting was held on June 22, 2006. The purpose of the meeting was to introduce the team to long-term CSO control planning, and to discuss the implications for the waterbodies and the larger community. DEP presented their understanding of Jamaica Bay and the CSO tributaries, their water quality issues and uses, and explained fundamental concepts such as how the sewage collection system works, what a CSO is, ongoing DEP initiatives to improve water quality, and the regulatory process that partly motivates CSO control. Stakeholders expressed interest/concern in the following subjects: high nitrogen levels, increased residential development and the capacity of the sewers, degradation of wetlands and marshlands, lack of public access to the Bay for boating and swimming, plans (by others) to dispose of dredge materials in borrow pits, the decreasing yields and quality of the fish, odors, and clarity of the water

The second Jamaica Bay Stakeholder team meeting was held on September 14, 2006. The objectives of the meeting were to describe investigations or analyses performed as part of the project; to provide background on water quality planning, and to finalize lists of existing uses and goals for the waterbody. The presentation began with an overview of Jamaica Bay and CSO tributaries, which included a discussion of previous studies conducted of the waterbodies, a review of existing sewer collection system mapping and a clarification of the difference between WB/WS Facility Plan and a LTCP. Beau Ranheim, the Section Chief of the DEP Harbor Survey Program, spoke about the program's water sampling efforts and procedures, current and historical water quality values in the water bodies and the remote monitoring program. Mr. Ranheim indicated that the data generated from the Harbor Survey Program was used as the baseline data in the water quality modeling effort. The process of developing, calibrating and running the Jamaica Bay model was also discussed with the public. The meeting concluded with the DEP moderating a discussion about stakeholder uses and goals for Jamaica Bay and the CSO tributaries. The stakeholders indicated an interest in boating, fishing, swimming and shellfishing; however, they felt that a lack of access was causing a decrease in recreational water activity. The stakeholders opined that the New York City Economic Development Corporation was encouraging development along the Bay, which in turn caused the privatization of the shoreline and the destruction of wetlands.

The third Jamaica Bay Stakeholder team meeting was held on January 11, 2007. The presentation began with discussion of DEP's a proposed pilot study on Best Management Practices (BMPs) developed as part of the Jamaica Bay Watershed Protection Plan. The project will examine possibilities for street-side storm water infiltration; the construction of urban wetlands on vacant properties; improvements to street tree planting; soil enhancements; and green roofs. The presentation continued with a discussion of the sources of pollutants in the waterbodies, with the treated effluent from the Wastewater Treatment Plants (WWTP) being the largest source of these pollutants. The presented data indicates that CSOs have a minor effect on the Bay, although the ongoing modeling suggests that CSOs appear to have an effect on the tributaries. Potential CSO abatement alternatives for the Jamaica Bay and Tributaries WB/WS Plan were presented, with John Gebrian of O'Brien & Gere presenting alternatives in the 26th Ward WWTP drainage area and Kevin Ward of Hazen and Sawyer presenting alternatives in the Jamaica WWTP drainage area. The range of presented alternatives included cleaning sediment from sewers, high level sewer separation, in-line storage, storage tunnels and treatment plant capacity upgrades. Knee-of-the-curve graphs, which plot the cost of the different CSO abatement scenarios against percent reduction in CSOs were presented. The stakeholders offered a wide range of input, including: several comments on the BMP pilot study; questioned how the Port Authority managed their stormwater system at JFK Airport; complained about significant odor problems in Pumpkin Patch Channel; suggested that a tunnel be constructed to convey flow directly from the WWTPs into the Atlantic Ocean (bypassing Jamaica Bay); and asked for more information on the possibility of increasing the capacity of catch basins.

The fourth and final Jamaica Bay Stakeholder team meeting was held on June 7, 2007. The presentation began with a review of Jamaica Bay and CSO tributary water quality compliance issues. The presentation continued with the engineering consultants leading a discussion on the CSO abatement alternatives that were evaluated for the 26th Ward WWTP and Jamaica WWTP drainage areas and how cost-benefit, also known as knee-of-the-curve, analysis was used to select the WB/WS Facility Plan from this group of alternatives. The alternatives that achieve the maximum benefit per dollar were selected as the recommended WB/WS Facility Plan. The components of the selected WB/WS plan for the 26th Ward include: removal of sediment in sections of major sewers; expansion of the WWTP treatment capacity by 50 MG; continued/improved floatables capture; evaluation of BMPs and LIDs; and, dredging and aeration of Fresh Creek to improve DO levels. The recommended WB/WS plan for the Jamaica WWTP drainage area includes: several sewer system improvements in Bergen Basin; the implementation of the Southeast Queens Drainage Plan; an evaluation of BMPs and LIDs; and, dredging and aeration in Bergen and Thurston Basin to improve DO levels.

After the presentation from the engineering consultants, the DEP explained the next steps going forward. Once meeting notes are completed, stakeholders will be informed and they will have 30 days to comment. The DEP indicated that it was on track to submit the Jamaica Bay and CSO Tributaries WB/WS Facility Plan to the DEC by the Consent Order mandated date of June 30, 2007. After opening the floor, the stakeholders raised the following issues: were future climate change issues (i.e. the rise of the sea level) considered in the evaluation; was it possible to outfit an existing basin with a flood gate and use it for storage; were new developments being constructed with separate sewers; was piping the CSO directly into the Atlantic Ocean (similar to Boston) considered as an alternative; and, several questions were asked about BMPs/LIDs.

7.0 Evaluation of Alternatives

As described in Section 1, Jamaica Bay and its CSO tributaries currently appear on the DEC "Section 303(d) List of Impaired Waters" for all of a combination of the following: low DO, Nitrogen levels, and pathogens associated with CSO and other urban inputs. The CSO Consent Order requires DEP to complete an approvable WB/WS Facility Plan for Jamaica Bay and CSO tributaries by June 2007, which was submitted. The present document incorporates comments received from DEC on the June 2007 document. Although a WB/WS Facility Plan does not necessarily require consistency with federal CSO Policy for CSO Long Term Control Plans, it is DEP's intention that this WB/WS Facility Plan satisfies the requirements of a CSO LTCP.

As previously discussed in Section 5, the DEP has been engaged for many years in water-quality improvement projects and CSO facility planning for Jamaica Bay and its CSO tributaries. As noted in Section 5 of this report, a number of CSO controls have been proposed, constructed and/or partially constructed prior to the requirement of New York City to conduct Long Term CSO Control Planning. This section of the report assesses additional CSO controls that could be implemented to further improve water quality in Jamaica Bay and its CSO tributaries.

This section presents the evaluation of alternatives for CSO control, analyses that were performed in accordance with federal CSO LTCP guidance. Section 7.1 summarizes the regulatory framework for the evaluation of alternatives. Section 7.2 identifies and provides an initial screening of a full spectrum of successfully applied CSO control technologies. The CSO control technologies that pass through the initial screening are then examined in detail in Section 7.3 to create various alternatives that can be evaluated for effectiveness in mitigating CSOs in Jamaica Bay and CSO tributaries. Section 7.4 presents a performance versus cost analysis of the feasible alternatives retained in 7.3, as well as a 100% reduction alternative, based on projected CSO volumes and frequencies and attainment of existing water quality standards. Section 7.5 describes the basis of selection and the costs and benefits of the WB/WS Facility Plan.

7.1 REGULATORY FRAMEWORK FOR EVALUATION OF ALTERNATIVES

The evaluation of alternatives to address CSO discharges and associated water quality impacts involve regulatory considerations in addition to those presented in Section 1. The following subsections present a summary of these considerations.

7.1.1 Water Quality Objectives

As previously described in Section 1.2.1, Jamaica Bay and its CSO tributaries appear on the 2010 DEC "Section 303(d) List of Impaired Waters" for the following impairments, all caused by "Urban/CSO, Municipal" sources:

- Pathogens
- D.O./Oxygen Demand
- Nitrogen

Jamaica Bay is designated as a SB waterbody, while each of the CSO tributaries is designated as a Class I waterbody. The New York State numerical and DEC narrative surface water quality standards for Class SB and I waters are listed below in Table 7-1.

Table 7-1. New York State Numerical and Narrative Surface Water Quality Standards

Parameter	Class SB	Class I (Saline)
Waterbody	Jamaica Bay	CSO Tributaries
Usage	Primary and secondary contact recreation and fishing. Suitable for fish propagation and survival.	Secondary contact recreation, fishing. Suitable for fish propagation and survival.
Dissolved Oxygen (mg/L)	≥ 5.0 (1) Never < 3.0	≥ 4.0
Total Coliform (#/100 mL)	≤ 2,400 (2) ≤ 5,000 (3)	≤ 10,000 (3)
Fecal Coliform (#/100 mL)	200 (4)	≤ 2,000 (4)
Taste, color, and odor producing toxic and other deleterious substances	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.	
Turbidity	No increase that will cause a substantial visible contrast to natural conditions.	
Oil and floating substances	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best use.	
Garbage, cinders, ashes, oils, sludge and other refuse	None in any amounts.	
Phosphorus and nitrogen	None in any amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.	

(1) Daily average
(2) Monthly median value of five or more samples
(3) Monthly 80th percentile of five or more samples
(4) Monthly geometric mean of five or more samples

7.1.2 Range of Alternatives

The federal CSO Policy calls for LTCPs to consider a number of factors when evaluating CSO control alternatives, as described in Sections II.C.4 and II.C.5 of the Policy (40 CFR 122 [FRL-4732-7]). EPA expects the analysis of alternatives to be sufficient to make a reasonable assessment of the expected performance and the cost of the alternatives. With regard to performance, EPA expects the LTCP to "consider a reasonable range of alternatives" in the selection process. The LTCP should consider four or more alternatives, providing a range of control above the existing condition and extending to full elimination of CSOs, as measured in terms of CSO frequency or CSO capture.

7.1.3 "Presumption" and "Demonstration" Approaches

Whether a particular alternative provides sufficient control can be determined in two different manners. In the "Presumption Approach," alternatives that meet any of a number of discharge-based criteria may be "presumed" to provide sufficient CSO control as to meet the water-quality based requirements of the CWA. These discharge-based criteria, which are applicable for an entire combined-sewer system (e.g. a WWTP drainage area) and not necessarily the drainage area of a particular waterbody include:

i. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a Combined Sewer System (CSS) as the result of a precipitation event that does not receive a minimum treatment specified below;

ii. The elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis; or

iii. The elimination or removal of no less than the mass of the pollutant […] for the volumes that would be eliminated or captured for treatment under item ii above.

Combined sewer flows remaining after implementation of the Nine Minimum Controls and within the criteria specified at II.C.4.a.i or ii should receive a minimum of:

- Primary clarification (Removal of floatables and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification);
- Solids and floatables disposal; and
- Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residuals, where necessary.

In the "Demonstration Approach", alternatives providing sufficient CSO control are those that, through modeling and/or other analyses, are expected to provide sufficient CSO control as to meet the water-quality based requirements of the CWA. The criteria associated with the Demonstration Approach are:

i. The planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSOs;

ii. The CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribute to their impairment. Where WQS and designated uses are not met in part because of natural background conditions or pollution sources other than CSOs, a total maximum daily load, including a waste load allocation and a load allocation, or other means should be used to apportion pollutant loads;

iii. The planned control program will provide the maximum pollution reduction benefits reasonably attainable; and

iv. The planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS or designated uses.

7.1.4 Cost/Performance Consideration

EPA expects the permittee to use the costs associated with each of these alternatives to demonstrate the relationships among a comprehensive set of reasonable control alternatives that correspond to the different ranges specified in Section II.C.4 of the federal CSO policy. This should include an analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs. This analysis, often known as "knee of the curve," should be among the considerations used to help guide selection of controls.

7.1.5 Consideration of Non-CSO Inputs

Load sources other than CSOs were included in the receiving water modeling to assess water quality conditions. These other inputs consist primarily stormwater and tidal exchange with the Lower New York Bay via Rockaway Inlet. Other sources of pollutants of concern were found to be insignificant.

7.1.6 Consideration of Other Parameters

Other parameters such as existing use and stakeholder goals for waterbody use were taken into account when determining the necessary level of CSO control. Other parameters considered as part of the evaluations of alternatives for Jamaica Bay include the following:

- Water Quality: As previously discussed in Section 4.8 of this report (Water Quality Conditions), Jamaica Bay is a eutrophic system as it relates to dissolved oxygen concentration, algal levels and water clarity. Generally, euthrophic conditions are the result of over-enrichment of nutrients, inadequate flushing, warm temperatures and adequate sunlight. The major sources of nitrogen, phosphorous, and carbon to Jamaica Bay have been determined to be the New York City WWTPs which discharge into Jamaica Bay (O'Brien & Gere, 2006).
- Aquatic Life Uses: Aquatic life in Jamaica Bay is described in detail in Section 4.
- Sensitive Areas: As discussed in Section 4, the DEC, as the permitting authority, has not designated Jamaica Bay nor its CSO tributaries as a sensitive area. There are no areas within the Bay or its CSO tributaries that satisfy the CSO Control Policy criteria for sensitive areas. Therefore, prioritization of goals, selection of control alternatives, and scheduled implementation of these alternatives can be given to those alternatives that most reasonably attain the maximum benefit to water quality throughout the Bay and/or tributaries.
- Bathing Beaches: As discussed in Section 4, there are no public or private bathing beaches in what is defined as Jamaica Bay. However, beaches are present along Rockaway Inlet, the entrance to Jamaica Bay.

- Stakeholder Goals: As discussed in Section 6, stakeholder goals for the waterbody include enhancing secondary-contact recreational uses, and a reduction in pathogen levels and access to Jamaica Bay to support these recreational uses. There was consensus on the goal of making the water as clean as possible to support aquatic life. Finally, since planned projects for riparian zones will increase access to the Bay, improved aesthetic conditions are desired, including the removal of odors, oil slicks, and floatables.

7.2 SCREENING OF CSO TECHNOLOGIES

A wide range of CSO control technologies were considered for application to 26th Ward WWTP and Jamaica WWTP combined sewer systems (CSS), which discharge into CSO tributaries and into Jamaica Bay. These technologies are grouped into the following general categories:

- Watershed-Wide Non-Structural Controls
- Inflow Control
- Green Infrastructure
- Sewer System Optimization
- Sewer Separation
- Storage
- Treatment
- Receiving Water Improvement
- Solids and Floatables Control

Each technology is described below, and a preliminary assessment is provided in Table 7-2.

Table 7-2. Preliminary Screening of Technologies

CSO Control Technology	Performance				Implementation and Operational Factors
	CSO Volume Reduction	Bacteria Removal	Floatables Control	Suspended Solids Reduction	
Watershed – Wide Non-Structural Controls (Section 7.2.1)					
Public Education	None	Low	Medium	Low	Cannot reduce the volume, frequency or duration of CSO overflows.
Street Sweeping	None	Low	Medium	Medium	Effective at floatables removal, cost-intensive O&M; Ineffective at reducing CSO volume, bacteria and very fine particulate pollution.
Construction Site Erosion Control	None	Low	Low	Medium	Reduces sewer sediment loading; Enforcement required; Contractor

CSO Control Technology	Performance				Implementation and Operational Factors
	CSO Volume Reduction	Bacteria Removal	Floatables Control	Suspended Solids Reduction	
					pays for controls.
Catch Basin Cleaning	None	Low	Medium	Low	Labor intensive; Requires specialized equipment.
Industrial Pretreatment	Low	Low	Low	Low	
Inflow Control (Section 7.2.2)					
Storm Water Detention	Medium	Medium	Medium	Medium	Requires large area in congested urban environment; Potential siting difficulties and public opposition; Construction would be disruptive to affected areas; Increased O&M.
Street Storage of Storm Water	Medium	Medium	Medium	Medium	Potential flooding and freezing problems; Public opposition; Low operational cost.
Water Conservation	Low	Low	Low	Low	Potentially reduces dry weather flow making room for CSO; Ancillary benefit is reduced water consumption.
Inflow/Infiltration Control	Low	Low	Low	Low	Infiltration usually lower volume than inflow; Infiltration can be difficult to control.
Green Infrastructure (see Sections 5 and 8)					
Sewer System Optimization (Section 7.2.4)					
Optimize Existing System	Medium	Medium	Medium	Medium	Low cost relative to large scale structural BMPs limited by existing system volume and dry weather flow dam elevations.
Real Time Control	Medium	Medium	Medium	Medium	Highly automated system; Increased O&M; Increased potential for sewer backups.
Sewer Separation (Section 7.2.5)					
Complete Separation	High	Medium	Low	Low	Disruptive to affected areas; Cost intensive; Potential for increased stormwater pollutant loads; Requires homeowner participation.
Partial Separation	High	Medium	Low	Low	Disruptive to affected areas; Cost intensive; Potential for increased stormwater pollutant loads.
Rain Leader Disconnection	Medium	Medium	Low	Low	Low cost; Requires home and business owner participation; Potential for increased stormwater pollutant loads.
Storage (Section 7.2.6)					
Closed Concrete Tanks	High	High	High	High	Requires large space; Disruptive to affected area; Cost intensive; Aesthetically acceptable.
Storage Pipelines/Conduits	High	High	High	High	Disruptive to affected areas; Potentially expensive in congested urban areas; Aesthetically acceptable; Provides storage and conveyance.
Tunnels	High	High	High	High	Non-disruptive; Requires little area at ground level; Capital intensive; Provides storage and conveyance; Pump station required to lift stored flow out of tunnel.

CSO Control Technology	Performance				Implementation and Operational Factors
	CSO Volume Reduction	Bacteria Removal	Floatables Control	Suspended Solids Reduction	
Treatment (Section 7.2.7)					
Screening/Netting Systems	None	None	High	None	Controls only floatables.
Primary Sedimentation[1]	Low	Medium	High	Medium	Limited space at WWTP; Difficult to site in urban areas
Vortex Separator (includes Swirl Concentrators)	None	Low	High	Low	Variable pollutant removal performance. Depending on available head, may require foul sewer flows to be pumped to the WWTP and other flow controls; Increased O&M costs.
High Rate Physical/Chemical Treatment[1]	None	Medium	High	High	Limited space at WWTP; Requires construction of extensive new conveyance conduits; High O&M costs.
Disinfection	None	High	None	None	Cost intensive/Increased O&M.
Expansion of WWTP	High	High	High	High	Limited by space at WWTP; Increased O&M.
Receiving Water Improvement (Section 7.2.8)					
Outfall Relocation	High	High	High	High	Relocates discharge to different area; Requires the construction of extensive new conveyance conduits.
In-Stream Aeration	None	None	None	None	High O&M; Only effective for increasing DO; Limited effective area; May require dredging.
Maintenance Dredging	None	None	None	None	Removes deposited solids after build-up occurs.
Solids and Floatables Controls (Section 7.2.9)					
Netting Systems	None	None	High	None	Easy to implement; Potential negative aesthetic impact.
Containment Booms	None	None	High	None	Simple to install; Difficult to clean; Negative aesthetic impact.
Skimming Vessels	None	None	High	None	Easy to implement but limited to navigable waters.
Manual Bar Screens	None	None	High	None	Prone to clogging; Requires manual maintenance.
Weir-Mounted Screens	None	None	High	None	Relatively low maintenance; Requires suitable physical configuration; Must bring power to site.
Fixed Baffles	None	None	High	None	Low maintenance; Easy to install; Requires proper hydraulic configuration.
Hinged Baffles	None	None	High	None	Moving parts make them susceptible to failure.
Floating Baffles	None	None	High	None	Moving parts make them susceptible to failure.
Catch Basin Modifications / Hooding	None	None	High	None	Requires suitable catch basin configuration and increases maintenance efforts.

[1] Process includes pretreatment screening and disinfection.

7.2.1 Watershed-Wide Controls or Non-Structural Controls

To control pollutants at their source, management practices can be applied where pollutants accumulate. Source management practices are described below.

Public Education

Public education programs can be aimed at reducing (1) littering by the public and the potential for litter to be discharged to receiving waters during CSO events and (2) illegal dumping of contaminants in the sewer system that could be discharged to receiving waters during rain events. Public education programs cannot reduce the volume, frequency or duration of CSO overflows, but can help improve CSO quality by reducing floatable debris. Public education and information is an integral part of any LTCP. Public education is also an ongoing DEP program (DEP, 2005b).

Street Sweeping

The major objectives of municipal street cleaning are to enhance the aesthetic appearance of streets by periodically removing the surface accumulation of litter, debris, dust, and dirt, and to prevent these pollutants from entering storm or combined sewer systems. Common methods of street cleaning are manual, mechanical and vacuum sweepers, and street flushing. Studies on the effect of street sweeping on the reduction of floatables and pollutants in runoff have been conducted. New York City found that street cleaning can be effective in removing floatables. Increasing street cleaning frequency from two times per week to six times per week reduced floatables by approximately 42 percent on an item count basis at a very high cost. A significant quantity of floatables was found to be located on sidewalks that were not cleanable by conventional equipment (HydroQual, 1995). However, in spite of these limitations, the Department of Sanitation of New York City (DSNY) does have a regular street sweeping program targeting litter reduction. DSNY also has an aggressive enforcement program targeting property owners to minimize the amount of litter on their sidewalks. These programs are described in New York City's Citywide Comprehensive CSO Floatables Plan (DEP, 2005a).

Studies, funded by the National Urban Renewal Program (NURP) during the late 1970s to the early 1980s, reported that street sweeping was generally ineffective at removing pollutants and improving the quality of urban runoff (MWCOG, 1983; EPA, 1983). The principal reason for this is that mechanical sweepers, employed at that time could not pick up the finer particles (diameter < 60 microns). Studies have shown that these fine particles contain a majority of the target pollutants on city streets that are washed into sewer systems (Sutherland, 1995). In the early 1990s, new vacuum-assisted sweeper technology was introduced that can pick up the finer particles along city streets. A recent study showed that these vacuum-assisted sweepers have a 70 percent pickup efficiency for particles less than 60 microns (Sutherland, 1995).

Street sweeping only affects the pollutant concentration in the runoff component of combined sewer flows. Thus, a street sweeping program is ineffective at reducing the volume and frequency of CSO events. Furthermore, the total area accessible to sweepers is limited. Areas such as sidewalks, traffic islands, and congested street parking areas cannot be cleaned using this method.

Although a street sweeping program employing high efficiency sweepers could reduce the concentrations of some pollutants in CSOs, bacteriological pollution originates primarily from the sanitary component of sewer flows. Thus, minimal reductions in fecal coliform and E. coli concentrations of CSOs would be expected.

Construction Site Erosion Control

Construction site erosion control involves management practices aimed at controlling the washing of sediment and silt from disturbed land associated with construction activity. Erosion control has the potential to reduce solids concentrations in CSOs and reduce sewer cleanout operation and maintenance (O&M) costs. For applicable projects, New York City's CEQR requirements addresses potential impacts associated with sediment runoff as well as required measures to be employed to mitigate any potential impacts.

Catch Basin Cleaning

The major objective of catch basin cleaning is to reduce conveyance of solids and floatables to the combined sewer system by regularly removing accumulated catch basin deposits. Methods to clean catch basins include manual, bucket, and vacuum removal. Cleaning catch basins can only remove an average of 1-to 2 percent of the five day biochemical oxygen demand (BOD5) produced by a combined sewer watershed (EPA, 1977). As a result catch basins cannot be considered an effective pollution control alternative for BOD5 removal.

New York City has an aggressive catch basin hooding program to contain floatables within catch basins and remove the material through catch basin cleaning (Citywide Comprehensive CSO Floatables Plan, Modified Facility Planning Report, City of New York, Department of Environmental Protection, July 2005). While catch basins can be effective in reducing floatables in combined sewers, catch basin cleaning does not necessarily increase floatables retention in the catch basin. Results of a pilot scale study showed that floatables capture improves as material accumulates in the catch basin (HydroQual, 2001f). During a rain event, the accumulated floatables can dissipate the hydraulic load entering a catch basin, thereby reducing turbulence in the standing water and reducing the escape of floatables. Thus, while hooding of catch basins will improve floatables capture, the hooding program is not expected to result in a major increase in catch basin cleaning.

Industrial Pretreatment

Industrial pretreatment programs are geared toward reducing potential contaminants in CSO by controlling industrial discharges to the sewer system. DEP has an industrial pretreatment program in place as discussed in Section 3 of this report.

7.2.2 Inflow Control

Inflow control involves eliminating or retarding stormwater inflow to the combined sewer system, lowering the magnitude of the peak flow through the system, and thereby reducing overflows. Methods for inflow control are described below:

Stormwater Detention

Stormwater detention utilizes a surface storage basin or facility to capture stormwater before it enters the combined sewer system. Typically, a flow restriction device is added to the catch basin to effectively block stormwater from entering the basin. The stormwater is then diverted along natural or man-made drainage routes to a surface storage basin or "pond-like" facility where evaporation and/or natural soil percolation eventually empties the basin. Such systems are applicable for smaller land areas, typically up to 75 acres, and are more suitable for non-urban areas. Such a system is not considered viable for a highly congested urban area such as New York City. Stormwater blocked from entering catch basins would be routed along streets to the detention pond which would be built in the urban environment. Extensive public education and testing is required to build support for this control and to address public concerns such as potential unsafe travel conditions, flood damage, or damage to roadways.

Street Storage of Stormwater

Street storage of stormwater utilizes the City's streets to temporarily store stormwater on the road surface. Typically, the catch basin is modified to include a flow restriction device. This device limits the rate at which surface runoff enters the combined sewer system. The excess stormwater is retained on the roadway, entering the catch basin at a controlled rate. Street storage can effectively reduce inflow during peak periods and can decrease CSO volume. It also can promote street flooding and must be carefully evaluated and planned to ensure that unsafe travel conditions and damage to roadways does not occur. For these reasons, street storage of stormwater is not considered a viable CSO control technology in New York City.

Water Conservation

Water conservation is geared toward reducing the dry weather flow in the combined sewer system, thereby increasing the system's ability to accommodate more stormwater and reduce CSO discharges. Water conservation includes measures such as installing low flow fixtures, public education to reduce wasted water, leak detection and correction, and other similar programs. The City of New York has an on-going water conservation and public education program. The DEP's ongoing efforts to save water that reduce inflows to the combined sewers include installing individual water meters on water service lines to encourage conservation and equipping fire hydrants with special locking devices. Water conservation programs have resulted in the reduction of water consumption Citywide by approximately 230 MGD over a 10-year period or a reduction of 43 gallons per person per day from 1996 to 2006 (DEP, 2007). This change equates to a 17.5 percent reduction in overall daily water consumption, even as the population increased by approximately nine percent. The water consumption on a daily per capita basis decreased by 24.5 percent. Water conservation, as a CSO control technology, is effectively implemented to a satisfactory level, and New York City has achieved significant reductions in wastewater flow through its existing water conservation program.

As described above, reduced flow strategies are expected to require little incremental expenditure as water consumption and wastewater flows have been on the decline in recent years. Furthermore, the combination of automated meter reading, the ability of customers to track water usage, and national water efficient fixture standards is expected to keep flows stable. Additional conservation measures, such as toilet and other fixture rebate programs, are expected to have only nominal costs associated with them, and would be necessary only if the declining trend reverses.

Infiltration/Inflow (I/I) Reduction

Infiltration and inflow is ground water and other undesired water that enters the collection system through leaking pipe joints, cracked pipes, and manholes. Excessive amounts of infiltration and inflow take up the hydraulic capacity of the collection system. In contrast, the inflow of surface drainage is intended to enter the CSS the combined sewer system. Sources of inflow that might be controlled include leaking or missing tide gates and inflow in the separate sanitary system located upstream of the combined sewer system.

DEP conducted an Infiltration/Inflow (I/I) analysis in the early 1990s (URS, 1992) that identified excessive I/I within the Jamaica WWTP service area by comparing measured nighttime flow rates to estimates of water usage developed from a derived per capita water usage rate and data from available records. Groundwater was found to be at or above normal levels during the investigation and was identified as a major source of infiltration. The system-wide estimate of extraneous flow (16.9 MGD at Jamaica WWTP) was considered to be much less than the benchmark established by NYSDEC at the time, but targeted evaluation of portions of the collection system identified areas where a Sewer System Evaluation Survey (SSES) and subsequent removal of I/I sources could result in beneficial reductions. Infiltration and inflow control will be reevaluated during the development of the Drainage Basin Specific LTCP.

7.2.3 Green Solutions

See Sections 5.9 and 8.8.

7.2.4 DEP Sewer System Optimization

This CSO control technology involves making the best use of existing facilities to limit overflows. The techniques are described below:

Optimize Existing System

This approach involves evaluating the current standard operating procedures for facilities such as pump stations, control gates, inflatable dams, and treatment facilities to determine if improved operating procedures can be developed to provide benefit in terms of CSO control.

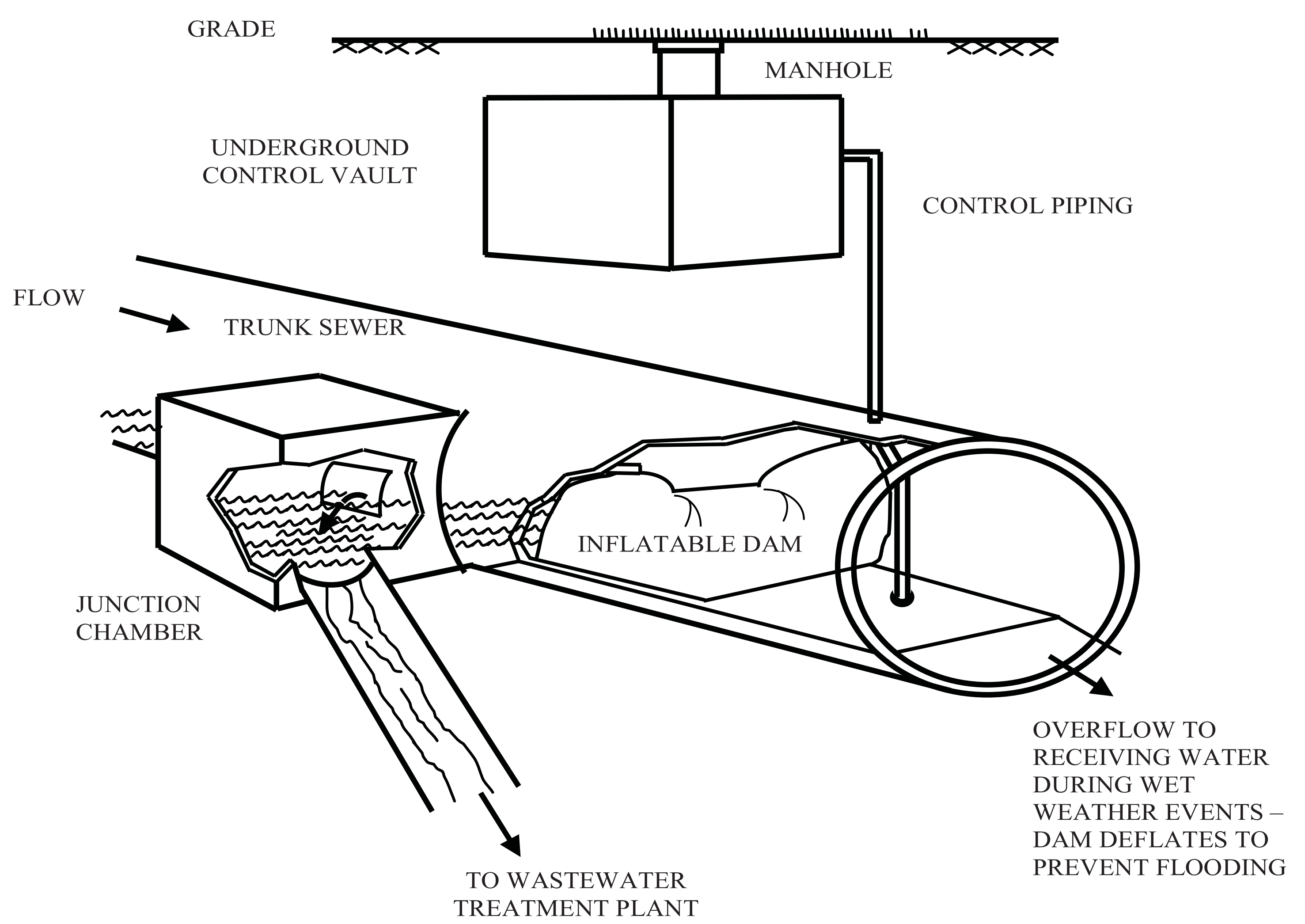
Real Time Control (RTC)

RTC is any response – manual or automatic – made in response to changes in the sewer system condition. For example, the depth of flow of sewage within the sewer system and flow data can be monitored in "real time" at key points in the sewer system and transferred to a control device such as a central computer where decisions can be made to operate control components such as gates, pump stations or inflatable dams to maximize use of the existing sewer system and limit overflows. Data monitoring need not be centralized; local dynamic controls can be used to control regulators to prevent localized flooding. However, system wide dynamic controls are typically used to implement control objectives such as maximizing flow to the WWTP or transferring flows from one portion of the CSS to another to fully utilize the system. Predictive control, which incorporates use of weather forecast data is also possible, but is complex and requires sophisticated operational capabilities. RTC can reduce CSO volumes when in-system storage capacity is available. In-system storage is a method of using excess sewer capacity by containing combined sewage within a sewer and releasing it to the WWTP after the storm event when capacity for treatment becomes available. Technologies available for equipping sewers for in-system storage include inflatable dams, mechanical gates and increased overflow weir elevations. RTC has been used in other cities such as Louisville, Kentucky; Cleveland, Ohio; and Quebec, Canada. Refer to Figure 7-1 for a diagram of an example inflatable dam system.

New York City has conducted an extensive pilot study on the use of inflatable dams (O'Brien & Gere, 2004) within the City's combined sewers. This pilot study involved the use of inflatable dams and RTC at two locations (Metcalf Avenue and Lafayette Avenue) in the Bronx. Testing completed in early 2007 and the equipment remained idle until August 2009, when decommissioning was completed. From this study, the City found that the technology was feasible for further consideration. However, widespread application of inflatable dams and RTC is limited in NYC as it does not provide for storage of large enough volumes of combined sewage to adequately improve water quality, especially in areas where tributary water quality is degraded.

Based on the experience gained from both the pilot and permanent installations, DEP has identified significant issues related to the viability of inflatable dams. Acquiring bidders was difficult because there has been only two manufacturers of inflatable dam systems historically: one no longer manufactures the dams and the other has curtailed service in the United States market. Aside from competitive bidding requirements, the limited market results in questionable reliability in the supply of replacement parts. While these challenges may be manageable for a limited number of facilities, wide spread application of dams may lead to ineffective operation, creating considerable operation and maintenance issues, and could lead to flood-inducing malfunctions.

Both optimization of the existing system and real time control will be retained for further consideration when evaluating potential alternatives for CSO control in Jamaica Bay and CSO Tributaries.



NYC Environmental Protection

Inflatable Dam System

FIGURE 7-1

7.2.5 Sewer Separation

Sewer separation is the conversion of a combined sewer system into a system of separate sanitary and storm sewers. This alternative prevents sanitary wastewater from being discharged to receiving waters. However, when combined sewers are separated, storm sewer discharges to the receiving waters will increase since stormwater will no longer be captured and treated at the downstream WWTP. In addition, this alternative involves substantial excavation that could exacerbate traffic problems within the City.

Varying degrees of sewer separation could be achieved as described below and illustrated in Figure 7-2.

Rain Leader (Gutters and Downspouts) Disconnection

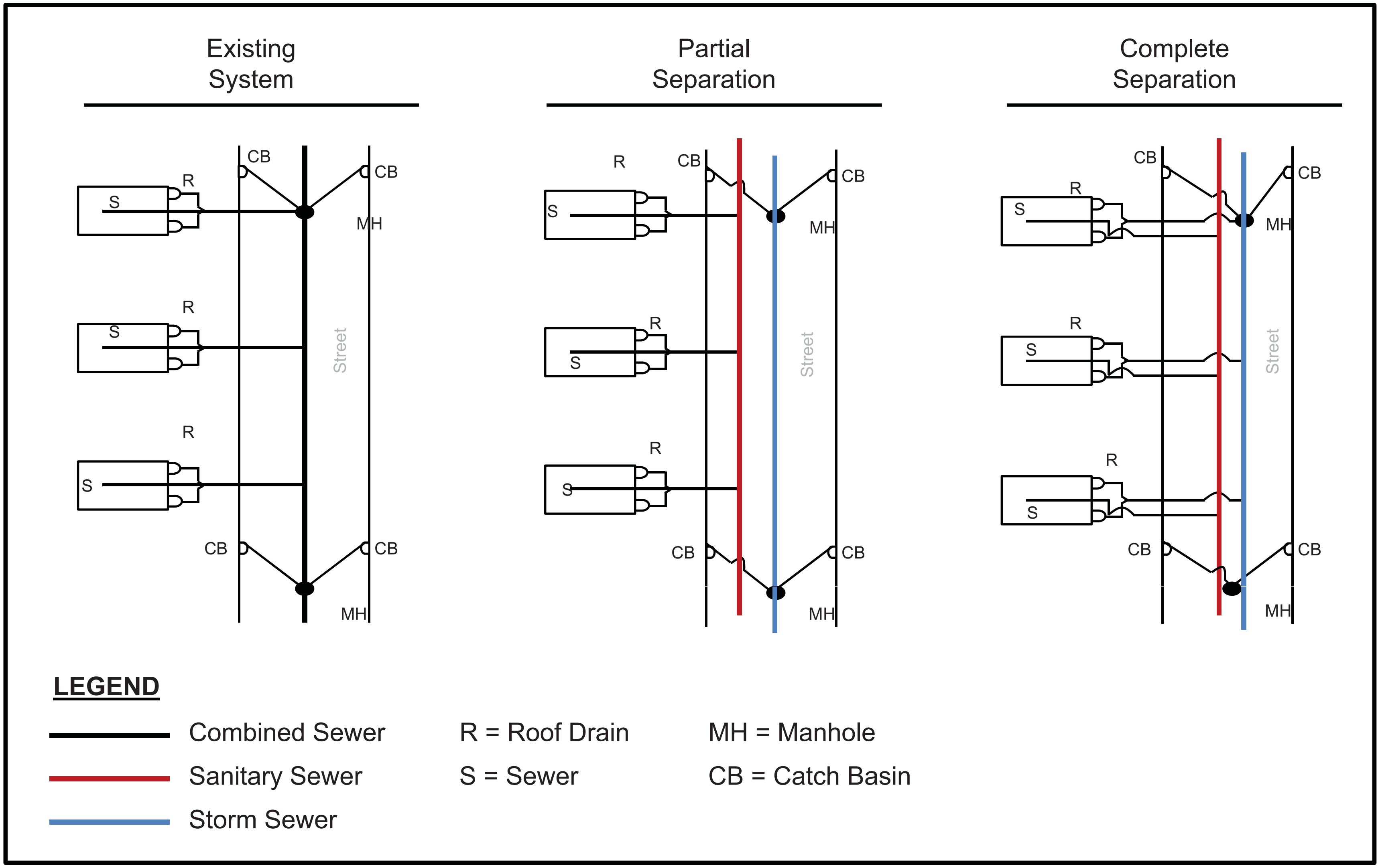
Rain leaders are disconnected from the combined sewer system with storm runoff diverted elsewhere. Depending on the location, leaders may be run to a dry well, vegetation bed, a lawn, a storm sewer or the street. Unfortunately, this scheme is inconsistent with existing city codes and regulations but these regulations may be modified in the future to support future green initiatives. Rain leader disconnection could contribute to nuisance street flooding and may only briefly delay the water from entering the combined sewer system through catch basins. For this reason, rain leader disconnection will be eliminated from further consideration.

Partial Separation

Combined sewers are separated in the streets only, or other public rights-of way. This is accomplished by constructing either a new sanitary wastewater system or a new stormwater system. Partial separation through construction of high level storm sewers (HLSS) is a potentially feasible alternative that is featured in the New York City Mayor's "PlaNYC 2030" initiative. Therefore, the DEP will continue to promote and support opportunities for local partial separation in select locations throughout the City. This technology is retained for further consideration on a site specific basis and is believed to be most cost-effective in areas near the shorelines where there is no need to build large diameter and long storm sewers to convey the separated stormwater to the receiving waterbody.

Complete Separation

In addition to separation of sewers in the streets, stormwater runoff from private residences or buildings (i.e. rooftops and parking lots) is also separated. Complete separation is almost impossible to attain in New York City since it requires re-plumbing of apartment, office and commercial buildings where roof drains are interconnected to the sanitary plumbing inside the building. In urban areas there is a lack of pervious surface areas to disperse the storm runoff into the ground, which could lead to nuisance flooding, and wet foundations and basements. These risks have led to the prohibition of stormwater disconnections from the combined sewers in the City Building Code. In addition, the widespread excavation and lengthy timeframes required to broadly implement separation would lead to unacceptable street disruptions and may not be feasible in areas with dense buried infrastructure.



Environmental Protection

Sewer Separation Alternatives

FIGURE 7-2

7.2.6 Storage and Conveyance

The objective of retention basins (also referred to as off-line storage) is to reduce overflows by capturing combined sewage in excess of WWTP capacity during wet weather for controlled release into the WWTP after the storm event. Retention basins can provide a relatively constant flow into the treatment plant thereby reducing their hydraulic impact on downstream WWTPs. Retention basins have had considerable use and are well documented. Retention facilities may be located at overflow points or near dry weather or wet weather treatment facilities. A major factor determining the feasibility of using retention basins is land availability. Operation and maintenance costs are generally small, typically requiring only collection and disposal cost for residual sludge solids, unless inlet or outlet pumping is required. Many demonstration projects have included storage of peak storm water flows, including those in Richmond, Virginia; Chippewa Falls, Wisconsin; Boston, Massachusetts; Milwaukee, Wisconsin; Columbus, Ohio.

The following subsections describe types of CSO retention facilities:

Closed Concrete Tanks

Closed concrete tanks are similar to open tanks, except that the tanks are covered and include many mechanical facilities to minimize their aesthetic and environmental impact. Closed concrete tanks typically include odor control systems, washdown/solids removal systems, and access for cleaning and maintenance of the tank. Closed concrete tanks have been constructed below grade such that the overlying surface can be used for parks, playgrounds, parking or other light public uses.

Storage Pipelines/Conduits

Large diameter pipelines or conduits can provide significant storage in addition to the ability to convey flow. The pipelines are fitted with some type of discharge control to allow flow to be stored within the pipeline during wet weather. After the rain event, the contents of the pipeline are allowed to flow by gravity to downstream WWTPs for ultimate treatment. A pipeline has the advantage of requiring a relatively small right-of-way for construction. The primary disadvantage is that it takes a relatively large diameter pipeline or cast-in-place conduit to provide the volume required to accommodate large periodic CSO flows requiring a greater construction effort than a pipeline used only for conveyance. For large CSO areas, pipeline size requirements may be so large that construction of a tunnel is more feasible.

Tunnels

Tunnels are similar to storage pipelines in that they can provide both significant storage volume and conveyance capacity. Tunnels have the advantage of causing minimal surface disruption and of requiring little right-of-way for construction. Excavation to construct the tunnel is carried out deep beneath the surface and therefore would not influence traffic. The ability to construct tunnels at a reasonable cost depends on the geology. Tunnels have been used in many CSO control plans including Chicago, Illinois; Rochester, New York; Cleveland, Ohio; Richmond, Virginia; and Toronto, Canada, among others. A schematic diagram of a typical storage tunnel system is shown in Figure 7-3. The storage tunnel stores flow and then conveys it to a dewatering station where floatables are removed at a screening house and then flows are lifted for conveyance to the WWTP.

The three storage alternatives discussed above – closed concrete tanks, storage pipelines / conduits, and tunnels – will be retained for further consideration.

7.2.7 Treatment

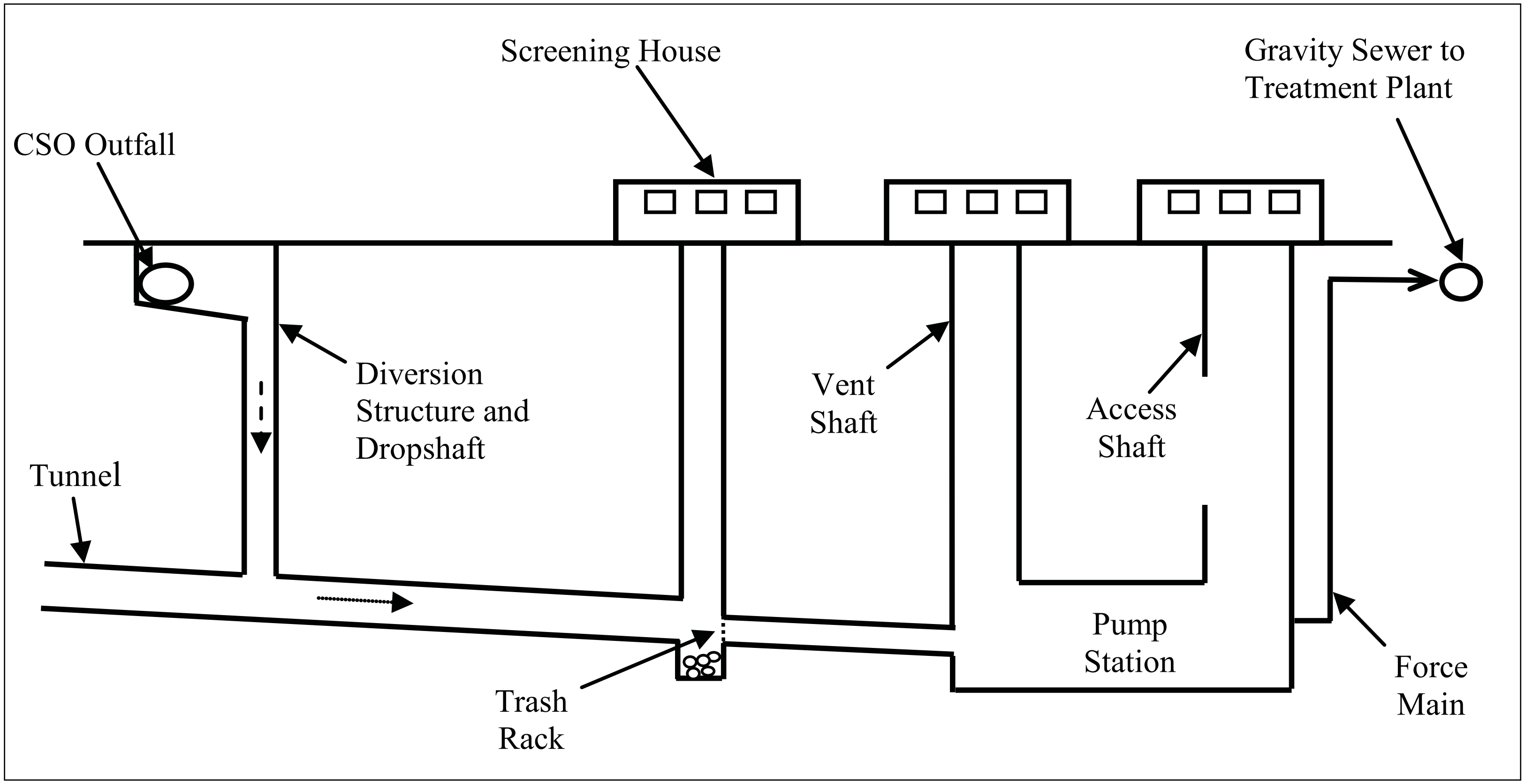
Treatment alternatives include technologies intended to separate solids and/or floatables from the combined sewer flow, disinfect for pathogen treatment or provide secondary treatment for some portion of the combined flow. The following are types of treatment technologies:

Screening

The major objective of screening is to provide high rate solids/liquid separation for combined sewer floatables and debris thereby preventing floatables from entering receiving waters. The following categories of screens are applicable to CSO outfall applications:

- Trash Racks and Manually Cleaned Bar Racks – Trash racks are intended to remove large objects from overflow and have a clear spacing of between 1.5 to 3.0 inches. Manually cleaned bar racks are similar to trash racks and have clear spacings of between 1.0 to 2.0 inches. Both screens must be manually raked and the screenings must be allowed to drain before disposal.
- Netting Systems – Netting systems are intended to remove floatables and debris at CSO outfalls. A system of disposable mesh bags is installed in either a floating structure at the end of the outfall or in an underground chamber on the land side of the outfall. Nets and captured debris must be periodically removed using a boom truck and disposed of in a landfill.
- Mechanically Cleaned Bar Screens – Mechanically cleaned bar screens typically have clear spacing between 0.25 and 1.0 inches. Bars are mounted 0 to 39 degrees from the vertical and rake mechanisms periodically remove material trapped on the bar screen. Facilities are typically located in a building to house collected screenings that must be collected after a CSO event and then transported to a landfill.
- Fine Screens – Fine screens in CSO facilities typically follow bar screens and have openings between 0.010 and 0.5 inches. Flow is passed through the openings and solids are retained on the surface. Screens can be in the shape of a rotary drum or linear horizontal or vertical screens. Proprietary screens such as ROMAG have been specifically designed for wet weather applications. These screens retain solids on the dry weather side of the overflow diversion structure so they can be conveyed to the wastewater treatment plant with the sanitary wastewater thereby minimizing the need for on-site collection of screenings for truck transport.

Manually cleaned screens for CSO control at remote locations have not been widely applied due to the need to clean screens and the potential to cause flooding if screens bind. Mechanically cleaned screens have had much greater application at CSO facilities. Due to the



Storage Tunnel Schematic

FIGURE 7-3

widely varying nature of CSO flow rates, even mechanically cleaned screens are subject to blinding under certain conditions. In addition, the screening must be housed in a building to address aesthetic concerns and odor facilities may be required as well. Fine screens have had more limited application for CSOs in the United States. ROMAG reports that over 250 fine screens have been installed in Europe and several screens have been installed in the United States (EPA, 1999a).

While screening provides an aesthetic benefit to the waterbody, it would not provide any improvement to the measured water quality parameters, such as DO, total coliform and fecal coliform. Also, screening the combined sewer flow does not involve the capture of storm sewer floatables that would discharge into Jamaica Bay. Screening technologies are generally considered to have significant operational and maintenance requirements.

Primary Sedimentation

The objective of sedimentation is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. It is one of the most common and well-established unit operations for wastewater treatment. Sedimentation tanks also provide storage capacity, and disinfection can occur concurrently in the same tank. It is also very adaptable to chemical additives, such as lime, alum, ferric chloride, and polymers, which provide higher suspended solids and BOD removal. Many CSO control demonstration projects have included sedimentation. These include Dallas, Texas; Saginaw, Michigan; and Mt. Clements, Michigan (EPA, 1978). Studies on existing stormwater basins indicate suspended solids removals of 15 to 89 percent; BOD5 removals of 10 to 52 percent (EPA, 1978, Fair and Geyer, 1965, Ferrara and Witkowski, 1983, Oliver and Gigoropolulos, 1981).

The DEP's WWTPs are designed to accept their respective 2×DDWF for primary treatment during wet weather events. As such, NYC already controls a significant portion of combined sewage through the use of this technology.

Vortex Separation

Vortex separation technologies currently marketed include: EPA Swirl Concentrator, Storm King Hydrodynamic Separator (of British design), and the FluidSep vortex separator (of German design). Although each of the three is configured somewhat differently, the operation of each unit and the mechanisms for solids separation are similar. Flow enters the unit tangentially and is directed around the perimeter of a cylinder, creating a swirling, vortex pattern. The swirling action causes solids to move to the outside wall and fall toward the bottom, where the solids concentrated flow is conveyed through a sewer line to the WWTP. The overflow is discharged over a weir at the top of the unit. Various baffle arrangements capture floatables that are subsequently carried out in the underflow. Principal attributes of the vortex separator are the ability to treat high flows in a very small footprint, and a lack of mechanical components and moving parts, thereby reducing operation and maintenance.

Vortex separators have been operated in Decatur Illinois; Columbus, Georgia; Syracuse, New York; West Roxbury, Massachusetts; Rochester, New York; Lancaster, Pennsylvania; Toronto, Ontario, Canada. Vortex separator prototypes have achieved suspended solids removals of 12 to 86 percent in Lancaster, Pennsylvania; 18 to 55 percent in Syracuse, New York; and 6 to 36 percent in West Roxbury, Massachusetts. BOD5 removals from 29 to 79 percent have been achieved with the swirl concentrator prototype in Syracuse New York. (Alquier, 1982).

New York City constructed the Corona Avenue Vortex Facility (CAVF) in the late 1990's to evaluate the performance of three swirl/vortex technologies at a full-scale test facility (133 MGD each). The purpose of the test was to demonstrate the effectiveness of the vortex technology for control of CSO pollutants, primarily floatables, oil and grease, settleable solids and total suspended solids. The two-year testing program, completed in late 1999, evaluated the floatables-removal performance of the facility for a total of 22 wet weather events. Overall, the results indicated that the vortex units provided virtually no reductions in total suspended solids and an average floatables removal of approximately 60 percent during the tested events. Based on the results of the testing, DEP concluded that widespread application of the vortex technology is not effective for control of CSOs and was not a cost effective way to control floatables. As such, the application of this technology will be limited and other methods to control floatable discharges into receiving waters will need to be assessed. DEP is planning to decommission this facility in accordance with all applicable laws and regulations.

Also, the performance of vortex separators has been found to be inconsistent in other demonstrations. A pilot study in Richmond, Virginia showed that the performance of two vortex separators was irregular and ranged from 0 percent to 26 percent with an average removal efficiency of about 6 percent (Greeley and Hansen, 1995). The performance of vortex separators is also a strong function of influent TSS concentrations. A high average influent TSS concentration will yield a higher percent removal. As a result, if influent CSO is very dilute with stormwater, the overall TSS removal will be low. Suspended solids removal in the beginning of a storm event may be better if there is a pronounced first flush period with high solids concentrations (City of Indianapolis, 1996). Removal effectiveness is also a function of the hydraulic loading rate with better performance observed at lower loading rates. Furthermore, one of the advantages of vortex separation – the lack of required moving parts – requires sufficient driving head.

Based on the poor results of the testing at the Corona Vortex Facility (DEP 2003, 2005), and the general lack of available head, vortex separators have been removed from further consideration in New York City in general and from consideration within the Jamaica Bay watershed.

High Rate Physical Chemical Treatment (HRPCT)

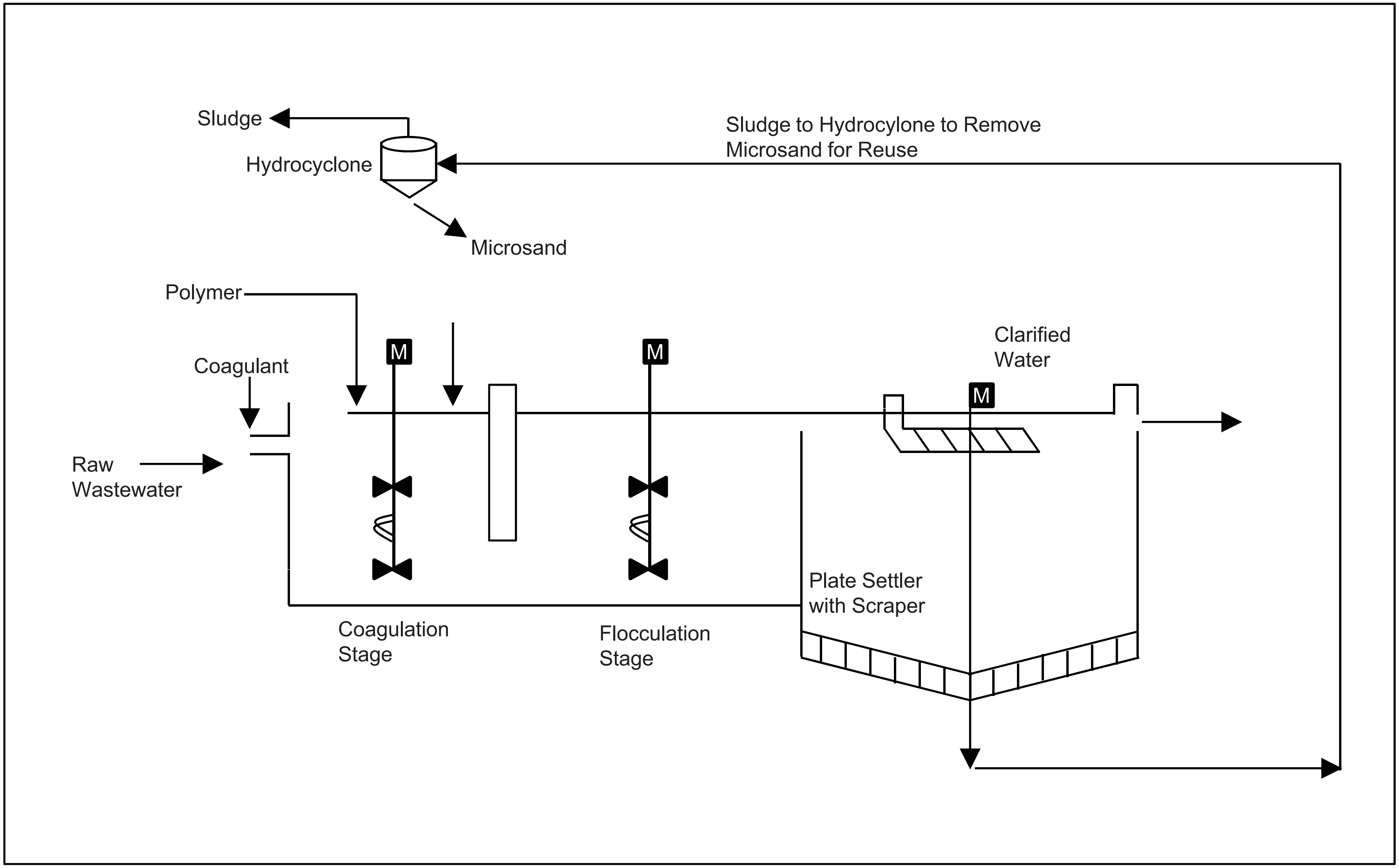
High rate physical/chemical treatment is a traditional gravity settling process enhanced with flocculation and settling aids to increase loading rates and improve performance. The pretreatment requirements for high rate treatment are screening and degritting, identical to that required prior to primary sedimentation. The first stage of HRPCT is coagulant addition, where ferric chloride, alum or a similar coagulant is added and rapidly mixed into solution. Degritting may be incorporated into the coagulation stage with a larger tank designed for gravity settling of grit material. The coagulation stage is followed by a flocculation stage where polymer is added and mixed to form floc particles that will settle in the following stage. Also in this stage recycled sludge or micro sand from the settling stage is added back in to improve the flocculation process. Finally, the wastewater enters the gravity settling stage that is enhanced by lamella tubes or plates. Disinfection, which is not part of the HRPCT process, typically is completed after treatment to the HRPCT effluent. Sludge is collected at the bottom of the clarifier and either pumped back to the flocculation stage or wasted periodically when sludge blanket depths become too high. The two principal manufacturers of HRPCT processes are Infilco Degremont Incorporated (IDI), which manufacturers the DensaDeg process, and US Filter, which manufactures the Actiflo process.

IDI offers the DensaDeg 2D and 4D processes, both of which require screening upstream. The 2D process requires upstream grit removal as well, but the 4D process integrates grit removal into the coagulation stage. Otherwise the 2D and 4D processes are identical. DensaDeg performance varies with surface overflow rate and chemical dosages, but in general removal rates of 80 to 95 percent for TSS and 30 to 60 percent for BOD can be expected. Phosphorous and nitrogen can also be removed with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Removal efficiencies are also dependent on start-up time. Typically the DensaDeg process requires approximately 30 minutes before optimum removal rates are achieved to allow for the build-up of sludge solids.

The US Filter Actiflo process is different from the DensaDeg process in that fine sand is used to ballast the sludge solids. As a result, the solids settle faster, but specialized equipment must be incorporated in the system to accommodate the handling of sand throughout the system. Figure 7-4 shows the components of a typical US Filter Actiflo system. The process does require screening upstream. Grit removal is recommended, but since the system uses microsand as ballast in the process, the presence of grit is tolerable in the system. If grit removal does not precede the process, the tanks must be flushed of accumulated grit every few months to a year, depending on the accumulation of grit and system run times.

Actiflo performance varies with surface overflow rate and chemical dosages, but in general removal rates of 80 to 95 percent for TSS and 30 to 60 percent for BOD are typical. Phosphorous and nitrogen are also removable with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Phosphorous removal is typically between 60 and 90 percent, and nitrogen removal is typically between 15 and 35 percent. Removal efficiencies are also dependent on start-up time. Typically the Actiflo process takes about 15 minutes before optimum removal rates are achieved.

Pilot testing of HRPCT was performed at the 26th Ward WWTP in Brooklyn, and consisted of evaluating equipment from three leading HRPCT manufacturers from May through August 1999. The three leading processes tested during the pilot test were the Ballasted Floc ReactorTM from Microsep/US Filter, the ActifloTM from Kruger, and the Densadeg 4DTM from Infilco Degremont. Pilot testing suggested good to excellent performance on all units, often in excess of 80 percent for TSS and 50 percent for BOD5. However, operational challenges suggested the need for further testing, which was to be performed in a demonstration-scale facility. Facility planning at that time did not reveal any opportunities to apply HRPCT for CSO abatement in New York City, so the demonstration project was indefinitely postponed. Because the operational challenges remain unresolved, HRPCT will not be retained for further consideration for the purposes of this technology evaluation.



US Filter Actfiflo HRPCT

FIGURE 7-4

Disinfection

The major objective of disinfection is to control the discharge of pathogenic microorganisms in receiving waters. Disinfection of combined sewer overflow is included as part of many CSO treatment facilities, including those in Washington, D.C.; Boston, Massachusetts; Rochester, New York; and Syracuse, New York. The disinfection methods considered for use in combined sewer overflow treatment are chlorine gas, calcium or sodium hypochlorite, chlorine dioxide, peracetic acid, ozone, ultraviolet radiation, and electron beam irradiation. The chemicals are all oxidizing agents that are corrosive to equipment and in concentrated forms are highly toxic to both microorganisms and people. Each is described below.

- Chlorine Gas: Chlorine gas is extremely effective and relatively inexpensive. However, it is extremely toxic and its use and transportation must be monitored or controlled to protect the public. Chlorine gas is a respiratory irritant and in high concentrations can be deadly. Therefore, it is not well suited to populous or potentially non-secure areas.
- Calcium or Sodium Hypochlorite: Hypochlorite systems are common in wastewater treatment installations. For years, large, densely populated metropolitan areas have employed hypochlorite systems in lieu of chlorine gas for safety reasons. The hypochlorite system uses sodium hypochlorite in a liquid form much like household bleach and is similarly effective as chlorine gas although more expensive. It can be delivered in tank trucks and stored in aboveground tanks. The storage life of the solution is 60 to 90 days.
- Chlorine Dioxide: Chlorine dioxide is an extremely unstable and explosive gas and any means of transport is potentially very hazardous. Therefore, it must be generated
- on site. The overall system is relatively complex to operate and maintain compared to more conventional chlorination.
- Ozone: Ozone is a strong oxidizer and must be applied to CSO as a gas. Due to the instability of ozone, it must be generated on site. The principle advantage of ozone is that there is no trace residual chlorine remaining in the treated effluent. Disadvantages associated with ozone use as a disinfectant is that it is relatively expensive, with the cost of the ozone generation equipment being the primary capital cost item. Operating costs can be very high depending on power costs, since ozonation is a power intensive system. Ozonation is also relatively complex to operate and maintain compared to chlorination. Ozone is not considered practical for CSO applications because it must be generated on site in an intermittent fashion in response to variable and fluctuating CSO flow rates.
- UV Disinfection: UV disinfection uses light with wavelengths between 40 and 400 nanometers for disinfection. Light of the correct wavelength can penetrate cells of pathogenic organisms, structurally altering DNA and preventing cell function. As with ozone, the principle advantage of UV disinfection is that no trace chlorine residual remains in the treated effluent. However, because UV light must penetrate the water to be effective, the TSS level of CSOs can affect the disinfection ability. As such, to be effective UV must be preceded by thorough separation of solids from the

combined sewage. Pretreatment by sedimentation, high-rate sedimentation, and/or filtration maybe required to reduce suspended solids concentrations to less than 20 to 40 mg/L or so depending on the water quality goals.

Disinfection reduces potential public health impacts from CSOs but cannot reduce CSO volume, settleable solids, or floatables.

In order to protect aquatic life in the receiving waters, dechlorination facilities would need to be installed whenever chlorination is used as a disinfectant. Dechlorination would be accomplished by injection of sodium bisulfite in the flow stream before discharge of treated CSO flow to waterways. Dechlorination with sodium bisulfite is rapid; hence no contact chamber is required. However, even with the addition of dechlorination, DEP believes that there could be a residual of as much as 1mg/L from a CSO disinfection facility and there is still a potential to form other harmful disinfection bi-products.

Disinfection would not reduce the CSO discharge volume and as such would not be considered as an alternative.

Expansion of WWTP Treatment

The DEP developed WWOPs for the 26th Ward, Coney Island, Jamaica, and Rockaway WWTPs (see Appendices A through D) per DEC requirement. These WWOPs provided recommendations for maximizing treatment of flow during wet weather events. The reports outlined three primary objectives in maximizing treatment for wet weather flows: (1) consistently achieve primary treatment and disinfection for wet weather flows up to 2xDDWF; (2) consistently provide secondary treatment for wet weather flows up to 1.5xDDWF before bypassing the secondary treatment system; and, (3) do not appreciably diminish the effluent quality or destabilize treatment upon return to dry weather operations.

7.2.8 Receiving Water Improvement

Receiving waters can also be treated directly with various technologies that improve water quality. Below are described the different treatment options that could aid in improving water quality in conjunction with CSO control measures:

Outfall Relocation

Outfall relocation involves moving the combined sewer outfall to another location. For example, an outfall may be relocated away from a sensitive area to prevent negative impacts to that area. In general, outfall relocation is not considered a feasible alternative in New York City, due in part to extensive construction, disruption to City streets and high construction costs.

However, it may be feasible for a collection system to be modified such that CSO is shifted to a different existing outfall that may have better mixing characteristics or the capability to better handle a CSO discharge. For example, moving a CSO discharge from poorly mixed or narrow channel/tributary to a well-mixed/open waters area would improve water quality in a particular waterbody.

As each of the CSO outfalls in the Jamaica Bay watershed eventually discharge into the Bay, an outfall would need to be relocated to a point outside the watershed to have a positive impact on the Bay's water quality. As this would be an extremely expensive and complex alternative, outfall relocation has been removed from consideration within the Jamaica Bay watershed.

Flushing Tunnel

A flushing tunnel improves the water quality of a receiving waterbody by introducing a steady flow of oxygen-rich water into an area that is stagnant and/or suffers from oxygen depletion. In addition to improving the water quality, a flushing tunnel allows the waterbody to become self-cleansing. A flushing tunnel would involve the construction of a tunnel well below existing grade elevation, from the source to the stagnant waterbody. In addition to the flushing tunnel, an intake structure with a trash rack would be located at the source of the water and a pumping station would be constructed to convey the flushing water from the tunnel entrance to the stagnant waterbody. If located in a navigable waterway, the intake structure and related infrastructure would have to be located so that it does not interfere with commercial and recreational maritime traffic.

While a flushing tunnel could improve the water quality at the head of the CSO tributaries, it would not reduce the number of CSO events or the volume of CSO that would be discharged into the tributaries and therefore Jamaica Bay itself. As a result, this alternative was not further evaluated.

In-Stream Aeration

In-stream aeration would improve the DO content of the Bay by adding air directly to the water column via diffusers placed within the waterbody. Air could be added in large enough volumes to bring any waterbody into compliance with the ambient water quality standards. However, depending on the amount of air that would be required to be transferred into the water column, the facilities necessary and the delivery systems required could be extensive and impractical. An alternative would be to deliver a lower volume of air and control short term anoxic conditions that may result from intermittent wet weather overflows. DEP continues to investigate in-stream aeration as a method of meeting DO standards at the recently constructed English Kills in-stream aeration facility. The first of three years of testing was completed in the summer of 2009 and preliminary data analysis was completed in February 2010. In-stream aeration will not be retained as an alternative for further consideration in the Jamaica WB/WS Facility Plan due to its excessive cost.

Environmental Dredging

The maintenance dredging technology is essentially the dredging of settled CSO solids from the bottom of waterbodies periodically. The settled solids would be dredged from the receiving waterbody as needed to prevent use impairments such as access by recreational boaters, as well as abate nuisance conditions such as odors. The concept would be to conduct dredging periodically or routinely to prevent the use impairment/nuisance conditions from occurring. Dredging would be conducted as an alternative to structural CSO controls such as storage. Bottom water quality between dredging operations would likely not improve and bottom habitat would degrade following each dredging.

This technology allows CSO settleable solids to continue to exit the sewer system and settle in the waterbody generally immediately downstream of the outfall, and without regular or periodic dredging the solids usually accumulate with leaves and other detritus into a “CSO mound". This CSO mound would then be dredged and removed from the water environment. The assumption is that dredging would occur prior to the CSO mound creating an impairment or nuisance condition. Generally, it is envisioned that maintenance dredging would be performed prior to a CSO mound building to an elevation that it becomes exposed at low tide or mean lower low tide. The extent and depth of dredging would depend on the rate of accretion, or build-up of settleable solids, and preferred years between dredging.

Dredging can be accomplished by a number of acceptable methods. Methods of dredging generally fall into either floating mechanical or hydraulic techniques, with a variety of variants for both techniques. The actual method of dredging selected would depend on the physical characteristics (grain size, viscosity, etc.) of the sediments that require removal, the extent of entrained pollutants (metals, etc), and the local water currents, the depth and width of the waterbody and other conditions such as bridges that could interfere with dredge/barge access. It is likely that CSO sediments would require removal with a closed bucket mechanical dredge or an auger/suction-head hydraulic dredge. Removal techniques, however, would be site specific.

After removal of CSO sediments, the material would likely be placed onto a barge for transport away from the site. On-site dewatering may be considered as well. Sediments would then be off-loaded from the barge and shipped by land methods to a landfill that accepts New York Harbor sediments. Recently, harbor sediments have been shipped to a facility licensed to accept such sediments.

Maintenance dredging will be retained as an alternative for further consideration in the Jamaica WB/WS Facility Plan.

7.2.9 Solids and Floatables Control

Technologies that provide solids and floatables control do not reduce the frequency or magnitude of CSO overflows, but can reduce the presence of aesthetically objectionable items such as plastic, paper, polystyrene, and sanitary “toilet litter” matter, etc. These technologies include both end-of-pipe technologies such as netting and screens, as well as BMPs such as catch basin modifications and street cleaning which could be implemented upstream of outfalls in the drainage area. Each of these technologies is summarized below:

Netting Devices

Netting devices can be used to separate floatables from CSOs by passing the flow through a set of netted bags. Floatables are retained in the bags, and the bags are periodically removed for disposal. Netting systems can be located in-water at the end of the pipe, or can be placed in-line to remove the floatables before discharge to the receiving waters.

Containment Booms

Containment booms are specially fabricated floatation structures with suspended curtains designed to capture buoyant materials. They are typically anchored to a shoreline structure and to the bottom of the receiving water. After a rain event, collected materials can be removed using either a skimmer vessel or a land-based vacuum truck. A 2-year pilot study of containment booms was conducted by New York City in Jamaica Bay. An assessment of their effectiveness indicated that the containment booms provided a retention efficiency of approximately 75 percent. Presently, Hendrix Creek, Bergen Basin and Thurston Basin have containment booms. An illustration of a containment boom is shown in Figure 7-5.

Skimmer Vessels

Skimmer vessels remove materials floating within a few inches of the water surface and are being used in various cities, including New York City. The vessels range in size from less than 30-feet to more than 100-feet long. They can be equipped with moving screens on a conveyor belt system to separate floatables from the water or with nets that can be lowered into the water to collect the materials. Skimmer vessels are typically effective in areas where currents are relatively slow-moving and can also be employed in open-water areas where slicks from floatables form due to tidal and meteorological conditions. New York City currently operates skimmer vessels to service containment boom sites and to conduct open-water operations.

Bar Screens (Manually Cleaned)

Manually cleaned bar screens can be located within in-line CSO chambers or at the point of the outfall to capture floatables. The configuration of the screen would be similar to that found in the influent channels of small wastewater pumping stations or treatment facilities. Retained materials must be manually raked and removed from the sites after every storm. For multiple CSOs, this would result in very high maintenance requirements. Previous experience with manually cleaned screens in CSO applications has shown these units to have a propensity for clogging. In Louisville, KY, screens installed in CSO locations became almost completely clogged with leaves from fall runoff. Because of the high frequency of cleaning required, it was decided to remove the screens. Thus, manually cleaned bar screens will be eliminated from further consideration.

Weir-Mounted Screens (Mechanically Cleaned)

Horizontal mechanical screens are weir-mounted mechanically cleaned screens driven by electric motors or hydraulic power packs. The rake mechanism is triggered by a float switch in the influent channel and returns the screened materials to the interceptor sewer. Various screen configurations and bar openings are available depending on the manufacturer. Horizontal screens can be installed in new overflow weir chambers or retrofitted into existing structures if adequate space is available. Electric power service must be brought to each site.

Although widely used in Europe, weir-mounted screens are relatively new devices in the United States. As with any type of screening device, they are used for removing floatables and other large detritus. Any removal of suspended solids would be incidental. As such, where

Environmental Protection

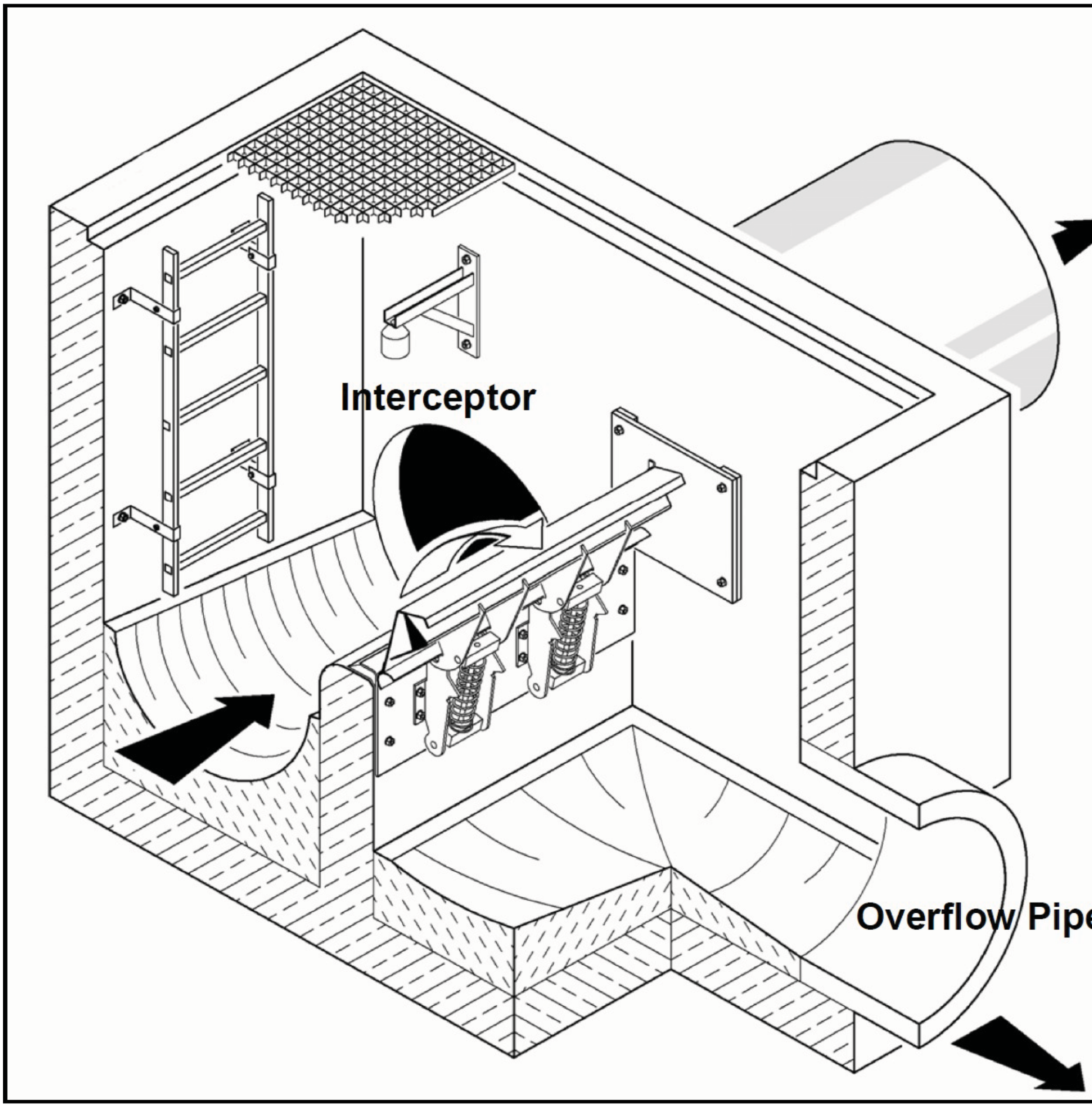
Containment Boom at the Head of Hendrix Creek

FIGURE 7-5

water quality evaluations indicate that suspended solids or oxygen demanding materials need to be removed, weir-mounted screens are not effective. Since water quality evaluations for Jamaica Bay indicate removal of these materials, other control or treatment processes downstream would be more effective.

Baffles Mounted in Regulator

- Fixed Underflow Baffles: Underflow baffles consist of a transverse baffle mounted in front of and typically perpendicular to the overflow pipe. During a storm event, the baffle prevents the discharge of floatables by blocking their path to the overflow pipe. As the storm subsides, the floatables are conveyed to downstream facilities by the dry weather flow in the interceptor sewer. The applicability and effectiveness of the baffle depends on the configuration and hydraulic conditions at the regulator structure. Baffles are being used in CSO applications in several locations including Boston, Massachusetts and Louisville, Kentucky. However, the typical regulator structures in New York City are not amenable to fixed baffle retrofits. Therefore, fixed underflow baffles will be eliminated from further consideration.
- Floating Underflow Baffles: A variation on the fixed underflow baffle is the floating underflow baffle developed in Germany and marketed under the name HydroSwitch by Grande, Novac & Associates. The floating baffle is mounted within a regulator chamber sized to provide floatables storage during wet weather events. All floatables trapped behind the floating baffle are directed to the WWTP through the dry weather flow pipe. By allowing the baffle to float, a greater range of hydraulic conditions can be accommodated. Although this technology has not yet been demonstrated in the United States, there are operating units in Germany.
- Hinged Baffle: The hinged baffle system incorporates two technologies, the hinged baffle and the bending weir. The system design is intended to retain floatables in regulators during storm events. During a storm event, the hinged baffle provides floatables retention while the bending weir increases flow to the plant. After a storm event, retained floatables drop into the regulator channel and then into the sewer interceptor to be removed at the treatment plant. During large storm events that exceed the capacity of the regulator, more flow backs up behind the baffle. To prevent flooding, the hinged baffle opens to allow more flow to pass through the regulator. The bending weir provides additional storage of stormwater and floatables within the regulator during storm events by raising the overflow weir elevation. Similar to the hinged baffle, the bending weir also helps to prevent flooding during large storm events by opening and allowing additional combined sewage to overflow the weir. The bending weir allows an increasing volume of combined sewage to overflow the weir as the water level inside the regulators rise. The major benefit of the system is that it includes a built-in mechanical emergency release mechanism. This feature eliminates the need for the construction of an emergency bypass that many other in-line CSO control technologies require. In addition, the system has no utility requirements and therefore has low operation and maintenance costs of a scale similar to tide gates. For the reasons stated above, a bending weir is the preferred technology over a hinged baffle. A three dimensional view of a bending weir installation is shown in Figure 7-6 (from John Meunier, Inc).



NYC Environmental Protection

Bending Weir Diagram

Catch Basin Modifications

Catch basin modifications consist of various devices to prevent floatables from entering the CSS. Inlet grates and closed curb pieces reduce the amount of street litter and debris that enters the catch basin. Catch basin modifications such as hoods, submerged outlets, and vortex valves, alter the outlet pipe conditions and keep floatables from entering the CSS. Catch basin hoods are similar to the underflow baffle concept described previously for installation in regulator chambers. These devices also provide a water seal for containing sewer gas. The success of a catch basin modification program is dependent on having catch basins with sumps deep enough to accommodate hood-type devices. A potential disadvantage of catch basin outlet modifications and other insert-type devices is that retained materials could clog the outlet if cleaning is not performed frequently enough. This could result in backup of storm flows and increased street flooding. New York City has moved forward with a program to hood all of its catch basins.

Floatables Control Best Management Practices (BMPs)

BMPs such as street cleaning and public education have the potential to reduce solids and floatables in CSO. These are described in the beginning of this section.

Table 7-3 provides a comparison of the floatables control technologies discussed above in terms of the effort to implement the technology, its required maintenance, effectiveness and relative cost. For implementation effort and required maintenance, technologies that require little to low effort are preferable to those requiring moderate or high effort. When considering effectiveness, a technology is preferable if the rating is high.

Table 7-3. Comparison of Solids and Floatable Control Technologies

Technology	Implementation Effort	Required Maintenance	Effectiveness	Relative Capital Cost
Public Education	Moderate	High	Variable	Moderate
Street Cleaning	Low	High	Moderate	Moderate
Catch Basin Modifications	Low	Moderate	Moderate	Low
Weir-Mounted Screens	Low	Moderate	High	Moderate
Screen with Backwash	High	Low	High	High
Fixed Baffles	Low	Low	Moderate	Low
Floating Baffles	High	Low	Moderate	Moderate
Bar Screens – Manual	Low	High	Moderate	Low
In-Line Netting	High	Moderate	High	High
End-of-Pipe Netting	Moderate	Moderate	High	Moderate
Containment Booms	Moderate	Moderate	Moderate	Moderate

7.2.10 Initial Screening of CSO Technologies

Table 7-4 presents a tabular summary of the results of the preliminary technology screening discussed in this section. Technologies that will advance to the alternatives development screening phase are noted under the column entitled "Retain for Consideration". These technologies have proven successful and have the potential for producing some measurable level of CSO control for Jamaica Bay. Other technologies were considered as having a positive effect on CSOs but either could only be implemented to a certain degree or could only provide a specific benefit level and, thusly, would have a variable effect on CSO overflow. For instance, DEP has implemented a water conservation program which, to date, has been largely effective. This program, which will be maintained in the future, directly affects dry weather flow since it pertains to water usage patterns. As such, technologies included in this category provide some level of CSO control but in-and-of-themselves do not provide the level of control sought by this program.

Technologies included under the heading "Consider Combining with Other Control Technologies" are those that would be more effective if combined with another control or would provide an added benefit if coupled with another control technology.

The last classification is for those technologies which did not advance through the preliminary screening process.

Table 7-4. Screening of CSO Control Technologies

CSO Control Technology	Retain for Consideration	Implemented to Satisfactory Level	Consider Combining with Other Control Technologies	Eliminate from Further Consideration
Source Control				
Public Education		X		
Street Sweeping		X		
Construction Site Erosion Control		X		
Catch Basin Cleaning		X		
Industrial Pretreatment		X		
Inflow Control				
Storm Water Detention				X
Street Storage of Storm Water				X
Water Conservation		X		
Inflow/Infiltration Reduction		X		
Green Infrastructure (see Sections 5.8 and 8.8)				
Sewer System Optimization				
Optimize Existing System	X			
Real Time Control				X
Sewer Separation				
Complete Separation	X			
Partial Separation	X			
Rain Leader Disconnection				X
Storage				
Closed Concrete Tanks				X
Storage Pipelines/Conduits	X			
Tunnels/Shafts	X			
Treatment				
Screening			X	
Primary Sedimentation		X		
Vortex Separator				X

CSO Control Technology	Retain for Consideration	Implemented to Satisfactory Level	Consider Combining with Other Control Technologies	Eliminate from Further Consideration
High Rate Physical/Chemical Treatment				X
Disinfection				X
Expansion/ Upgrade of WWTP	X			
Receiving Water Improvement				
Outfall Relocation				X
In-Stream Aeration				X
Maintenance Dredging	X			
Solids and Floatable Controls				
Netting Systems	X			
Containment Booms		X		
Manual Bar Screens				X
Weir Mounted Screens				X
Fixed Baffles				X
Floating Baffles				X
Hinged Baffle (Bending Weir)	X			
Catch Basin Modifications		X		

The technologies successively moving through the preliminary screening process were formed into alternatives that were further screened in subsequent sections for each of the five combined sewer outfall tributaries - Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin and Thurston Basin – that discharge CSO into Jamaica Bay.

7.3 ANALYSIS OF FEASIBLE ALTERNATIVES

The analysis of feasible alternatives will review the control technologies that were retained from Table 7-4 to "consider a reasonable range of alternatives" as expected by federal CSO policy. Full-year model simulations were performed for each engineering alternative selected, and each of these alternatives was then evaluated in terms of compliance with applicable water quality criteria, designated uses, and overall improvement from the established Baseline condition. Compliance with fish and aquatic-life uses was evaluated by comparing projected DO conditions to the applicable New York State numerical criterion. Compliance with recreational uses was evaluated by comparing projected indicator bacteria levels to New York State numerical criteria for secondary recreation. Aesthetics and riparian uses were evaluated by comparing projected levels of floatables, odors and other aesthetic conditions (based on CSO volume reduction) to narrative water quality standards.

The baseline sewer system characteristics, overflow volumes, interceptor conveyance capacity, and outfall and regulator configurations were thoroughly reviewed. From this evaluation it was determined that a number of conditions exist that could benefit from the application of CSO control technologies. As described below, the CSO technologies remaining after the initial screening (see Table 7-4) were further developed to determine the applicability of each to improve the conditions in the watershed.

The retained technologies, summarized below, are considered to be feasible insofar as there is no fatal flaw or obvious cost-benefit limitation, and implementation is expected to result in substantial improvements to water quality.

- Baseline (Section 7.3.1): The future "no build" case is not a retained technology as such because water quality goals are not currently attained. However, the Baseline serves as a metric for the other alternatives.
- Sewer System Optimization (Sections 7.3.2): Collection system improvements consisting of the removal of sediment in sections of major sewers in the 26th Ward drainage area and inflatable dams or bending weirs to induce in-line storage were evaluated in Hendrix Creek, regulator modifications (e.g. enlargement of orifice) and parallel sewers or interceptors. Note that sediment removal is not listed as a CSO abatement alternative because it is specifically listed in the 2005 ACO. Installation of bending weirs was evaluated at selected regulators in the Jamaica WWTP drainage system as well as automation of regulator J2.
- Partial Sewer Separation (Sections 7.3.2 through 7.3.3, 7.3.10). The separation of sewers to eliminate combined sewers was evaluated for the entire Jamaica Bay WWTP drainage system. Select portions of the Thurston Basin drainage area and the 26th Ward drainage area were considered for sewer separation.
- Storage (Sections 7.3.4 through 7.3.9, 7.3.11): In-line storage, deep storage tunnel and storage shaft alternatives were retained to reduce discharges in the CSO tributaries. Deep storage tunnels were considered, as opposed to closed storage tanks, because they have an advantage where siting issues present a major challenge, such as in an urban environment. For very large volumes, they are often the only feasible approach, and were therefore used to develop alternatives to provide various level of CSO reduction in Jamaica Bay. Treatment (Sections 7.3.2, 7.3.3). Upgrade to the 26th Ward WWTP consisting of constructing one new Primary Settling Tanks to increase redundancy, installing an influent flow distribution box to equally distribute flow to each pass, and refurbishing the four existing Primary Settling Tanks.
- Receiving Water Improvement (Sections 7.3.2, 7.3.3): *Dr*edging was considered for areas of Hendrix Creek.
- Solids and Floatables Control (Sections 7.3.2, 7.3.3). Bending weirs will be considered at several locations throughout the WW^{TP} service areas tributary to Jamaica Bay.

This list of feasible alternatives retained from the preliminary screening represents a toolbox from which a suitable technology may be applied to a particular level of CSO abatement. As suggested in EPA guidance for long-term CSO control plans, water quality modeling was performed for a "reasonable range" of CSO volume reductions, from no reduction up to 100 percent CSO abatement. The technology employed at each level of this range was selected based on engineering judgment and established principles. For example, any of the storage technologies may be employed to achieve a certain reduction in CSO discharged, but the water quality response would be the same, so the manner of achieving that level of control is a matter of balancing cost-effectiveness and feasibility. In that sense the alternatives discussed below each represents an estimate of the optimal manner of achieving that particular level of control. All costs presented in this section are in October 2011 dollars.

7.3.1 Baseline Conditions

The baseline conditions establish a "no build" alternative that can be used to judge the effectiveness of any proposed alternative. All model simulations were performed using the same conditions as established for the Baseline condition to isolate the effects and impacts of each assessed alternative. In this way, all evaluated alternatives were compared on the same basis. Baseline conditions are summarized below:

1. Dry-weather sanitary sewage flow rates reflective of year 2045 population projections.

2. Sustained wet-weather treatment capacities as reported in the 2003 BMP Annual report.

3. Documented sediments in sewers.

Table 7-5 presents an overview of the baseline water quality conditions for the CSO tributaries.

Table 7-5. Summary of Baseline Conditions

Item	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin	Thurston Basin
Annual CSO Volume (MG)	494	36	98	649	908
Percent reduction in Annual CSO Volume	N/A	N/A	N/A	N/A	N/A
Number of Projected Overflow Events per Year[2]	47	16	5	195	146
Percent hours DO>4.0 mg/L	57%	61%	87%	72%	63%
Percent months total coliform <10,000 per 100 mL	75%	100%	100%	67%	92%
Percent months fecal coliform <2,000 per 100 mL	75%	100%	100%	67%	92%

Notes:
1. The Spring Creek tank has a treated annual overflow volume of 98 MG. However, this overflow receives preliminary treatment;
2. Based on number of CSO events >0.01 MG.

7.3.2 Alternative 1: 2005 Consent Order Mandated Controls

The first and primary CSO control alternative assessed herein was for those combinations of controls required in the 2005 CSO Consent Order. The capital projects included under the Jamaica Tributaries and Jamaica Bay facility plans submitted in the late 1990s and updated circa 2003 (Hazen and Sawyer 1996, 2004; O'Brien & Gere 1989, 2003). The intent of these facility plans was to develop a cost-effective and environmentally sound plan to improve water quality in Jamaica Bay and those tributaries impacted by CSOs (excluding Paerdegat Basin) by focusing on the evaluation of existing water quality conditions in comparison to State numeric WQSs, the control of CSO's into the tributaries, identification of required CSO control systems, and the preliminary design(s) and recommendation(s) for possible implementation. The Jamaica Bay and Jamaica Tributaries CSO Facility Plans had the following recommended improvements:

- Meadowmere and Warnerville DWO Abatement: Two small neighborhoods, Meadowmere and Warnerville, located at the base of Thurston Basin, previously utilized septic systems to provide sanitary sewer service. These septic systems were identified as discharging into Jamaica Bay during both dry and wet weather flow periods. The project included the design and construction of a wastewater pumping station and force main system, a new separate wastewater conveyance system, and a storm water collection system for the Meadowmere and Warnerville neighborhoods. A separate gravity sewer system collects the flow from each neighborhood and then discharges it to the proposed Warnerville Wastewater Pumping Station. From the pump station, the flow is conveyed to the nearest existing DEP sanitary sewer system (near the intersection of Brookville Boulevard and 149th Avenue) for ultimate treatment at the Jamaica WWTP. Construction is substantially complete. The probable total project cost is $37.6 million.
- Expansion of the Wet Weather Capacity at Jamaica WWTP: The Jamaica WWTP wet weather capacity would be expanded from 200 MGD to 250 MGD. This project was recommended in the 1994 Jamaica Bay Comprehensive Plan and the 1996 Jamaica Tributaries CSO Facility Plan.
- Shellbank Basin Destratification System: As it is separately serviced by sanitary and storm sewer systems, Shellbank Basin is not considered a CSO tributary to Jamaica Bay. However, Shellbank Basin does suffer from water quality issues – its head end is much deeper than other parts of the basin, causing temperature stratification to occur. Because this lower level of water is essentially trapped and does not change during a normal tidal cycle, it results in an environment with depleted dissolved oxygen reserves. As such, the bottom of Shellbank Basin cannot support aquatic life, resulting in fish/crab kills and odor complaints, particularly during the summer/bathing season. A DEP pilot destratification system has been operating successfully in Shellbank Basin during the summer season since 2000. The system is designed to eliminate temperature stratification during the summer season, which leads to poor water quality conditions in the basin, odors and marine life kills. This pilot system consists of a small air compressor system which introduces oxygen to the bottom of Shellbank Basin. The proposed permanent destratification facility would be similar in nature to the pilot system – two air compressors, diffuser piping and a small building (less than 400 square feet) located towards the head end of Shellbank Basin. The construction for this project has begun.
- Laurelton and Springfield Blvd Storm Sewer Buildout: A drainage plan for 7,000 acres in southeast Queens is being developed to address flooding and to construct high-level storm sewers in a 1,450 acre CSO drainage area tributary to Thurston Basin. The drainage plan identifies the necessary capital sewer projects to alleviate flooding and convert the aforementioned CSO area to a high-level storm sewer system. Some sections of southeast Queens were developed faster than the NYCDEP was able to fully construct the storm and sanitary sewer system. As such, the area has a mixture of combined sewers, separate sewers, areas where storm sewers interconnect with combined sewers and areas with inadequate sewers. In fact, the

NYCDEP has constructed hundreds of seepage basins in the area to provide some level of relief to the communities until storm sewers could be properly constructed. NYCDEP has always intended to fully build-out the storm sewers in the area to prevent both street and basement flooding in the area. HLSS conversion would involve the construction of a storm drainage system that would convey wet weather flow from drainage inlets directly to Thurston Basin. While the existing combined sewer system would primarily convey sanitary flow after the construction of the HLSS, some storm water flow (roof drains, sump pumps, etc.) would continue to be conveyed for treatment at the Jamaica WWTP. It is important to note that this external project will impact the WB/WS Facility Plan and is therefore included as part of Alternative 1. However, at the time this report was written, the schedule for the storm sewer buildout is still to be determined. The projected total project costs is estimated to be $870M.

- Regulator Automation: Upgrade Regulator J2 to run in automated mode such that it conveys excess wet weather flow from Bergen Basin over to the Spring Creek AWWTP.
- Upgrading the Spring Creek AWWTP: Spring Creek AWWTP facility was placed into service in the early 1970's and has been upgraded to provide a minimum storage capacity of approximately 20 MG; approximately 13.8 MG in basin storage and approximately 6.2 MG in influent barrel storage. The upgraded CSO facility provides floatable control, high rate settling and storage of CSO flows. The upgraded facility was completed on April 30 2007, in compliance with the CSO Consent Order milestone.
- Sewer Cleaning in the 26th Ward WWTP Drainage Area (Williams Street, Hegeman Avenue, and Flatlands Avenue): Excess sediment was observed in several large sewers during facility planning work in the 1990s. Debris profiles taken in 1994 showed depths of debris as high as five feet in one barrel of the four-barrel sewer in Williams Avenue among other sections of the system. Based on these observations, sewer cleaning was included in the 2005 CSO Consent Order. Cleaning of the sewer system is anticipated to result in an annual reduction of 134 MG of CSO in the 26th Ward drainage area.
- Hendrix Creek Dredging: The purpose for dredging of Hendrix Creek is to control odors in the Creek caused by sediment from the CSO that is exposed above the water surface. This work has been completed.
- Expansion of the Wet Weather Capacity at 26th Ward WWTP: The expansion of the 26th Ward WWTP wet weather capacity from 200 MGD to 250 MGD. This project was recommended in the 1994 Jamaica Bay Comprehensive Plan and the 1996 Jamaica Bay CSO Facility Plan.

Implementation of the Facility Plan is calculated to reduce the net annual CSO volume in Fresh Creek by 52 percent (from 494 MG to 237 MG). The annual CSO volume in Hendrix Creek is calculated to decrease from 36 MG to 18 MG. It should be noted that the treated annual overflow at the Spring Creek AWPCP is calculated to increase by 72 percent (from 98 MG to 135 MG) as a result of the removal of sediment from the sewers and the automation of regulator J-2 in the Jamaica WWTP drainage area to divert additional flow to the CSO facility. Overflow from the Spring Creek CSO retention facility receives preliminary treatment including settleable solids and floatables control. This is true for all the remaining considered alternatives. Both Bergen and Thurston Basins would see a 55 percent and 42 percent reduction in annual overflow volume respectively. Table 7-6 summarizes the CSO reduction and water quality modeling results for Alternative 1.

Table 7-6. Alternative 1 CSO/Water Quality Modeling Results

Item	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	237	18	135	619	120
Percent reduction in Annual CSO Volume	53%	50%	-72%	5%	87%
Number of Projected Overflow Events per Year[3]	27	15	5	55	42
Percent hours DO>4.0 mg/L[2]	72%	78%	81%	50%	60%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	67%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	83%	100%	92%	58%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.

A summary of the cost for each component of Alternative 1 is provided in Table 7-7. The estimated Probable Total Project Cost (PTPC) for Alternative 1 is $1,483.53 million in October 2011.

Table 7-7. Alternative 1 Cost Summary

Component	PTPC ($ Million)
Meadowmere and Warnerville DWO Abatement	$37.6
Expansion of the Wet Weather Capacity at Jamaica WWTP	$592.11
Shellbank Basin Destratification System	$2.6
Laurelton and Springfield Blvd Storm Sewer Buildout	TBD
Regulator Automation at J2	$2.27
Upgrading the Spring Creek AWWTP	$147.69
Sewer Cleaning in the 26th Ward WWTP Drainage Area	$5.78
Hendrix Creek Dredging	$25.2
Expansion of the Wet Weather Capacity at 26th Ward WWTP	$670.28
Total	**$1,483.53**

1. The Laurelton and Springfield Blvd Storm Sewer Buildout project is ongoing with an estimated project cost of $870 million.

7.3.3 Alternative 2: Select Elements of the 2005 Consent Order with Additional CSO Reduction Elements

The expectation in the 2005 CSO Consent Order was that the 50 MGD wet weather expansion of the Jamaica WWTP would reduce CSO discharges to Bergen Basin, a result predicted by the modeling during the Jamaica Tributaries CSO Facility Plan (1996, updated 2003) that served as the basis for the 2003 Consent Order. The relatively simple modeling used at that time failed to identify the hydraulic constrictions in the West Interceptor. With the migration to a more refined InfoWorks CS model, the hydraulics of the West Interceptor were better understood, restrictions associated with regulators J3 and J14 and the downstream double barrel 36-inch Belt Parkway crossing were identified as impacting CSO discharges to Bergen Basin. Moreover, the updated model and subsequent model runs showed that even after complete alleviation of these collection system restrictions expanding plant capacity to 250 MGD results in virtually no additional reduction in CSO volume. This shallow depth of the West Interceptor (relative to its tributary regulator weir levels) and the slope limit the conveyance of flow to the WWTP. In short, the conveyance of flow to the Jamaica WWTP is limited by the collection system and not the WWTP capacity as previously believed. The specific findings that informed this recommendation are:

1. For any given collection system configuration, increasing the capacity of the Jamaica WWTP is not projected to reduce the total annual CSO volume;

2. Equivalent CSO reductions and corresponding increases in treatment volume can be realized by synergistic collection system modifications that target the combined sewer portions of the service area;

3. The total number of hours at or above 200 MGD (i.e. 2XDDWF) would increase marginally with WWTP expansion, but the facility would rarely realize flows above 200 MGD and, as stated previously, there is no corresponding reduction in CSO.

In lieu of the plant expansion, the 2005 Consent Order Mandated Controls were modified removing the expansion of the Jamaica WWTP and including the following system upgrades:

- New Parallel Sewer: The interceptor consists of a 48-inch dry weather interceptor that would parallel and provide additional capacity for the existing West Interceptor. The parallel interceptor would originate upstream of Regulator J3 and extend into the Jamaica WWTP. The project scope would involve constructing approximately 3,500 LF of gravity sewer main via open cut excavation within 150th Street, 149th Street and 134th Street and a 600 LF jack & bore under the Belt Parkway before connecting into the Jamaica WWTP.

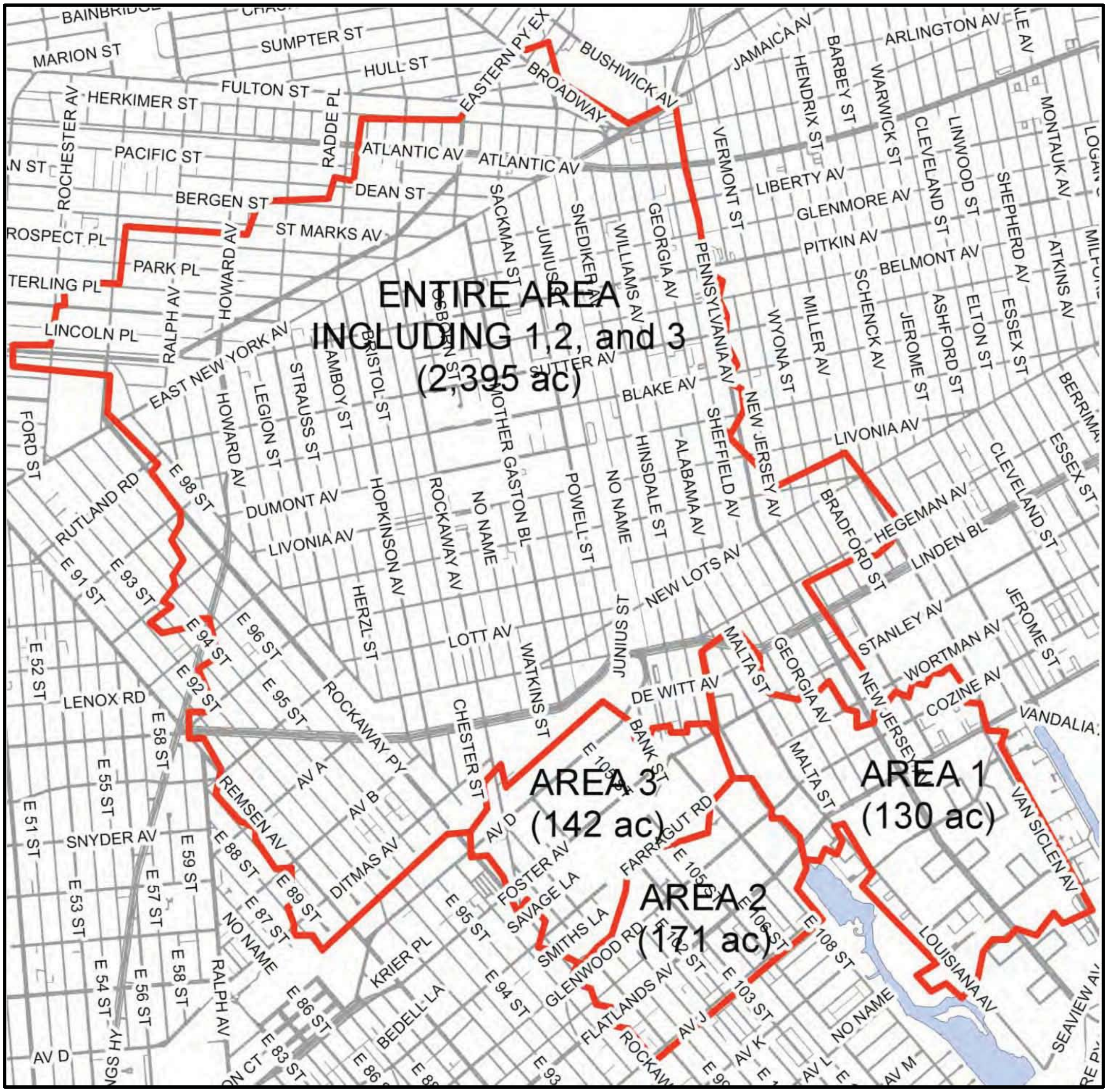
- Regulator Improvements: Install bending weirs at regulators J3, J6 and J14. Enlarge the orifice at J3 from 36”x48” to 60”x60” to help relieve the hydraulic constrictions within the West Interceptor.

The expansion of the 26th Ward WWTP was proposed to coincide with the planned stabilization work taking place at the plant making it cost effective. Since that time, other regulatory and constructability issues have been identified that will further increase associated costs and may present significant permitting issues. As such, the 2005 Consent Order Mandated Controls were modified removing the expansion of the 26th Ward WWTP and including the following system upgrades

- 26th Ward High Level Sewer Separation: Both PlaNYC and the Green Infrastructure Plan consider HLSS as an integral option for cost-effective water quality improvements. HLSS can achieve a range of CSO volume reductions at a range of costs and therefore fits DEP's adaptive management approach by allowing for phased improvements based on milestone measurements, while not impeding the implementation of additional controls. Moreover, the CSO benefit would be accompanied by additional benefits, including reduced flooding, sewer backups, and the number of hours per year that the 26th Ward WWTP would be required to attain 2xDDWF. These factors are a product of the reduction in all runoff to the combined sewer from impervious surfaces, which will reduce overall wet weather flow to the plant. To simulate HLSS in detail, GIS data was used to determine the area within each model subcatchment that is composed of property lots as defined by the Department of City Planning, then assuming that the "non-lot areas" would constitute the streets and sidewalks that would no longer contribute runoff to the combined sewers. Both the total subcatchment area and the percent impervious were recomputed and the model was rerun with the adjusted runoff properties. The Fresh Creek drainage area was targeted, and based on preliminary evaluations, an area totaling 443 acres immediately adjacent to Fresh Creek and extending northward into Brooklyn was the preferred opportunity, the sum of Areas 1, 2, and 3 as shown on Figure 7-7. The total estimated project cost is $110.75 million.
- 26th Ward WTTP Wet Weather Stabilization: This work includes the replacement of both Low Level and High Level Main Sewage Pumps, construction of a new Primary Settling Tank (PST No. 5) to add operating flexibility and reliability to the treatment of 170 MGD wet weather flow, a flow diversion structure to provide for relatively even distribution among the existing and newly constructed primary settling tanks, modifications to existing primary settling tanks to accept flow from the division structure, and modifications to one of the aeration tanks to connect the common primary settling tank effluent channel to the aeration tank influent channel. The Engineer's estimated cost for the pumps is $5 million and $122.7 million for the primary settling tank work.

Additionally, the following items were added to the consent order mandated controls:

- 26th Ward Green Infrastructure Demonstration Project: DEP has submitted the *NYC Green Infrastructure Plan*, which evaluates green infrastructure and other alternatives for this and other combined sewer watersheds as part of DEP's adaptive management strategy. DEP's modeling was based on the management of runoff from 10% of the impervious surfaces in CSO watersheds over 20 years, which was estimated to reduce CSO by 49 MG per year at a cost of $448,000 in the Jamaica Bay and CSO tributaries watershed. The green infrastructure project covers approximately 22 acres in the drainage area as shown on Figure 7-8. Similar to HLSS, the CSO benefit of green infrastructure would be accompanied by additional benefits, including reduced flooding, sewer backups, and the number of hours per year that the 26th Ward WWTP would be required to attain the 2xDDWF. Modeling results indicate that the reduction in flow to the plant is generally twice the reduction in CSO discharge volume.



Environmental Protection

26th Ward HLSS Areas

Environmental Protection

Green Infrastructure Pilot Study Area

- Solids and Floatables Controls: Continued use of the booms for floatables control in Bergen and Thurston Basins. The Bergen Basin boom has proven to have a high productivity rate and consistent production, while the Thurston Basin boom was determined to have sporadic, but improving, productivity (HydroQual, 2006).
- Implement a Post-Construction Water Quality Monitoring Plan

Implementation of Alternative 2 is calculated to reduce the net annual CSO volume in Fresh Creek by 62 percent (from 494 MG to 189 MG). As shown in Table 7-8, the majority of the CSO reduction is in Thurston Basin were annual overflow volume is calculated to decrease by 94 percent and capture 50 percent of the annual overflow volume in Bergen Basin.

Table 7-8. Alternative 2 CSO/Water Quality Modeling Results

Item	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	189	35	135	325	53
Percent reduction in Annual CSO Volume	62%	3%	-72%	50%	94%
Number of Projected Overflow Events per Year[3]	26	16	5	62	17
Percent hours DO>4.0 mg/L[2]	58%	63%	86%	73%	75%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	83%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	92%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins.
3. Based on number of CSO events >0.01 MG.
4. The Laurelton and Springfield Blvd Storm Sewer Buildout project is ongoing and is included in the modeling for this alternative.

A summary of the cost for each component of Alternative 2, each of which is included in all subsequent alternatives, is provided in Table 7-9. The estimated Probable Total Project Cost (PTPC) for Alternative 2 is $439.0 million.

Table 7-9. Alternative 2 Cost Summary

Component	PTPC ($ Million)
Meadowmere and Warnerville DWO Abatement	$37.6
Shellbank Basin Destratification System	$2.6
Regulator Automation at J2	$2.27
Upgrading the Spring Creek AWWTP	$147.69
Sewer Cleaning in the 26th Ward WWTP Drainage Area	$5.78
Hendrix Creek Dredging	$25.42
New 48-inch Parallel Sewer in JB WWTP	$17.6
Regulator Improvements at J3, J6, and J14	$3.6
26th Ward High Level Sewer Separation	$110.75
26th Ward WTTP Wet Weather Stabilization	$127.7
26th Ward Green Infrastructure Demonstration Project	$0.45
Total	**$439.0**

1. The Laurelton and Springfield Blvd Storm Sewer Buildout project in

ongoing with an estimated project cost of $870 million is included in the modeling for this alternative.

7.3.4 Alternative 3: 24 MG Fresh Creek CSO Storage Tunnel

A smaller CSO storage tunnel size was considered that would reduce the number of overflow events in Fresh Creek from 70 to 4 events annually. This alternative is similar in nature to the 100 percent CSO Storage Tunnel alternative (e.g. evaluated after implementation of the Consent Order mandated controls), but would be capable of retaining 24 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Fresh Creek from 237 MG to 27 MG.

This tunnel was conceptually designed to be approximately 8,440 feet in length, at a depth of 100-150 feet below grade and a diameter of 22 feet. The 24 MG CSO storage tunnel would have a similar layout and configuration as the 100 percent CSO storage tunnel, including the construction of a pump station and force main system that would convey the retained CSO directly to the 26th Ward WWTP. The probable total project cost for this alternative is approximately $776.6 million, including the costs for the Consent Order Controls.

As summarized in Table 7-12, the Fresh Creek 24 MG CSO Storage Tunnel alternative is estimated to reduce annual CSO volume in the Fresh Creek by 95 percent.

Table 7-12. Alternative 3 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	27	35	135	325	53
Percent reduction in Annual CSO Volume	95%	3%	-72%	50%	94%
Number of Projected Overflow Events per Year[3]	4	16	5	62	17
Percent hours DO>4.0 mg/L[2]	78%	63%	86%	73%	75%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	83%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	100%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

A summary of the cost for each component of Alternative 3 is provided in Table 7-13. The estimated Probable Total Project Cost (PTPC) for Alternative 3 is $1,373.8 million.

Table 7-13. Alternative 3 Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
24 MG Fresh Creek Tunnel	$934.8

Total	**$1,373.8**

7.3.5 Alternative 4: 14 MG Fresh Creek CSO Storage Tunnel

A smaller CSO storage tunnel size was considered that would reduce the number of overflow events in Fresh Creek from 70 to 8 events annually. This alternative is similar in nature to the previously described storage tunnels (e.g. evaluated after implementation of the Consent Order mandated controls), but would be capable of retaining 14 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Fresh Creek from 237 MG to 81 MG.

This tunnel was conceptually designed to be approximately 8,355 feet in length, at a depth of 100 – 150 feet below grade and a diameter of 18 feet. The 14 MG CSO storage tunnel would have a similar layout and configuration as the 45 MG and 24 MG CSO storage tunnels, including the construction of a pump station and force main system that would convey the retained CSO directly to the 26th Ward WWTP. The probable total project cost for this alternative is approximately $694.6 million, including the costs for the Consent Order Controls.

As summarized in Table 7-14, Alternative 4 is estimated to reduce annual CSO volume in Fresh Creek by 84 percent.

Table 7-14. Alternative 4 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	81	35	135	325	53
Percent reduction in Annual CSO Volume	84%	3%	-72%	50%	94%
Number of Projected Overflow Events per Year[3]	8	16	5	62	17
Percent hours DO>4.0 mg/L[2]	73%	63%	86%	73%	75%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	83%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	100%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. The Laurelton and Springfield Blvd Storm Sewer Buildout project is ongoing and is included in the modeling for this alternative.

A summary of the cost for each component of Alternative 4 is provided in Table 7-15. The estimated Probable Total Project Cost (PTPC) for Alternative 4 is $1,373.8 million.

Table 7-15. Alternative 4 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
14 MG Fresh Creek Tunnel	$817.2
Total	**$1,256.2**

7.3.6 Alternative 5: 40 MG Storage Tunnel in Bergen Basin

A smaller CSO storage tunnel size was considered that would reduce the number of overflow events in Bergen Basin from 55 to 4 events annually. This alternative is similar in nature to the previously described storage tunnels (e.g. evaluated after implementation of the Consent Order Mandated Control - Plan #2), but would be capable of retaining 40 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Bergen Basin from 394 MG (after the implementation of the Modified Consent Order Mandated Controls - Plan #2) to 115 MG.

This tunnel was conceptually designed to be approximately 18,020 feet in length, at a depth of 100 – 150 feet below grade and a diameter of 20 feet. The 40 MG CSO storage tunnel would have a similar layout and configuration as the 100 percent CSO storage tunnel, including the construction of a pump station and force main system that would convey the retained CSO directly to the Jamaica WWTP, an access/vent shaft along the length of the tunnel and diversion piping between the existing regulators and the deep tunnel. The probable total project cost for this alternative is approximately $809.7 million, including the costs for the Consent Order Mandated Controls – Plan #2 alternative.

As summarized in Table 7-16, Alternative 5 is estimated to reduce annual CSO volume in the Bergen Basin by 62 percent.

Table 7-16. Alternative 5 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	189	35	135	115	53
Percent reduction in Annual CSO Volume	62%	3%	-72%	82%	94%
Number of Projected Overflow Events per Year[3]	26	16	5	4	17
Percent hours DO>4.0 mg/L[2]	58%	63%	86%	53%	75%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	92%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	92%	100%	100%	83%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

A summary of the cost for each component of Alternative 5 is provided in Table 7-17. The estimated Probable Total Project Cost (PTPC) for Alternative 5 is $1,579.3 million.

Table 7-17. Alternative 5 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
40 MG Bergen Basin Tunnel	$1,140.3
Total	**$1,579.3**

7.3.7 Alternative 6: 22 MG Storage Tunnel in Bergen Basin

A third CSO storage tunnel size was considered that would reduce the number of overflow events in Bergen Basin from 55 to 8 events. This alternative is similar in nature to the previously described storage tunnels (e.g. evaluated after implementation of the Consent Order Mandated Control - Plan #2), but would be capable of retaining 22 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Bergen Basin from 394 MG to 303 MG.

This tunnel was conceptually designed to be approximately 18,100 feet in length, at a depth of 100 – 150 feet below grade and a diameter of 14 feet. The 22 MG CSO storage tunnel would have a similar layout and configuration as the 53 MG and 40 MG CSO storage tunnels, including the construction of a pump station and force main system that would convey the retained CSO directly to the Jamaica WWTP, an access/vent shaft along the length of the tunnel and diversion piping between the existing regulators and the deep tunnel. The probable total project cost for this alternative is approximately $689.6 million, including the costs for the Consent Order Mandated Controls - Plan #2 alternative.

As summarized in Table 7-18, Alternative 6 is estimated to reduce annual CSO volume in the Bergen Basin by 53 percent.

Table 7-18. Alternative 6 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	189	35	135	303	53
Percent reduction in Annual CSO Volume	62%	3%	-72%	53%	94%
Number of Projected Overflow Events per Year[3]	26	16	5	8	17
Percent hours DO>4.0 mg/L[2]	58%	63%	86%	50%	75%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	83%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	92%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

A summary of the cost for each component of Alternative 6 is provided in Table 7-19. The estimated Probable Total Project Cost (PTPC) for Alternative 6 is $1,407.2 million.

Table 7-19. Alternative 6 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
22 MG Bergen Basin Tunnel	$968.2
Total	**$1,407.2**

7.3.8 Alternative 7: 6.1 MG CSO Storage Tunnel in Thurston Basin

A smaller CSO storage shaft size was considered that would reduce the number of overflow events in Thurston Basin from 52 to 4 events annually. This alternative is similar in nature to the previously described storage shaft (e.g. evaluated after implementation of the Consent Order Mandated Controls - Plan #2), but would be capable of retaining 6.1 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Thurston Basin from 87 MG (after the implementation of the Modified Consent Order Mandated Controls - Plan #2) to 17 MG.

This storage shaft was conceptually designed to be approximately 100 feet in diameter and a depth of 130 feet below grade. The 6.1 MG CSO storage shaft would have a similar layout and configuration as the 100 percent CSO storage shaft, including the construction of a pump station and force main system that would convey the retained CSO into the nearby combined sewer system after secondary treatment capacity has been restored at the Jamaica WWTP. The probable total project cost for this alternative is approximately $411.4 million, not including the costs for the HLSS in Laurelton and other proposed improvements recommended in the Southeast Queens Drainage Plan.

As summarized in Table 7-20, the Alternative 7 is estimated to reduce annual CSO volume in the Thurston Basin by 98 percent.

Table 7-20. Alternative 7 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Percent hours DO>4.0 mg/L[2]	189	35	135	325	17
Percent months total coliform <10,000 per 100 mL[2]	62%	3%	-72%	50%	98%
Percent months fecal coliform <2,000 per 100 mL[2]	26	16	5	62	4
Annual CSO Volume (MG)	58%	63%	86%	73%	61%
Percent reduction in Annual CSO Volume	100%	100%	100%	83%	100%
Number of Projected Overflow Events per Year[3]	92%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

A summary of the cost for each component of Alternative 7 is provided in Table 7-21. The estimated Probable Total Project Cost (PTPC) for Alternative 7 is $1,028.8 million.

Table 7-21. Alternative 7 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
6.1 MG Bergen Basin Tunnel	$589.8

Total	**$1,028.8**

7.3.9 Alternative 8: 4 MG Storage Tunnel in Thurston Basin

A third CSO storage shaft size was considered that would reduce the number of overflow events in Thurston Basin from 52 to 8 events. This alternative is similar in nature to the previously described storage shaft (e.g. evaluated after implementation of the Consent Order Mandated Control - Plan #2), but would be capable of retaining 4 MG of CSO during a wet weather event. This alternative would reduce annual CSO volume in Thurston Basin from 87 MG (after the implementation of the Modified Consent Order Mandated Controls - Plan #2) to 25 MG.

This storage shaft was conceptually designed to be approximately 100 feet in diameter and a depth of 100 feet below grade. The 4 MG CSO storage shaft would have a similar layout and configuration as the 11 MG and 6.1 MG CSO storage shafts, including the construction of a pump station and force main system that would convey the retained CSO into the nearby combined sewer system after secondary treatment capacity has been restored at the Jamaica WWTP. The probable total project cost for this alternative is approximately $368.9 million, not including the costs for the HLSS in Laurelton and other proposed improvements recommended in the Southeast Queens Drainage Plan.

As summarized in Table 7-22, Alternative 8 is estimated to reduce annual CSO volume in the Thurston Basin by 97 percent.

Table 7-22. Alternative 8 CSO/Water Quality Modeling Results

Item	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	189	35	135	325	25
Percent reduction in Annual CSO Volume	62%	3%	-72%	57%	97%
Number of Projected Overflow Events per Year[3]	26	16	5	62	8
Percent hours DO>4.0 mg/L[2]	58%	63%	86%	73%	60%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	83%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	92%	100%	100%	75%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

A summary of the cost for each component of Alternative 8 is provided in Table 7-23. The estimated Probable Total Project Cost (PTPC) for Alternative 8 is $967.9 million.

Table 7-23. Alternative 8 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0

4 MG Bergen Basin Tunnel	$528.9
Total	**$967.9**

7.3.10 Alternative 9: Full Separation of Sewers in Jamaica Bay Service Area

As discussed, earlier sewer separation as a CSO control alternative was retained for further consideration. An assessment was made of the pollution control benefits of complete sewer separation as it compares to the CSO Consent Order mandated controls to assess whether sewer separation should continued to be considered herein as a CSO control option. The analysis consisted of using the calibrated sewer system model to determine the loadings of carbon generated by a separated sewer system and by a sewer system with the CSO Consent Order mandated controls. Table 7-24 presents the results. As can be seen, there is virtually no difference. A complete separation of sewers in the Jamaica WWTP service areas would not result in any benefit to the CSO tributaries or to Jamaica Bay, as the total carbon and BOD loadings are computed to be virtually identical for both scenarios. Since the CSO Consent Order mandated controls will divert to the WWTP, a large amount of the wet weather flow in the combined sewer system, capture of floatables under this scenario will in fact be greater than if the sewers were completely separated. Therefore this alternative has been eliminated from further consideration.

Table 7-24. Carbon Loadings to Jamaica WWTP Tributaries, CSO Consent Order Mandated Controls Compared to Full Separation

Watershed		Jamaica Sewershed		
		Flow (MGD)	Total Carbon (lbs/Day)	BOD (lbs/Day)
CSO Consent Order mandated controls	WWTP	93.24	8640	5814
	CSO	1.42	291	329
	Stormwater	29.54	3818	2096
	Total	124.2	**12749**	**8239**
Complete Sewer Separation	WWTP	88.04	8156	5490
	CSO	0	0	0
	Stormwater	36.16	4674	2569
	Total	124.2	**12830**	**8059**

7.3.11 Alternative 10: 100 Percent Capture CSO Storage Tunnel

An analysis was conducted to assess the size of a CSO tunnel required to completely retain all CSOs during the 1988 reference year precipitation pattern. As noted, tunnels were selected to be used for storage. Tunnels/shafts were chosen as the preferred storage units over retention tanks since there is no room within any of the tributaries or at any of the WWTP facilities in the Jamaica Bay Sewershed to construct tanks. Table 7-25 demonstrates the tunnel locations and reasons to include for evaluation or reject.

Table 7-25. Tunnel Locations and Reasons to Include or Reject

Tributary	Tunnel Viability	Reason
Fresh Creek	Yes	Tunnel would run from a Drop Shaft at the outfall structure and then run under Fresh Creek to Pump Shaft south of 26th Ward WWTP (Figure 7-9)
Hendrix Creek	No	In-line storage would provide 100 percent capture at a much lower cost than routing Hendrix Creek CSO to a tunnel.
Spring Creek	No	Spring Creek has an AWWTP that captures CSO flow. Any overflow from the AWWTP receives preliminary (settleable solids and floatables control) and therefore is not considered CSO.
Bergen Basin	Yes	Tunnel would run from a Drop Shaft between Regulators #3 & #14 to Work Shaft on west shore of Bergen Basin to Vent Shaft on Broad Channel (Figure 7-10)
Thurston Basin	Yes	Due to unavailability of land and constructability issues, a deep storage shaft will be considered in lieu of a deep storage tunnel

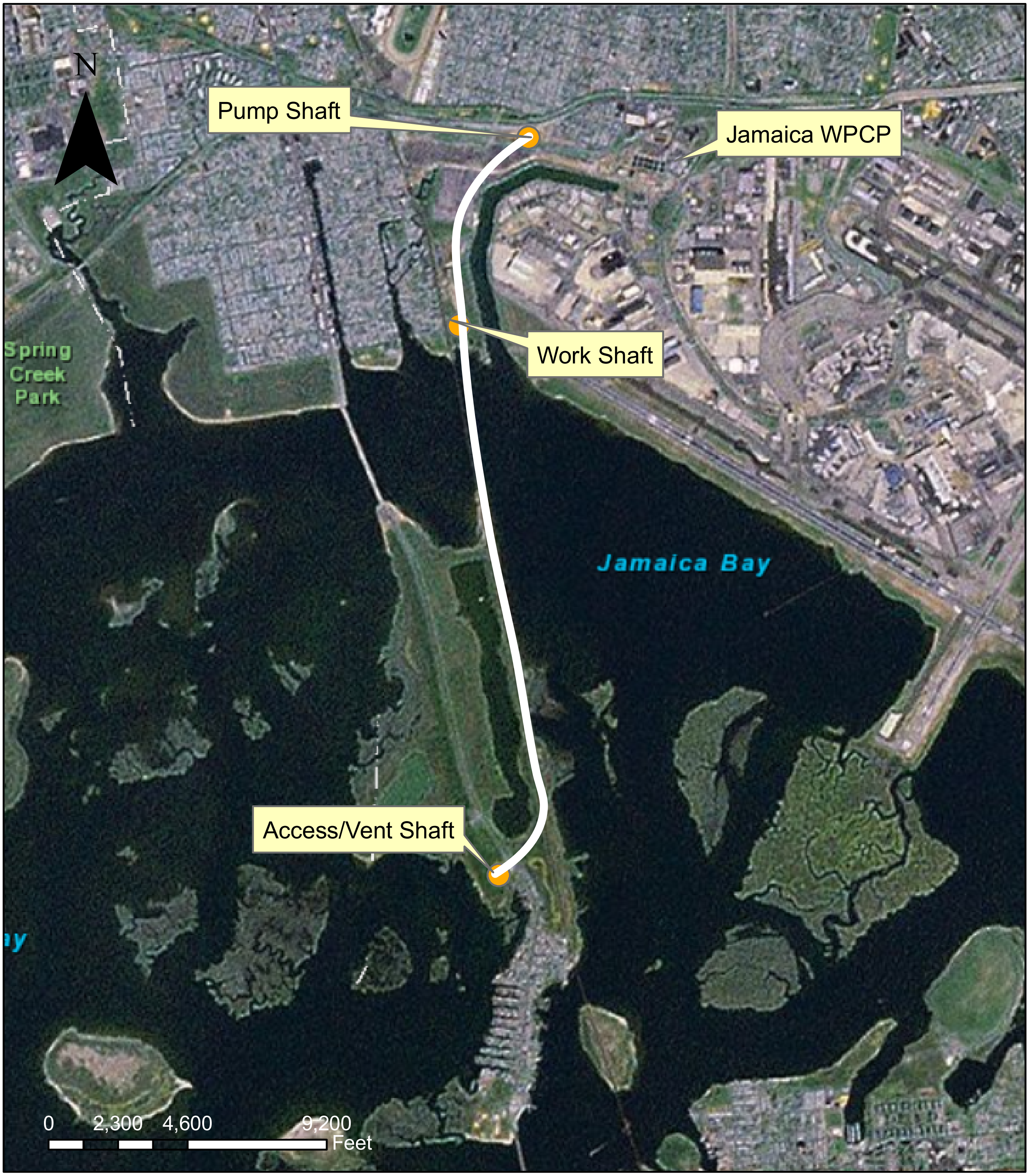
This alternative would involve construction of deep storage tunnels to intercept and store all CSO that would normally be discharged into the Jamaica Bay CSO tributaries during a wet weather event. The CSO stored in the tunnels would be pumped directly to the 26th Ward WWTP from the Fresh Creek and Jamaica Bay WWTP from the Bergen Basin and Thurston Basin tunnels after the appropriate secondary treatment capacity has been restored. The 100 percent storage tunnel alternative is evaluated after implementation of the Consent Order mandated controls. Sizing of the tunnels is summarized in Table 7-26 below.

Table 7-26. 100% Tunnel/Shaft Conceptual Sizing

	Fresh Creek Tunnel	Bergen Basin Tunnel	Thurston Basin Shaft
Storage Capacity (MG)	45	53	11
Length (ft)	8,415	18,610	150
Depth below Grade (ft)	100-150	100 - 150	NA
Diameter (ft)	30	22	125
Discharge WWTP	26th Ward	Jamaica Bay	Jamaica Bay

The Fresh Creek tunnel would have an entry/pump shaft near the vicinity of the 26th Ward WWTP, run southerly to the Spring Creek Park, southwesterly from Spring Creek Park towards the mouth of Fresh Creek and then northerly along Fresh Creek to the outfall structure dropshaft (see Figure 7-9). A pump station and force main system would be constructed at the drop/pump shaft, which would convey the retained CSO directly to the 26th Ward WWTP.

The Bergen Basin tunnel would have an entry/pump shaft near the vicinity of Regulators #3 and #14 and run southerly along the subway line, angling into the Broad Channel to an access shaft located along Cross Bay Boulevard (see Figure 7-10). A pump station and force main system would be constructed at the entry/pump shaft, which would convey the retained CSO directly to the Jamaica WWTP. In addition to the pump station, the Bergen Basin storage tunnel would also consist of the construction of an access/vent shaft and diversion piping between the existing regulators and the deep tunnel.



Environmental Protection

Bergen Basin Tunnel
100% Capture for Treatment

A deep shaft design was utilized instead of a storage tunnel for Thurston Basin because the construction of a deep tunnel would cause significant disruption to the surrounding neighborhood(s) and it would be difficult, if not impossible, to locate available land for its construction. The deep storage shaft was conceptually located near the vicinity of Regulator #6 and would be expected to occupy an entire city block. As a result, we have built in land acquisition costs into the overall cost of any deep storage shaft project. However, it is anticipated that any land acquisition process to construct a deep storage shaft would be met with strong opposition from the neighborhood/community. The probable total project cost for this alternative is approximately $542.1 million, not including the costs for the HLSS in Laurelton and other proposed improvements recommended in the Southeast Queens Drainage Plan.

As summarized in Table 7-27, Alternative 10 is estimated to reduce annual CSO volume to the CSO Tributaries and thereby Jamaica Bay by nearly 100 percent.

Table 7-27. Alternative 10 CSO/Water Quality Modeling Results

	Fresh Creek Value	Hendrix Creek Value	Spring Creek Value[1]	Bergen Basin Value	Thurston Basin Value
Annual CSO Volume (MG)	0	35	135	0	0
Percent reduction in Annual CSO Volume	100%	3%	-72%	100%	100%
Number of Projected Overflow Events per Year[3]	0	16	5	0	0
Percent hours DO>4.0 mg/L[2]	80%	63%	86%	53%	62%
Percent months total coliform <10,000 per 100 mL[2]	100%	100%	100%	92%	100%
Percent months fecal coliform <2,000 per 100 mL[2]	100%	100%	100%	83%	100%

Note:
1. The Spring Creek tank has a treated annual overflow volume of 135 MG. However, this overflow receives preliminary treatment.
2. Values calculated at the head end for Bergen and Thurston Basins
3. Based on number of CSO events >0.01 MG.
4. Laurelton Ave HLSS project is included in these projections.

The 100 percent CSO capture alternative as noted in Table 7-28 was calculated to reduce CSO overflows to zero in Fresh Creek, Bergen Basin, and Thurston Basin. Pathogens were calculated to attain the numerical criteria 100 percent of the time and DO concentrations were calculated to increase to 80 percent annual attainment.

A summary of the cost for each component of Alternative 10 is provided in Table 7-28. The estimated Probable Total Project Cost (PTPC) for Alternative 10 is $3,620.1 million.

Table 7-28. Alternative 10 Cost Summary

Component	PTPC ($ Million)
Alternative 2	$439.0
45MG Fresh Creek Tunnel	$1,116.1
53 MG Bergen Basin Tunnel	$1,287.9
11 MG Thurston Basin Tunnel	$777.1
Total	**$3,620.1**

7.4 EVALUATION OF ALTERNATIVE PLANS

7.4.1 CSO Reduction

The computerized landside hydrualic models were used to assess the ability of each of these alternatives to reduce overflows to the CSO Tributaries and thereby Jamaica Bay. The Baseline annual untreated overflow volume was calculated by adding the overflow volumes for the CSOs discharging to the tributaries of Jamaica Bay (shown in Table 7-5 above).

The alternatives span a wide range of CSO reduction. Hydraulic model results are summarized in Table 7-29 along with each alternative's cost. The annual percent CSO reduction and CSO volume/number of CSO events for the alternatives were plotted against probable total project cost in Figures 7-10 and 7-11, respectively.

- Alternative 2 consists of a multifaceted combination of CSO reduction alternatives. This alternative reduces the annual CSO volume 66 percent compared to baseline conditions and while the number of overflow events increases compared to the original facility plan (Alternative 1), Alternative 2 decreases the annual CSO overflow volume an additional 35 percent compared to the original facility plan components at a lower cost. This is a substantial decrease in annual overflow volume, provided by a lower cost, highly implementable alternative. Therefore, Alternative 2 was retained for further consideration.
- The storage tunnels in Alternative 10 can achieve a significant degree of CSO reduction, calculated to reduce the number of overflow events to zero per year. Therefore, these tunnels were retained for further consideration.
- Alternatives 3 through 8 consist of large storage tunnels of varying sizes to complement Alternative 2. These alternatives offer only a slight overall reduction in CSO volume and events at a substantial increase in cost. Therefore, Alternatives 3 through 8 were eliminated from further consideration.
- Based on knee-of-curve analyses, Alternatives 2 and 10 are the most promising.

Table 7-29. Summary of Jamaica Bay and CSO Tributaries Alternative Plans

Alternative	Description	PTPC ($ millions)	Events per year	Annual Untreated Overflow Volume[1, 2] (MG/year)	% CSO Reduction from Baseline
	Baseline	N/A	195	2185	N/A
1	2005 Consent Order Mandated Controls	$1,482.5	55	1129	48
2	Select Elements of 2005 Consent Order with Additional Combination of CSO Reduction Technologies	$439.0	62	737	66
3	Alternative 2 with 24 MG Fresh Creek CSO Storage Tunnel	$1,373.8	62	575	74
4	Alternative 2 with 14 MG Fresh Creek CSO Storage Tunnel	$1,256.2	62	629	71
5	Alternative 2 with 40 MG Bergen Basin	$1,579.3	26	527	76

Alternative	Description	PTPC ($ millions)	Events per year	Annual Untreated Overflow Volume[1, 2] (MG/year)	% CSO Reduction from Baseline
	CSO Storage Tunnel				
6	Alternative 2 with 22 MG CSO Storage Tunnel in Bergen Basin	$1,407.2	26	715	67
7	Alternative 2 with 6.1 MG CSO Storage Shaft in Thurston Basin	$1,028.8	62	701	68
8	Alternative 2 with 4 MG CSO Storage Shaft in Thurston Basin	$967.9	62	709	68
9	Alternative 2 with Jamaica Bay WWTP Service Area Sewer Separation	--	--	--	--
10	Alternative 2 with 100% Capture Tunnels/Shaft	$3,620.1	16	170	92

1. Based on number of CSO events >0.01 MG.
2. Includes 135 MG of annual overflow from Spring Creek AWPCP which provides preliminary treatment.

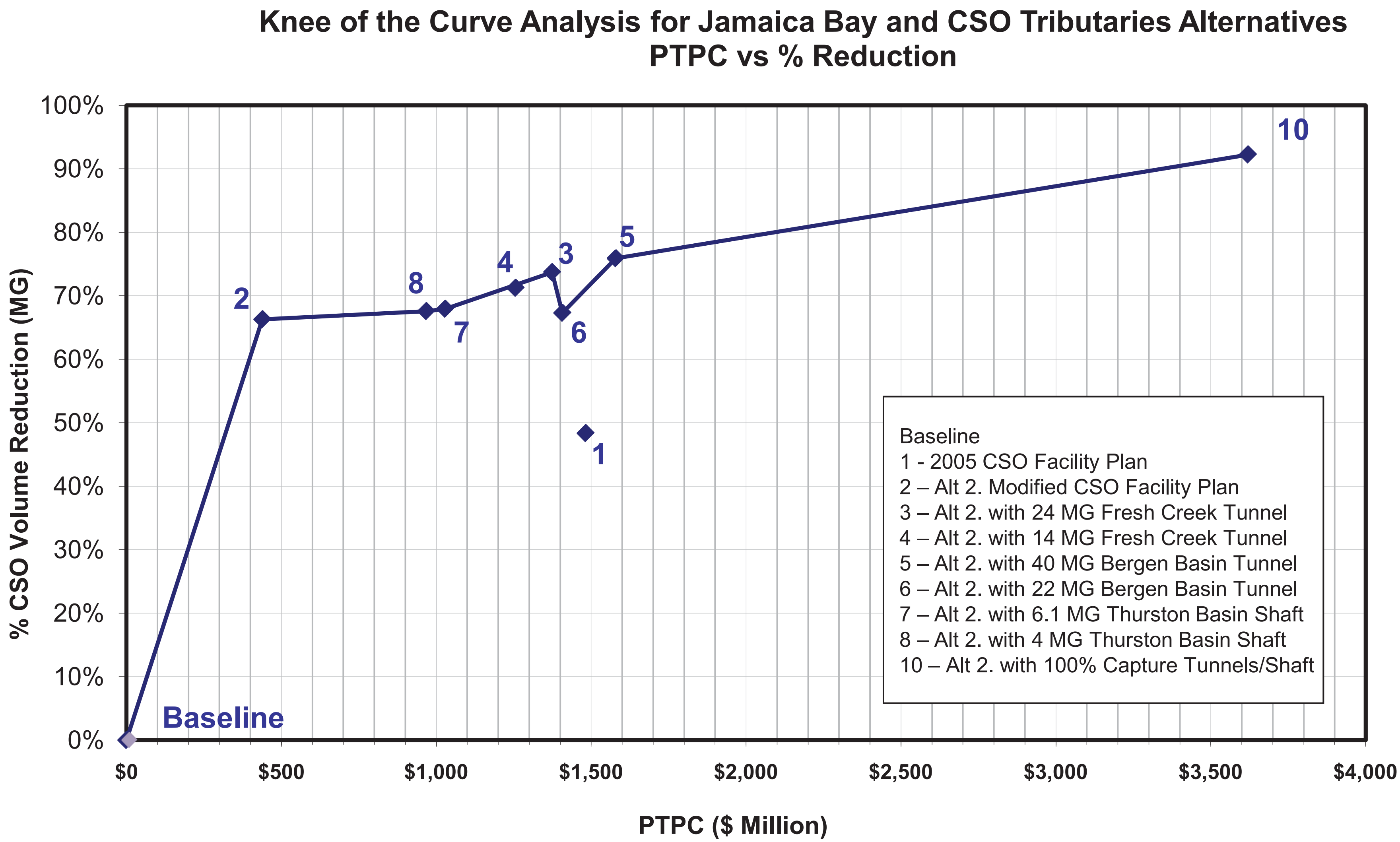
Alternatives 2 and 10 were evaluated using the water quality model and compared to the baseline water quality results.

7.4.2 Water Quality Benefits of Alternative Plans

To evaluate their impacts to water quality in Jamaica Bay, the baseline, Alternative 2, and 100 percent capture were analyzed using the receiving water quality model. These analyses focused on the improvements in DO concentration and pathogen (coliform) levels resulting from the various alternatives. Under baseline conditions, the water quality of Jamaica Bay is affected by the CSO discharges from Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin. There are no CSOs that discharge directly into Jamaica Bay.

DO Improvements

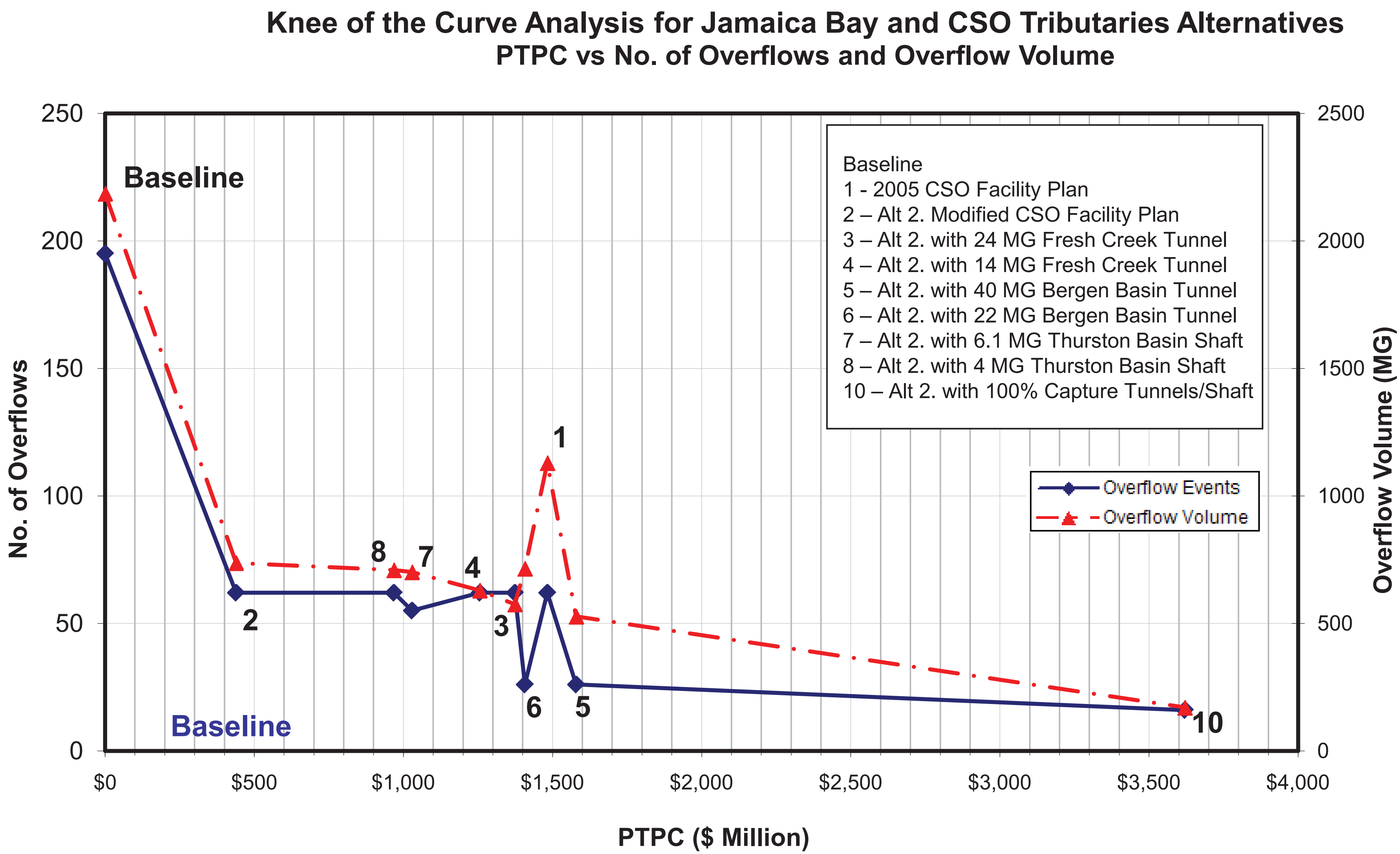
Attainment for DO is determined as a percentage of hours during the year that comply with the applicable existing Class I criteria for the CSO Tributaries. Figure 7-13 presents baseline conditions in the CSO Tributaries. Under baseline conditions, Class I DO criteria is projected to be met a minimum of 57 percent of the time in Fresh Creek, 61 percent of the time in Hendrix Creek, 87 percent of the time in Spring Creek, 72 percent of the time in Bergen Basin, and 63 percent of the time in Thurston Basin. Figure 7-14 shows the annual and summer attainment of Class SB dissolved oxygen standards in Jamaica Bay. Rockaway Inlet and the western portions of the bay complies nearly 100 percent of the time throughout the entire year. The eastern portion of the bay near Thurston Basin and JFK



NYC Environmental Protection

CSO Volume Reduction vs. PTPC

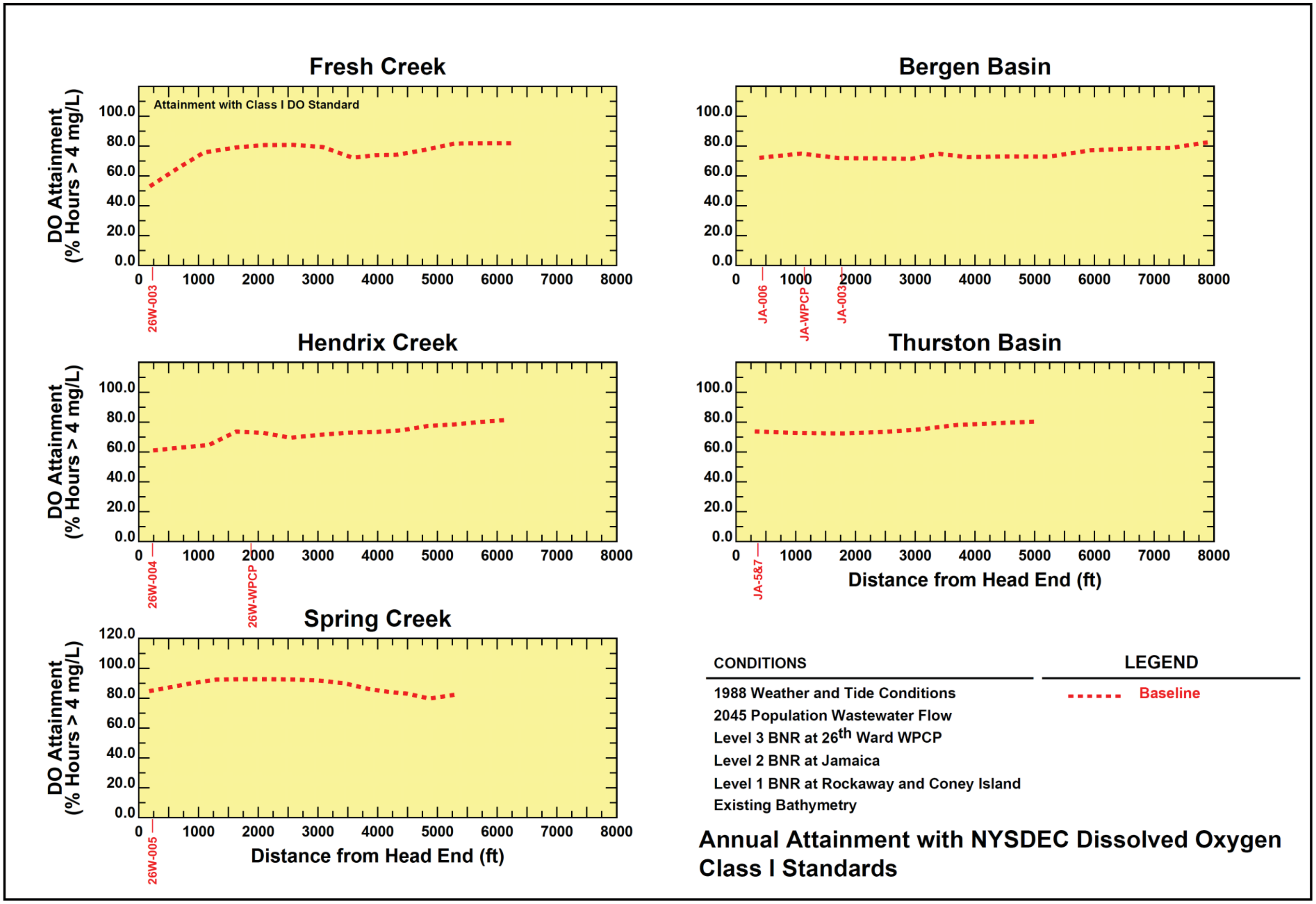
FIGURE 7-10



NYC Environmental Protection

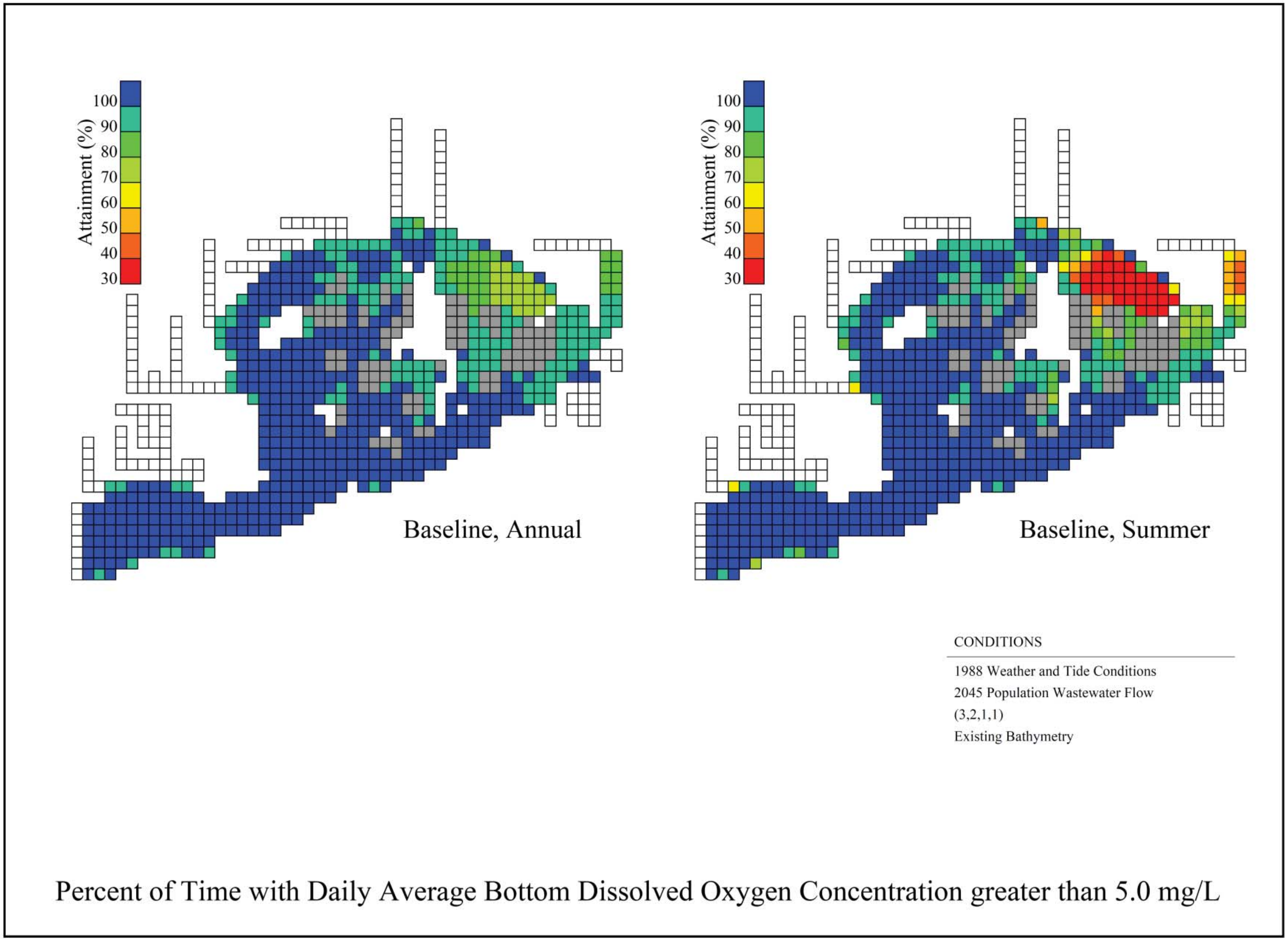
No. of Overflows and Overflow Volume vs. PTPC

FIGURE 7-11



CSO Tributaries Baseline Annual Attainment With Class I DO Standards

FIGURE 7-12



Jamaica Bay Baseline Attainment with Current NYSDEC Dissolved Oxygen Standards

FIGURE 7-13

International Airport shows compliance as low as 30 percent of the time during summer months and 60 percent of the time annually.

A comparison of annual attainment of DO standards for Baseline conditions, Alternative 2, and 100 percent capture are shown in Figure 7-15. For all the CSO tributaries Alternative 2 and 100 percent capture show almost identical improvement in DO concentrations. For Alternative 2, Class I DO criteria are projected to be met 58 percent of the time in Fresh Creek, 63 percent of the time in Hendrix Creek, near 86 percent of the time in Spring Creek, 73 percent in Bergen Basin, and 75 percent of the time in Thurston Basin. Figure 7-16 shows that baseline and the 100% capture option show almost identical DO attainment. It should be noted that while the modeling projections indicate that higher aquatic uses (fish propagation, never less than 4.0 mg/L) will not be met 100 percent of the time at all locations within the tributaries, capturing 100 percent of the CSO does not achieve full compliance. This indicates the non-attainment of DO in Jamaica Bay and its CSO tributaries is not directly attributed to CSO discharges.

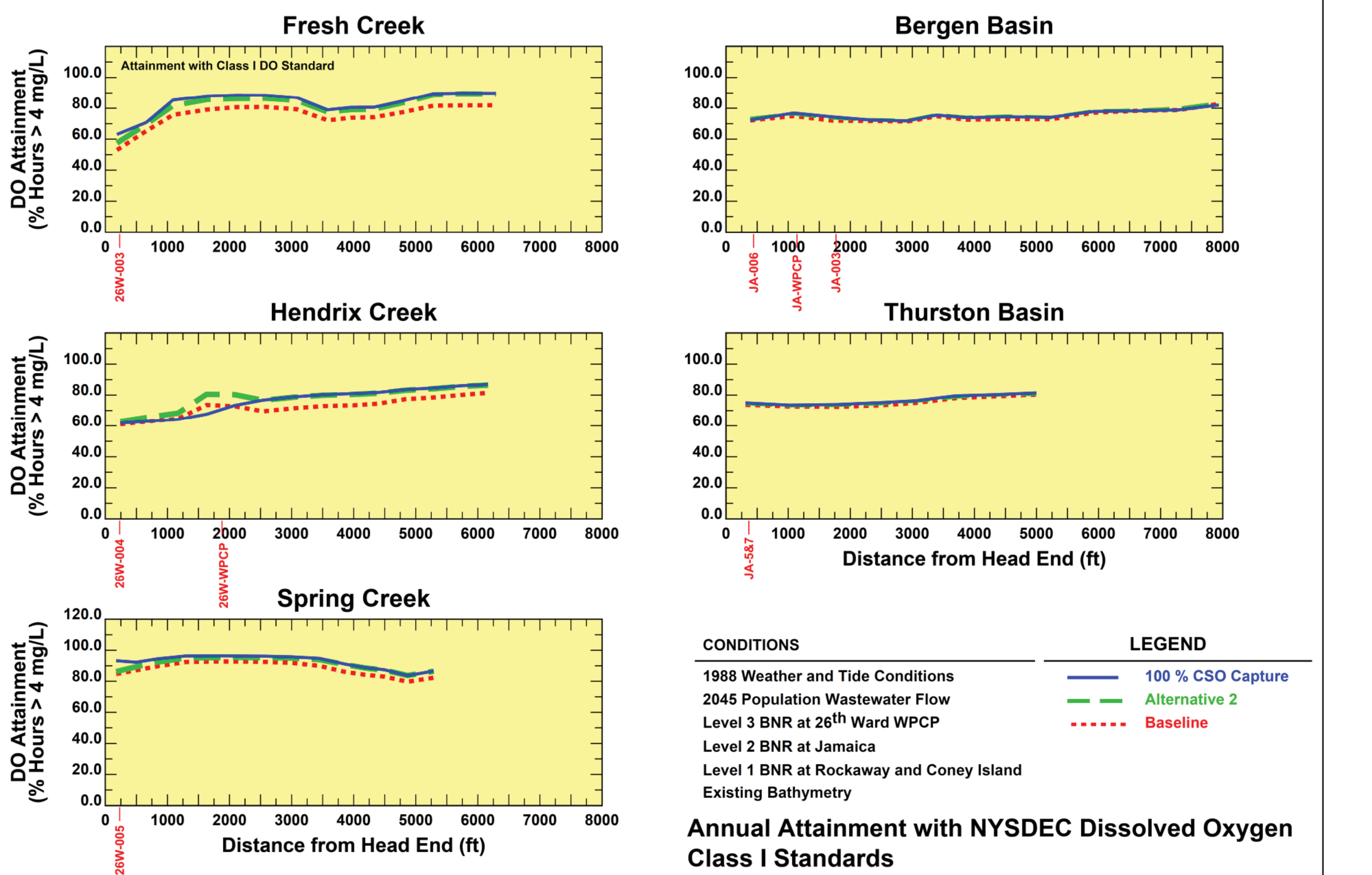
Total and Fecal Coliform Improvements

Model runs to quantify pathogen concentrations for each CSO tributary were conducted for the baseline, Alternative 2, and 100 percent capture. Attainments for total coliform and fecal coliform percentages are based upon meeting the geometric mean numerical criteria for a given month.

Figure 7-17 presents the annual attainment with NYSDEC Class I total coliform standards for baseline conditions for the CSO tributaries. Hendrix and Spring Creek were shown to be in complete compliance throughout the entire length of the waterbodies under baseline conditions. Under baseline conditions, Class I total coliform criteria is projected to be met a minimum of 75 percent of the time at the head end of Fresh Creek and near 100 percent compliance approximately 4000 feet into Fresh Creek. Bergen Basin complies with total coliform standards 67 to nearly 100 percent of the time under baseline conditions with variances along the length of the basin. Thurston Basin complies with total coliform standards 92 percent of the time and reaches nearly 100 percent compliance 2500 feet into the basin. As shown on Figure 7-18, Jamaica Bay is in continuous compliance with NYSDEC Class SB Total Coliform standards throughout the entire bay.

As shown on Figure 7-19, Alternative 2 provides nearly the exact same percent compliance with total coliform standards as the 100 percent capture option. The total coliform criteria for Alternative 2 are projected to be 100 percent in attainment throughout the year in Fresh, Hendrix, and Spring Creek as well as Thurston Basin. Furthermore, only approximately the first ½ mile of Bergen Basin shows less than 100 percent but great than 83 percent compliance. Fresh Creek shows a greater than 20 percent improvement in compliance for Alternative 2 while Bergen Basin is projected to improve its annual compliance from a minimum of 67 percent to 83 percent. Thurston Basin improves from slightly over 92 percent compliance to full compliance through the basin.

Figure 7-20 presents the annual attainment with NYSDEC Class I fecal coliform standards for baseline conditions for the CSO tributaries. Again Hendrix and Spring Creek show full compliance with fecal coliform standards along their entire lengths under baseline



CONDITIONS
1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica
Level 1 BNR at Rockaway and Coney Island
Existing Bathymetry

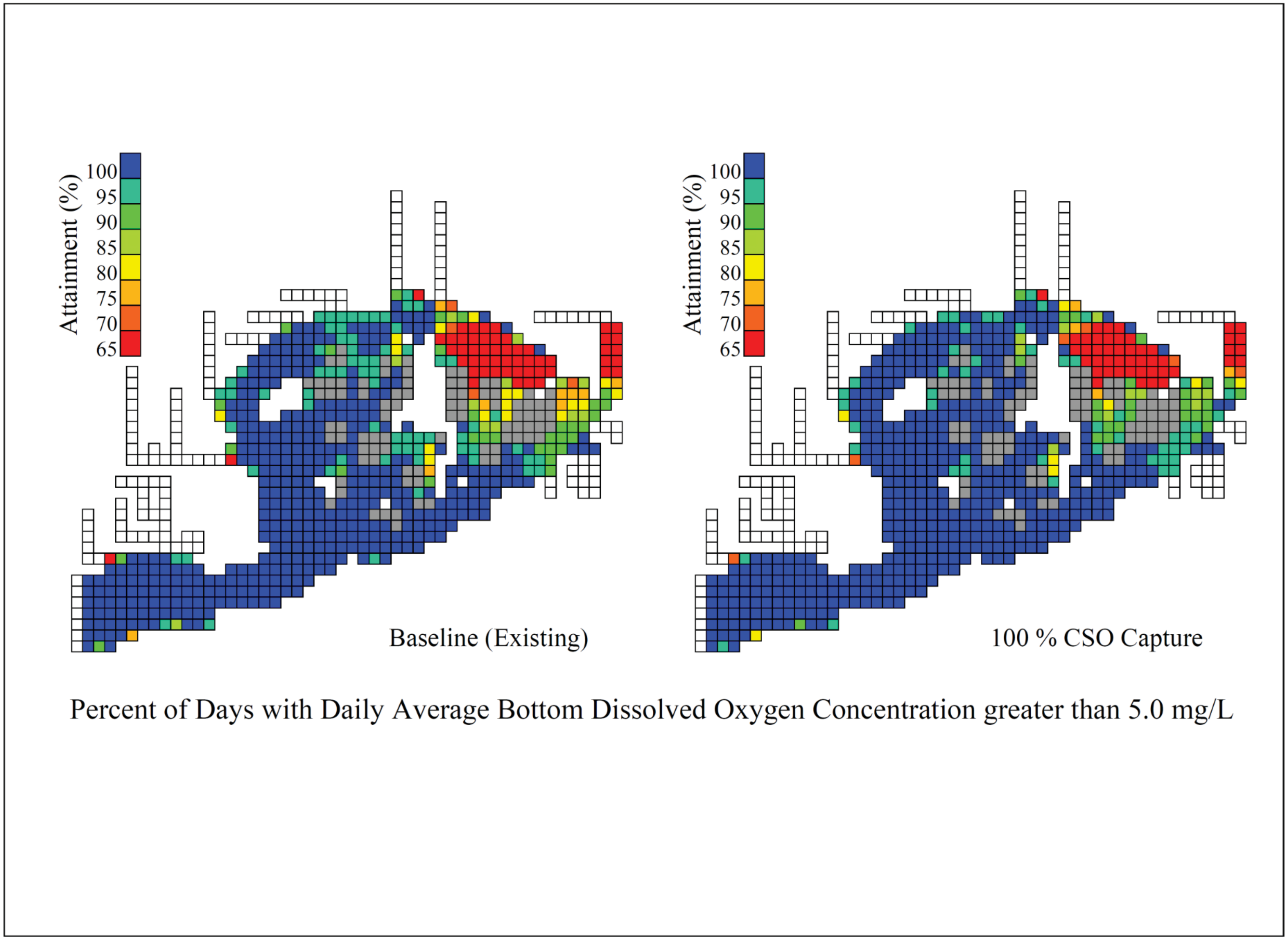
LEGEND
100 % CSO Capture
Alternative 2
Baseline

Annual Attainment with NYSDEC Dissolved Oxygen Class I Standards

Jamaica Bay Baseline Attainment with Current NYSDEC Dissolved Oxygen Standards

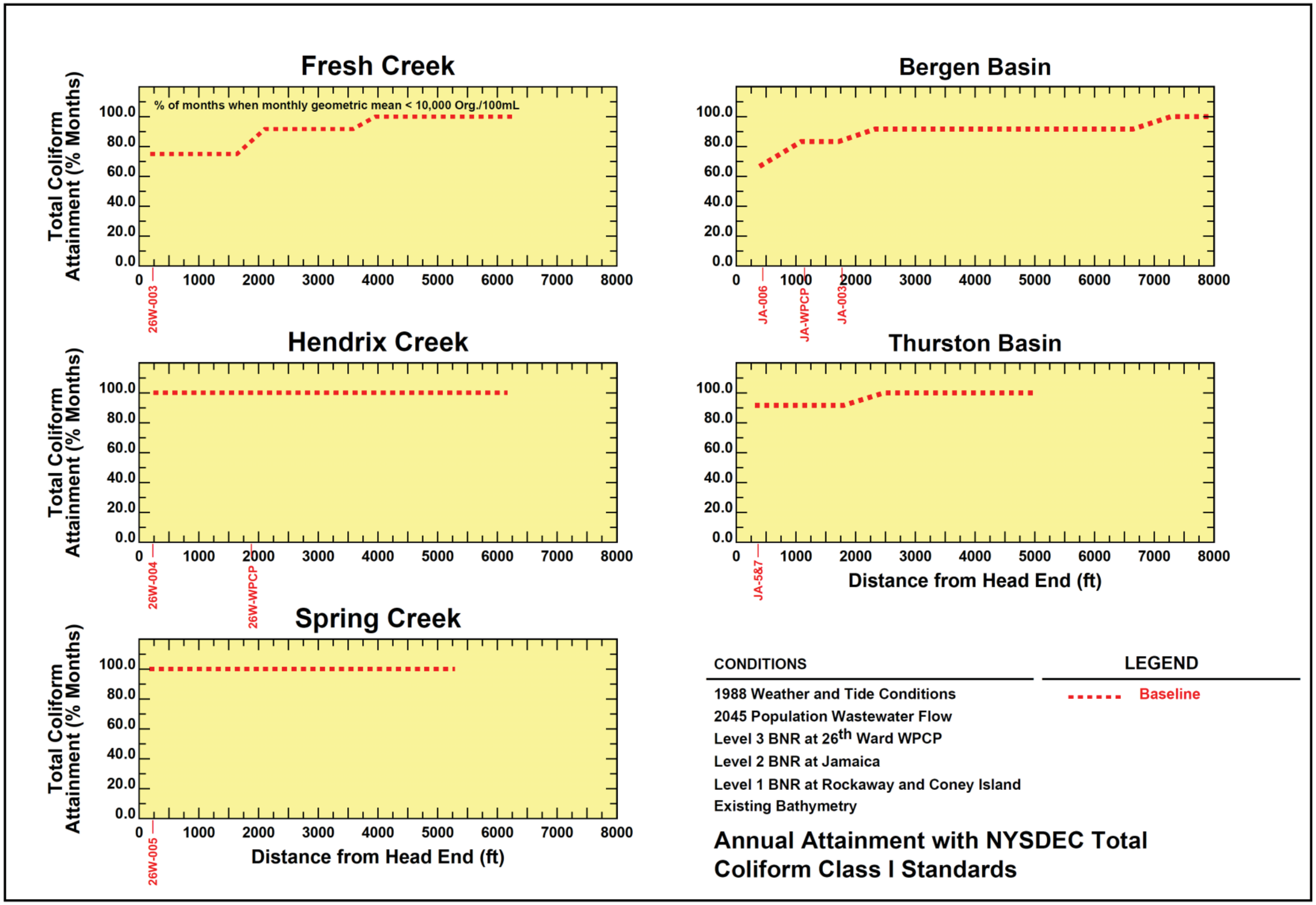
FIGURE 7-14

NYC Environmental Protection



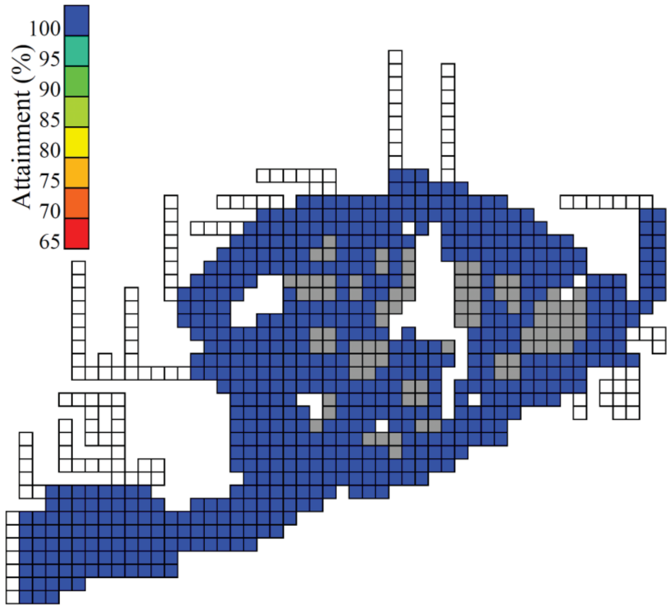
Jamaica Bay Baseline and 100% Capture Dissolved Oxygen Standards Attainment

FIGURE 7-15

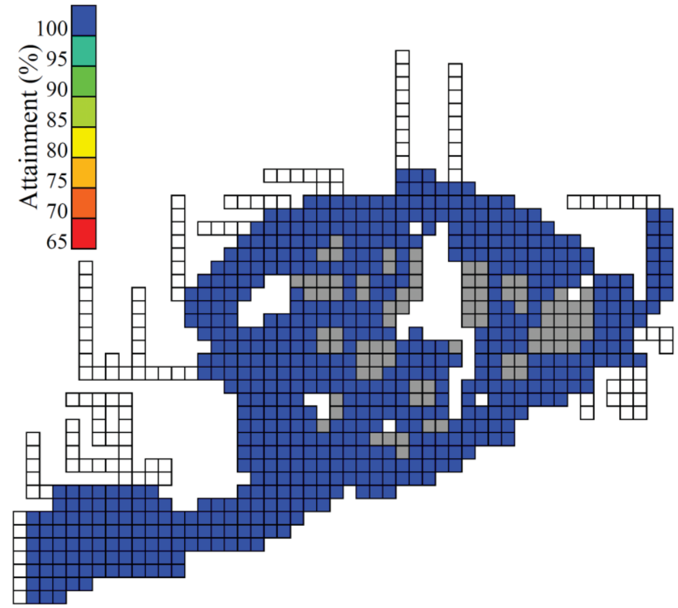


CSO Tributaries Baseline Annual Attainment With Class I Total Coliform Standards

FIGURE 7-16



(a) Baseline, Annual
Percent of Months with Monthly Median Total
Coliform Concentration less than 2,400 org/100mL

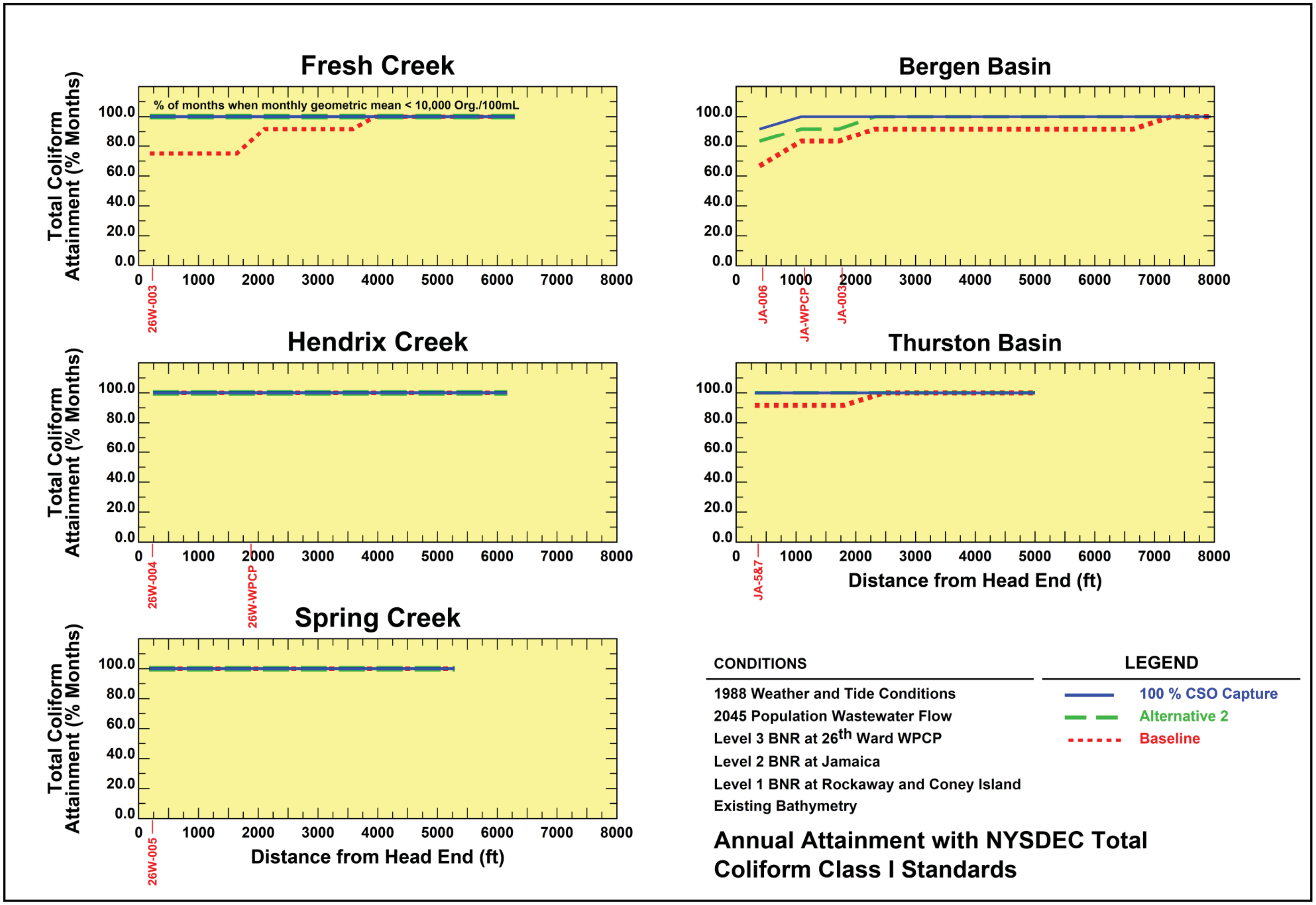


(b) Baseline, Annual
Percent of Months with 80th Percentile Total
Coliform Concentration less than 5,000 org/100mL

CONDITIONS
1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR in 26th Ward, Level 2 BNR in Jamaica
Level 1 BNR in Rockaway and Coney Island WPCPs
Existing Bathymetry

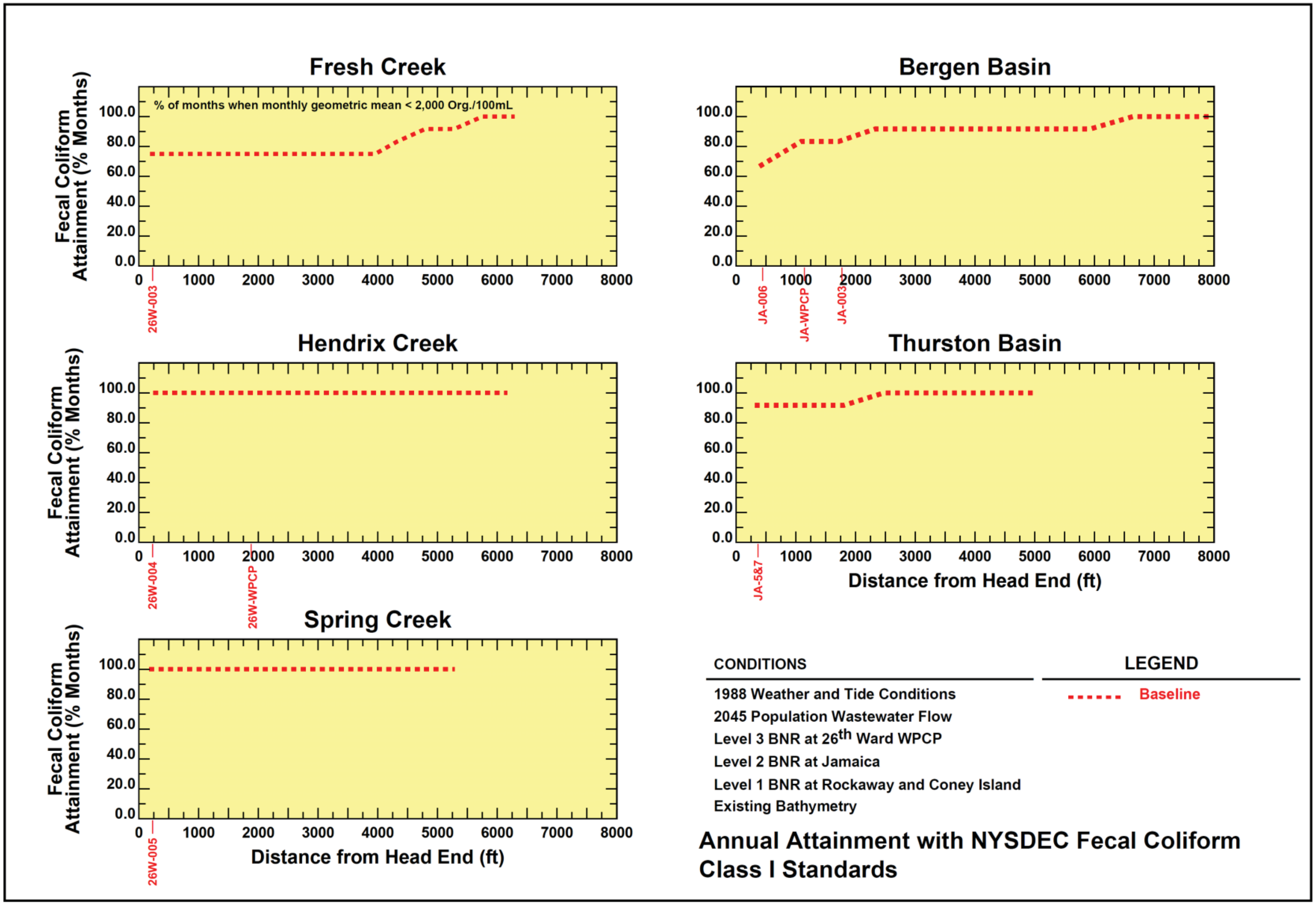
Jamaica Bay Baseline Annual Attainment With Class I Total Coliform Standards

FIGURE 7-17



Alternatives Annual Attainment with NYSDEC Total Coliform Class I Standards

FIGURE 7-18



Environmental Protection

CSO Tributaries Baseline Annual Attainment with NYSDEC Fecal Coliform Class I Standards

FIGURE 7-19

conditions. The majority of Fresh Creek complies with the standard approximately 75 percent of the time with the waters immediately adjacent to Jamaica Bay in nearly full compliance. Bergen Basin complies with the fecal coliform standards between 67 and 100 percent of the time with more compliance adjacent to the Bay. Thurston Basin complies with the fecal coliform standards more than 92 percent of the time and reaches full compliance after approximately 2500 feet.

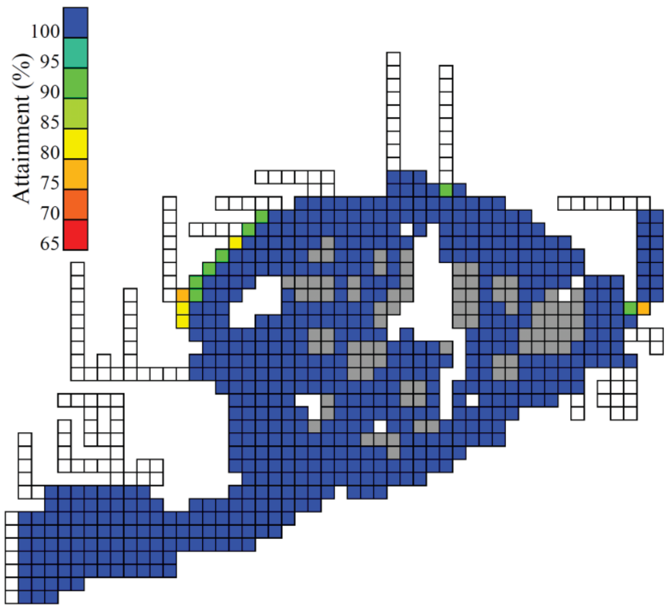
Annually the vast majority of Jamaica Bay is in compliance with NYSDEC Class SB fecal coliform standards nearly 100 percent of the time under baseline conditions (See Figure 7-21, item a). However, as shown on Figure 7-21 item b, the percent compliance decreases during the summer months to 65 to 100 percent of the time in the Bay with the highest level of compliance near Rockaway Inlet.

As with total coliform, model predictions for fecal coliform show almost identical results for Alternative 2 and the 100 percent capture option (See Figure 7-22). Hendrix Creek, Spring Creek and Thurston Basin are predicated to be in nearly 100 percent compliance. For Alternative 2, Fresh Creek shows an improvement from a minimum of 75 percent to just over 92 percent compliance with the majority of the creek in compliance with the standard. Fecal coliform compliance increased from 67 percent to 75 percent in Bergen Basin.

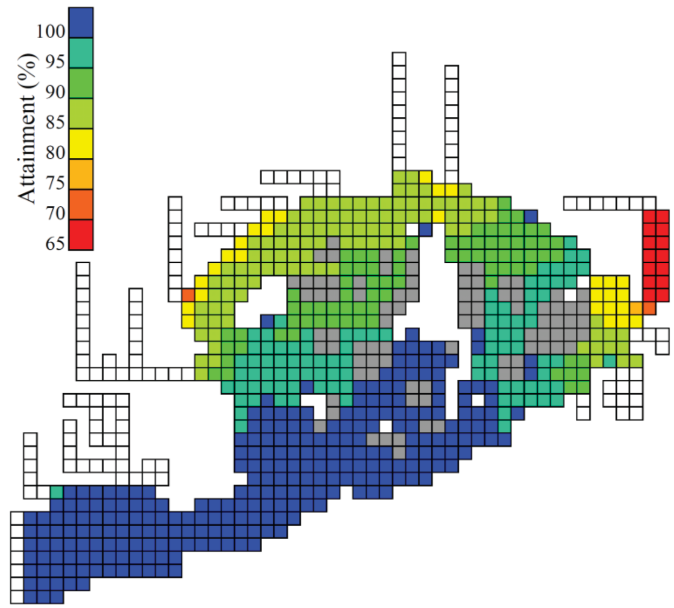
Floatables Improvements

As discussed in Section 5, DEP has taken a number of steps to reduce floatables entering Jamaica Bay though the implementation of the 14 SPDES required BMPs. The major floatables reductions associated with these programs come through the diversion of additional wet weather flow to WWTPs for treatment, capture of floatables in catch basins with the installation of catch basin hoods, and the end-of-pipe collection of floatables in the Interim Floatables Containment Program (booms). However, some floatables are still discharged from CSOs and impact the uses of local waters.

Each of the alternatives noted above will result in substantial reductions in floatables entering the Bay. Because the plans convey additional flow to the WWTP for treatment, each is expected to reduce overflow floatables in proportion to the amount of increased conveyance to the WWTP (Table 7-30).



(a) Baseline, Annual
Percent of Months with Monthly Geometric
Mean of Fecal Coliform less than 200 org/100mL

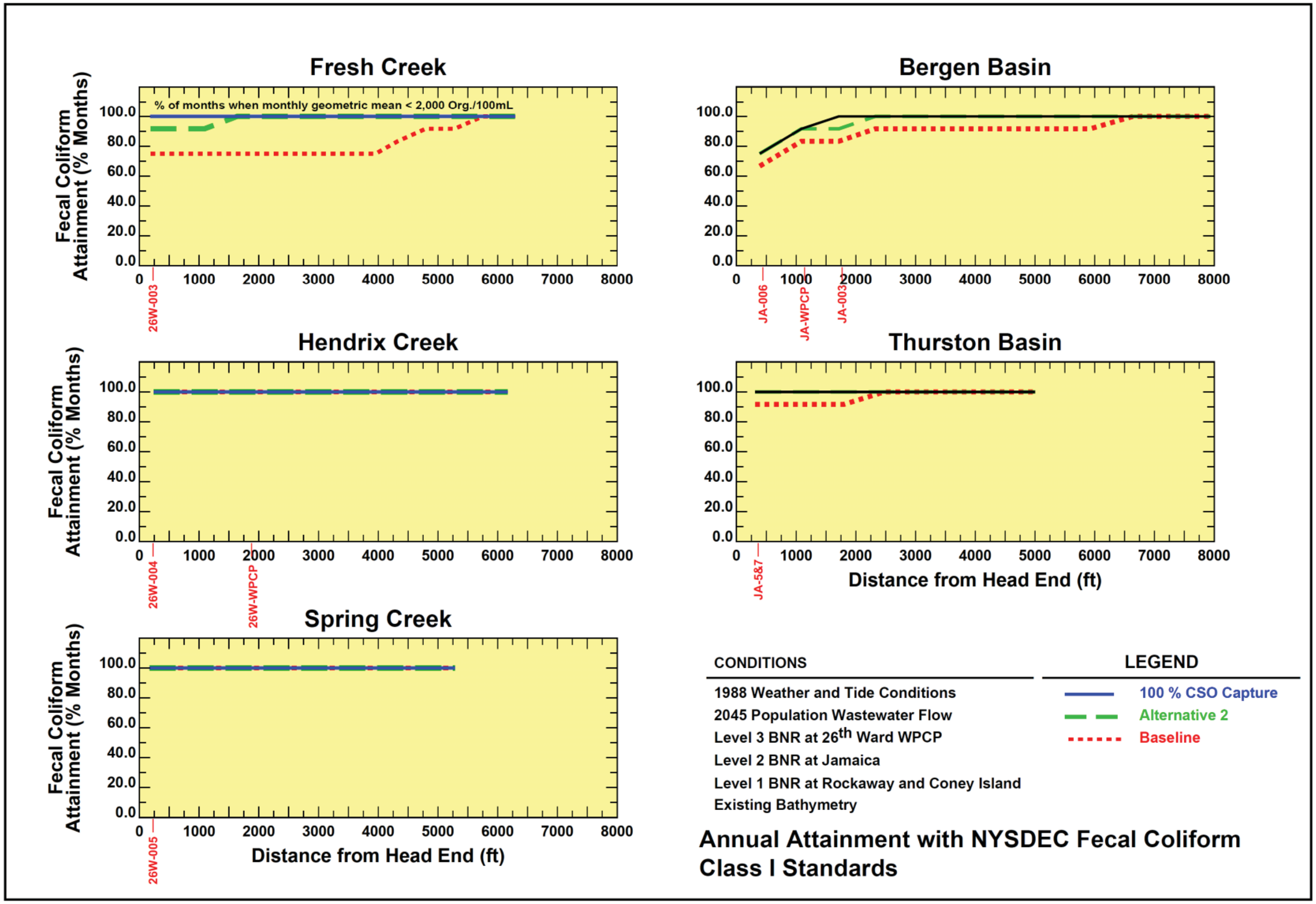


(b) Baseline, Annual
Percent of Time 30-day Rolling Geometric
Mean of Enterococci less than 35 org/100mL

CONDITIONS
1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward, Level 2 BNR at Jamaica WPCP
Level 1 BNR at Rockaway and Coney Island WPCPs
Existing Bathymetry

Jamaica Baseline Annual Attainment with NYSDEC Fecal Coliform Class SB Standards

FIGURE 7-20



Alternatives Annual Attainment with NYSDEC Fecal Coliform Class I Standards

FIGURE 7-21

Table 7-30. Reduction of Floatables from Jamaica Bay and CSO Tributaries

Alternative	Description	% Floatables Reduction from Baseline
	Baseline	N/A
1	2005 Consent Order Mandated Controls	65
2	Elements of 2005 Consent Order Mandated Controls with Additional Combination of CSO Reduction Technologies	79
3	Alternative 2 with 24 MG Fresh Creek CSO Storage Tunnel	84
4	Alternative 2 with 14 MG Fresh Creek CSO Storage Tunnel	83
5	Alternative 2 with 40 MG Bergen Basin CSO Storage Tunnel	86
6	Alternative 2 with 22 MG CSO Storage Tunnel in Bergen Basin	79
7	Alternative 2 with 6.1 MG CSO Storage Shaft in Thurston Basin	80
8	Alternative 2 with 4 MG CSO Storage Shaft in Thurston Basin	80
9	Alternative 2 with Jamaica Bay WWTP Service Area Sewer Separation	--
10	Alternative 2 with 100% Capture Tunnels/Shaft	99

In addition, certain alternatives include positive screening of floatables. Therefore, the flow discharging from the outfalls with these controls will have a substantial portion of the visible floatables removed before discharge. As presented in Section 5.3.7 and in Table 5-6, the volumes of collected floatables captured in Jamaica Bay were 69 CY in 2010.

7.4.3 Dissolved Oxygen Component Analysis

DO component analyses were conducted for each of the Jamaica Bay CSO tributaries for Baseline and Alternative 2 conditions. The North Channel Model (NCM) was used for the 26th Ward WWTP tributaries including Fresh Creek, Hendrix Creek, and Spring Creek. The Jamaica Eutrophication Model (JEM) was used for the Jamaica WWTP basins including Bergen Basin and Thurston Basin. A discussion of each model is provided in Section 4.

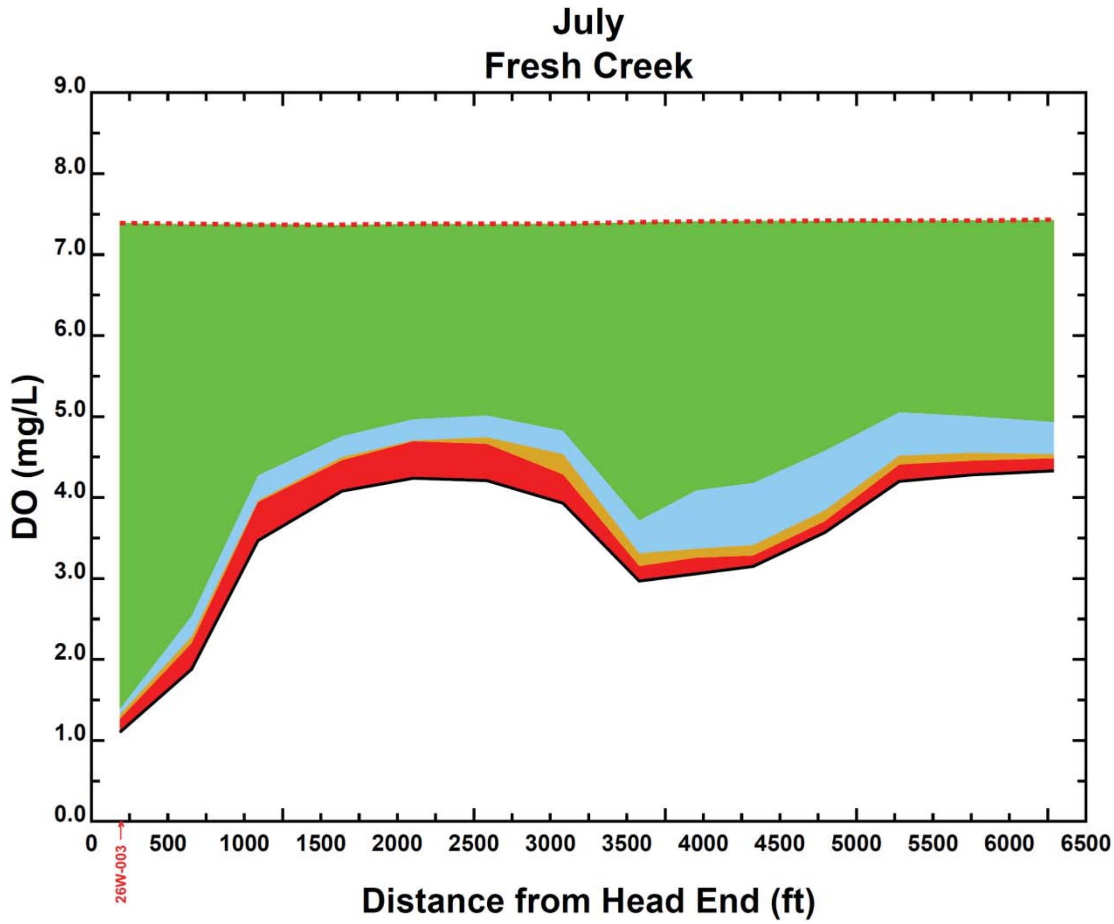
For the 26th Ward WWTP tributaries, monthly average bottom DO concentrations and monthly average DO saturation concentrations model runs were conducted for Baseline and Alternative 2 conditions. These model results served as the basis of comparison for the component analysis. A component analysis was then performed to determine the individual impact of each source type loading including CSO, stormwater, and WWTPs' discharge on DO concentrations in the CSO tributaries. For each source type model run, the individual loading was removed from the model conditions and a new DO concentration model run was conducted. The DO deficit associated with each source type was calculated as the difference between the DO concentration in the Baseline or Alternative 2 model run and the loading removal model runs. The total DO deficit was calculated as the summation of the deficit from each source type and the remaining deficit was assigned to those sources outside modeled source types.

Model runs were conducted for each tributary simultaneously. This allows for sources discharging to one creek to impact the other tributaries. In general, the impacts of stormwater and CSOs discharging into one creek should have relatively minor impacts on other creeks. However the impact of 26^{th} Ward WWTP discharge into Hendrix Creek was found to have a more significant impact on the other creeks.

The DO component analysis conducted for the Jamaica WWTP CSO tributaries was conducted in a similar fashion as the 26^{th} Ward WWTP analysis. Only direct discharges to the basins were included in the analysis. Therefore, the only portion of the Jamaica WWTP included in the component analysis is the excess flow above 140 MGD that is not discharged through the main outfall located in Grassy Bay. As for the 26^{th} Ward WWTP CSO tributaries, component analyses for both Bergen and Thurston Basins were run simultaneously. However, if for example, the stormwater component was being analyzed, only stormwater inputs into Bergen and Thurston Basins were removed. Stormwater inputs from the other portions of the JEM domain were not removed.

Figures 7-23 and 7-24 present an example of the component analysis results for Fresh Creek during July for the Baseline and Alternative 2 results, respectively. July was a relatively wet month with low observed DO concentrations. Based on the model results, the DO deficit is dominated by inputs entering the mouth of Fresh Creek from Jamaica Bay. Near the head end of the creek, the CSOs are the second largest cause of the DO deficit, but result in less than 1.0 mg/L DO deficit. Near the mouth of the creek, discharge from the 26^{th} Ward WWTP is the second largest cause for reduced DO concentrations. The stormwater contribution to the deficit is relatively small.

Figure 7-24 presents the results for Alternative 2 in Fresh Creek for the month of July. The impact on DO concentrations from CSOs have been significantly reduced, but the overall impact on the average dissolved oxygen concentration is relatively minor. Figures for all five tributaries for the month of July are presented in Appendix E.



CONDITIONS

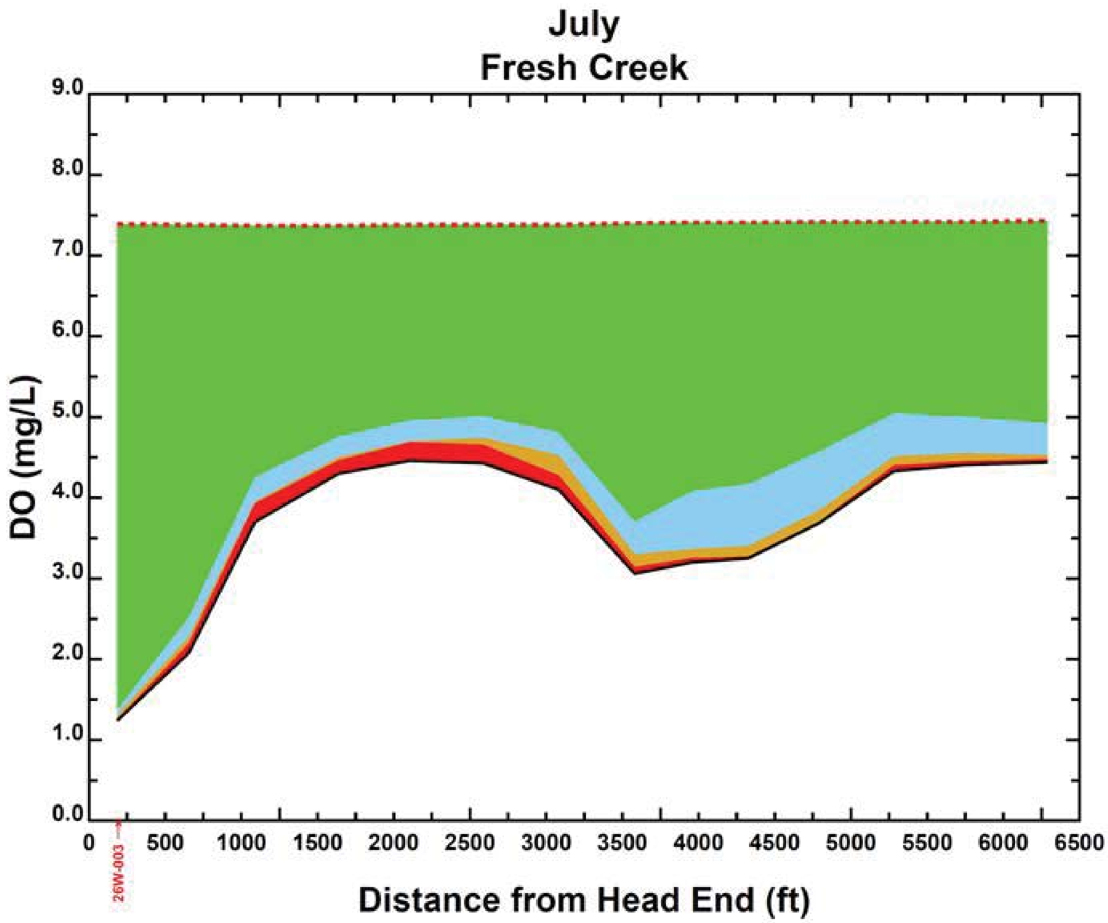
1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Baseline

Environmental Protection

Fresh Creek Component Analysis - Baseline Conditions



CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Alternative 2

Environmental Protection

Fresh Creek Component Analysis - Alternative 2

7.5 RECOMMENDED ALTERNATIVE

The CSO Policy (EPA, 1994) expects that long-term CSO control planning will "consider a reasonable range of alternatives" that would achieve a range of CSO control levels, up to 100 percent Capture. The Policy further states that the "analysis of alternatives should be sufficient to make a reasonable assessment of cost and performance" and that the selected alternative must provide "the maximum pollution reduction benefits reasonably attainable." For the alternatives presented, an evaluation of cost and performance was conducted to assist in the alternative selection.

7.5.1 Basis for Recommendation

As outlined above a reasonable range of CSO reduction alternatives was evaluated for Jamaica Bay. A number of the alternatives were potentially cost-effective. The recommended plan is formulated below, based on cost-effectiveness as well as other factor, such as constructability, operability, and reliability. Based on the initial cost analysis, Alternatives 2 appears to be the most cost-effective.

The next closest alternatives in terms of CSO reduction are Alternatives 7 and 8 which achieve nearly the same percentage annual CSO reduction as Alternative 2, albeit at a much higher cost. Alternatives 7 and 8 will reduce CSO overflow volumes to the Bay from 2,185 MG/yr to 701 MG/yr and 709 MG/yr respectively. This is a 68 percent reductions whereas Alternative 2 is a 66 percent reduction. The cost for this extra 2 percent reduction in CSO annually is more than $500 million. The exorbitant probable total project cost of the other alternatives compared to Alternative 2 eliminates them as viable options.

Water quality modeling of both pathogens and DO does not provide a clear preference among the alternatives. The knee-of-curve analysis for annual DO does not show a clear knee among any of the alternatives for fecal coliform. Alternative 2 is the least expensive alternative, while Alternative 10 the most expensive, however, they have identical DO results with only small negligible differences (Figure 7-14). The tunnel alternatives can achieve almost 100 percent reduction in floatables; however, these alternatives are expensive and have lengthy implementation schedules. With respect to odors, the expected improvement among the alternatives is directly related to their CSO reduction. Therefore, the selection based on odor would mirror that for CSO reduction.

7.5.2 Conclusions

The knee-of-the-curve analysis, water quality improvements, and constructability issues, Alternative 2 is recommended as the most viable WB/WS Facility Plan. The major elements of the selected alternative are a new parallel 48-inch sewer to complement existing double barrel 36-inch Belt Parkway crossing, remove sediment in sections of major sewers in Williams Street, Hegeman Avenue, and Flatlands Avenue, 26th Ward High Level Sewer Separation, 26th Ward WWTP Wet Weather Stabilization, Dredge the CSO mound at Hendrix Creek, and upgrading the

Spring Creek AWWTP. Additionally the recommended plan includes installing bending weirs at regulators J3, J6 and J14, enlarging the orifice at J3, automation of regulator J2, and continuing the floatables capture in the CSO tributaries. The 26th Ward Green Infrastructure Demonstration Project is also included as a component of the recommended plan.

Alternative 2 is a cost-effective, highly-implementable CSO reduction plan for Jamaica Bay that produces a 79 percent decrease in the annual CSO volumes discharged to the Bay. The regulator modifications, sewer separation and upgrades to the Spring Creek AWWTP will reduce the CSO floatables discharged to the Bay. Odors will be reduced as a result of dredging Hendrix Creek to remove exposed sediment mounds and due to the reduction CSO volume. The specific elements of the recommended plan along with the PTPCs are summarized in Section 8. The plan achieves a high level of CSO removal, the modifications are cost-effective, implementable, and achieve satisfactory water quality benefits without precluding the future construction of additional controls, and adaptive approach that will benefit the LTCP phase of facility planning in Jamaica Bay.

8.0 Waterbody/Watershed Facility Plan

The WB/WS Facility Plan described in this section is the culmination of efforts by DEP to attain the existing water quality standards for Jamaica Bay and CSO Tributaries and recognizes that achieving water quality objectives may require more than the simple reduction in CSO discharges. The multi-faceted approach incorporates several cost-effective engineering solutions with demonstrable positive impacts on water quality, including increased DO concentrations, decreased coliform concentrations, and reductions in nuisance odors and floatables that are a consequence of CSO discharges. The recommended approach also maximizes utilization of the existing collection system infrastructure and treatment of combined sewage at the 26th Ward, Jamaica, and Rockaway WWTPs as well as the Spring Creek AWPCP.

The subsections that follow present the recommended CSO control components required to ensure the full implementation of the Jamaica Bay and CSO Tributaries WB/WS Facility Plan goals. Post-construction compliance monitoring (including modeling), discussed in detail in Section 8.3, is an integral part of the WB/WS Facility Plan, and provides the basis for adaptive management for Jamaica Bay.

If post-construction monitoring indicates that additional controls are required, protocols established by DEP and the City of New York for capital expenditures require that certain evaluations are completed prior to the construction of the additional CSO controls. Depending on the technology implemented and on the engineer's cost estimate for the project, these evaluations may include pilot testing, detailed facility planning, preliminary design, and value engineering. Each of these steps provides additional opportunities for refinement and adaptation so that the fully implemented program achieves the goals of the original WB/WS Facility Plan.

8.1 PLAN OVERVIEW

The central elements of the Jamaica Bay and CSO Tributaries WB/WS Facility Plan are the reduction of CSO to the tributaries through modifications to the existing sewer system and wet weather stabilization at the 26th Ward WWTP. As discussed in Section 7.0, a variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Jamaica Bay, ranging from watershed management approaches to total CSO removal, and the consent order mandated controls yields the greatest improvement in water quality for the capital expenditure required, based on a knee-of-curve type analysis.

The recommended Jamaica Bay and CSO Tributaries WB/WS Facility Plan consists of the following elements:

- Meadowmere and Warnerville DWO Abatement
- Shellbank Basin Destratification System
- Laurelton and Springfield Blvd Storm Sewer Buildout
- Regulator Automation

- Upgrading the Spring Creek AWPCP
- Sewer Cleaning in the 26th Ward WWTP Drainage Area
- Hendrix Creek Dredging
- New 48-inch Parallel Sewer
- Regulator Impro^{ve}ments
- 26th Ward High Level Sewer Separation
- 26th Ward WWTP Wet Weather Stabilization
- 26th Ward Green Infrastructure Demonstration Project
- Continue the floatables capture in the CSO tributaries
- Post-Construction Monitoring

The WB/WS Facility Plan is predicted to achieve attainment of DO numerical criteria a minimum of 60 percent of the time in Fresh Creek, 60 percent of the time in Hendrix Creek, near 85 percent of the time in Spring Creek, 72 percent in Bergen Basin, and 75 percent of the time in Thurston Basin. Model results show that reducing the CSO by 100 percent had a negligible impact on DO concentrations in Jamaica Bay itself. Total coliform concentrations meet Class I standards nearly 100 percent of the time in Fresh Creek, Hendrix Creek, Spring Creek, and Thurston Basin along with the majority of Bergen Basin . Fecal Coliform concentrations completely meet Class I water quality standards in Hendrix Creek, Spring Creek and Thurston Basin with the implementation of the WB/WS Facility Plan. Fresh Creek and Bergen Basin comply with the standard 90 percent and 75 percent of the time respectively. The estimated PTPC of the Jamaica Bay and CSO Tributaries WB/WS Facility Plan is $765.0 million in October 2011 dollars. Each component of the Plan is discussed in greater detail in the following sections.

8.1.1 Meadowmere and Warnerville DWO Abatement

Two small neighborhoods, Meadowmere and Warnerville, located at the base of Thurston Basin, previously utilized septic systems to provide sanitary sewer service. These septic systems were identified as discharging into Jamaica Bay during both dry and wet weather flow periods. The project included the design and construction of a wastewater pumping station and force main system, a new separate wastewater conveyance system, and a storm water collection system for the Meadowmere and Warnerville neighborhoods. A separate gravity sewer system collects the flow from each neighborhood and then discharges it to the proposed Warnerville Wastewater Pumping Station. From the pump station, the flow is conveyed to the nearest existing DEP sanitary sewer system (near the intersection of Brookville Boulevard and 149th Avenue) for treatment at the Jamaica WWTP. Construction is substantially complete. The probable total project cost is $37.6 million.

8.1.2 Shellbank Basin Destratification System

As it is separately serviced by sanitary and storm sewer systems, Shellbank Basin is not considered a CSO tributary to Jamaica Bay. However, Shellbank Basin does suffer from water quality issues – its head end is much deeper than other parts of the basin, causing temperature stratification to occur. Because this lower level of water is essentially trapped and does not change during a normal tidal cycle, it results in an environment with depleted dissolved oxygen reserves. As such, the bottom of Shellbank Basin cannot support aquatic life, resulting in fish/crab kills and odor complaints, particularly during the summer bathing season. A DEP pilot destratification system has been operating successfully in Shellbank Basin during the summer season since 2000. The system is designed to eliminate temperature stratification during the summer season, which leads to poor water quality conditions in the basin, odors and marine life kills. This pilot system consists of a small air compressor system which introduces oxygen to the bottom of Shellbank Basin. The proposed permanent destratification facility would be similar in nature to the pilot system – two air compressors, diffuser piping and a small building (less than 400 square feet) located towards the head end of Shellbank Basin. The construction for this project has begun.

8.1.3 Laurelton and Springfield Boulevard Storm Sewer Buildout

A drainage plan for 7,000 acres in southeast Queens is being developed to address flooding and to construct high-level storm sewers in a 1,450 acre CSO drainage area tributary to Thurston Basin. The drainage plan identifies the necessary capital sewer projects to alleviate flooding and convert the aforementioned CSO area to a high-level storm sewer system. Some sections of southeast Queens were developed faster than the DEP was able to fully construct the storm and sanitary sewer system. As such, the area has a mixture of combined sewers, separate sewers, areas where storm sewers interconnect with combined sewers and areas with inadequate sewers. In fact, the DEP has constructed hundreds of seepage basins in the area to provide some level of relief to the communities until storm sewers could be properly constructed. DEP has always intended to fully build-out the storm sewers in the area to prevent both street and basement flooding in the area. HLSS conversion would involve the construction of a storm drainage system that would convey wet weather flow from drainage inlets directly to Thurston Basin. While the existing combined sewer system would primarily convey sanitary flow after the construction of the HLSS, some storm water flow (roof drains, sump pumps, etc.) would continue to be conveyed for treatment at the Jamaica WWTP. Due to the extent of the project in multiple phases over a number of years, the cost for the storm sewer buildout is still to be determined. It is important to note that this external project will impact the WB/WS Facility Plan. However, at the time this report was written, the cost and schedule for the storm sewer buildout provided in the latest available quarterly report is still to be determined.

8.1.4 Regulator Automation

The automation of Regulator J2 includes the installation of an electro-hydraulic actuator that is capable of controlling flows at the regulator. Under dry weather conditions, Regulator J2 conveys flow to the Jamaica WWTP via the Howard Beach Pumping Station. During wet weather periods, the Regulator J2 diverts wet weather flow to the Spring Creek AWPCP for retention.

8.1.5 Upgrading the Spring Creek AWPCP

Spring Creek AWWTP facility was placed into service in the early 1970s and has been upgraded to provide a minimum storage capacity of approximately 20 MG; approximately 13.8 MG in basin storage and approximately 6.2 MG in influent barrel storage. The upgraded CSO facility provides floatables control, high rate settling and storage of CSO flows. The upgraded facility was completed on April 30, 2007, in compliance with the CSO Consent Order milestone.

8.1.6 Sewer Cleaning in the 26th Ward WWTP Drainage Area

Excess sediment was observed in Williams Street, Hegeman Avenue, and Flatlands Avenue sewers during facility planning work in the 1990s. Debris profiles taken in 1994 showed depths of debris as high as five feet in one barrel of the four-barrel sewer in Williams Avenue among other sections of the system. Based on these observations, sewer cleaning was included in the 2005 CSO Consent Order.

8.1.7 Hendrix Creek Dredging

The purpose for dredging of Hendrix Creek is to control odors in the Creek caused by sediment from the CSO that is exposed above the water surface. The dredging is intended to remove sediment from the upper 1,500 feet of the Creek to a finished elevation of approximately -2.5 ft below mean low water (MLW). A two foot cap of clean sand over the sediment surface exposed after dredging is included in the conceptual design. Therefore, dredging to an elevation of -4.5 ft MLW is planned and will result in an estimated 20,000 cubic yards of material dredged from Hendrix Creek.

8.1.8 New 48-inch Parallel Sewer

The interceptor consists of a 48-inch dry weather interceptor that would parallel and provide additional capacity for the existing West Interceptor. The parallel interceptor would originate upstream of Regulator J3 and extend into the Jamaica WWTP. The project scope would involve constructing approximately 3,500 LF of gravity sewer main via open cut excavation within 150th Street, 149th Street and 134th Street and a 600 LF jack & bore under the Belt Parkway before connecting into the Jamaica WWTP.

8.1.9 Regulator Improvements

Enlarge the Orifice at Regulator J3

In reviewing the Bergen Basin combined sewer layout, the discharge orifice at Regulator J3 was also identified as a "bottleneck". Because of this and other flow restrictions, wet weather flow is forced to back up and overflow at the Regulator J3 and J14 control structures, discharging into Bergen Basin. In order to reconcile this restriction, the Regulator J3 orifice will be enlarged from 36-inch x 48-inch to 60-inch x 60-inch.

Installation of Bending Weirs

The crown of the West Interceptor is slightly lower than the weir crest at regulator J3 and is *higher* than the J14 weir crest. The combination of flat slope and low weir crest elevations with respect to the interceptor elevation results in CSO discharges at interceptor flows lower than pipe full capacity. Bending weirs on J3, J6 and J14 will be installed to improve conveyance to the Jamaica Bay WWTP.

8.1.10 26th Ward High Level Sewer Separation

Both PlaNYC and the Green Infrastructure Plan consider HLSS as an integral option for cost-effective water quality improvements. HLSS can achieve a range of CSO volume reductions at a range of costs and therefore fits DEP's adaptive management approach by allowing for phased improvements based on milestone measurements, while not impeding the implementation of additional controls. Moreover, the CSO benefit would be accompanied by additional benefits, including reduced flooding, sewer backups, and the number of hours per year that the 26th Ward WWTP would be required to attain 2xDDWF. These factors are a product of the reduction in all runoff to the combined sewer from impervious surfaces, which will reduce overall wet weather flow to the plant. To simulate HLSS in detail, GIS data was used to determine the area within each model subcatchment area that is composed of property lots as defined by the Department of City Planning, then assuming that the "non-lot areas" would constitute the streets and sidewalks that would no longer contribute runoff to the combined sewers. Both the total subcatchment area and the percent impervious were recomputed and the model was rerun with the adjusted runoff properties. The Fresh Creek drainage area was targeted, and based on preliminary evaluations, an area totaling 443 acres immediately adjacent to Fresh Creek and extending northward into Brooklyn was the preferred opportunity.

8.1.11 26th Ward WWTP Wet Weather Stabilization

26th Ward has two raw sewage pump stations, the High Level and Low Level pump stations, each with three pumps. There are two submersible pumps installed in the Low Level wet well; these pumps are for emergency purposes and were originally installed in the fall of 2001. The Low Level main sewage pumps and associated motors and drives will be replaced.

The raw sewage then flows into four preliminary settling tanks via a force main that discharges into a vertical influent conduit which then transitions into two horizontal distribution channels. Primary sludge is presently removed from the existing preliminary settling tanks using longitudinal and cross collectors and discharged to sludge hoppers. Sludge is pumped from the hoppers by primary sludge pumps to degritting cyclones and classifiers located in the Sludge Degritting Wing of the Main Building. The wet weather stabilization of 26th Ward will increase the reliability of preliminary treatment at the plant and improve flow distribution to the Preliminary Settling Tanks (Hazen and Sawyer, 2011). This work includes the replacement of both Low Level and High Level Main Sewage Pumps, construction of a new Primary Settling Tank (PST No. 5) to add operating flexibility and reliability to the treatment of 170 MGD wet weather flow, a flow diverision structure to provide for relatively even distribution among the existing and newly constructed primary settling tanks, modifications to existing primary settling tanks to accept flow from the division structure, and modifications to one of the aeration tanks to connect the common primary settling tank effluent channel to the aeration tank influent channel.

8.1.12 26th Ward Green Infrastructure Demonstration Project

DEP has submitted the *NYC Green Infrastructure Plan*, which evaluates green infrastructure and other alternatives for this and other combined sewer watersheds as part of DEP's adaptive management strategy. DEP's modeling was based on the management of runoff from 10% of the impervious surfaces in CSO watersheds over 20 years, which was estimated to reduce CSO by 49 MG per year at a cost of $448,000 in the Jamaica Bay and CSO tributaries watershed. Similar to HLSS, the CSO benefit of green infrastructure would be accompanied by additional benefits, including reduced flooding, sewer backups, and the number of hours per year that the 26th Ward WWTP would be required to attain the 2xDDWF. Modeling results indicate that the reduction in flow to the plant is generally twice the reduction in CSO discharge volume.

8.1.13 Continue the Floatables Capture in the CSO Tributaries

Continued use of the booms for floatables control in Bergen and Thurston Basins are a key element of the plan. The Bergen Basin boom has proven to have a high productivity rate and consistent production, while the Thurston Basin boom was determined to have sporadic, but improving, productivity (HydroQual, 2006).

8.1.14 Continue Implementation of Programmatic Controls

As discussed in detail in Section 5.0, DEP currently operates several programs designed to reduce CSO to a minimum and provide treatment levels appropriate to protect waterbody uses. As the effects of the WB/WS Facility Plan and subsequent LTCP become understood through long-term monitoring, ongoing programs will be routinely evaluated based on receiving water quality considerations. Floatables reduction plans, targeted sewer cleaning, real-time level monitoring, and other operations and maintenance controls and evaluations will continue, in addition to the following.

- The 14 BMPs for CSO control required under the City's 14 SPDES permits will continue. In general, the BMPs address operation and maintenance procedures, maximum use of existing systems and facilities, and related planning efforts to maximize capture of CSO and reduce contaminants in the combined sewer system, thereby reducing water quality impacts. A detailed discussion of the existing BMP program is included in Section 5.3.

- The Citywide Comprehensive CSO Floatable Plan (HydroQual, 2005b and 2005c) provides substantial control of floatables discharges from CSOs throughout the City and provides for compliance with appropriate DEC and IEC requirements. The Floatables Plan is a living program that is expected to change over time based on continual assessment and changes in related programs.

8.1.15 Construction Costs

Costs for the recommended plan are summarized in Table 8-1. Costs are presented as estimated PTPCs adjusted to October 2011 dollars and do not account for escalation over the time period shown in the schedule.

Table 8-1. Recommended Plan PTPC

Elements of the Recommended Plan	PTPC [1] (Million)
Meadowmere and Warnerville DWO Abatement	$37.6
Shellbank Basin Destratification System	$2.6
Laurelton and Springfield Blvd Storm Sewer Buildout [2]	TBD
Regulator Automation at J2	$2.27
Upgrading the Spring Creek AWPCP	$147.69
Sewer Cleaning in the 26th Ward WWTP Drainage Area	$5.78
Hendrix Creek Dredging	$25.42
New 48-inch Parallel Sewer to JA WWTP	$17.6
Regulator Improvements at J3, J6, and J14	$3.6
26th Ward High Level Sewer Separation	$110.75
26th Ward WTTP Wet Weather Stabilization	$127.7
26th Ward Green Infrastructure Demonstration Project	$0.45
Total	**$439.0**

(1) Probable Total Project Cost: Includes Hard and Soft Construction Costs - baselined to October 2011
(2) The Laurelton and Springfield Blvd Storm Sewer Buildout project in ongoing with an estimated project cost of $870 million.

8.2 POST-CONSTRUCTION COMPLIANCE MONITORING

Post-construction compliance monitoring will be integral to the optimization of the WB/WS Facility Plan, providing data for model validation, feedback to facility operations, and an assessment metric for the effectiveness of these facilities. Each year's data set will be compiled and evaluated to refine the understanding of the interaction between Spring Creek and the CSO controls, with the ultimate goal of fully attaining compliance with current water quality standards or for supporting a UAA to revise such standards. The data collection monitoring will contain three basic components:

1. The CSO Facility monitoring requirements contained in the 26th Ward, Rockaway, and Jamaica Bay WWTP SPDES permit as well at the Spring Creek AWPCP SPDES permit;
2. Receiving water data collection in Jamaica Bay and the CSO Tributaries using existing DEP Harbor Survey locations and adding stations as necessary; and
3. Modeling of the associated receiving waters to characterize water quality

The Post-Construction Compliance Monitoring Program is described herein at the direction of NYSDEC to provide documentation of the program. The full details of the program are being developed under the City-Wide LTCP, including monitoring and laboratory protocols, QA/QC, and other aspects, to ensure adequate spatial coverage, consistency, and a technically sound sampling program for the entire New York Harbor. The details provided herein are limited to the Jamaica Bay and CSO Tributaries WB/WS Facility Plan Post-Construction Compliance Monitoring Program and may be modified as the City-Wide program takes form. Any further modifications to the Monitoring Program will be submitted to NYSDEC for review and approval as part of the drainage basin specific LTCPs.

8.2.1 Receiving Water Monitoring

The post-construction compliance monitoring program will continue along the protocols of the Harbor Survey initially, including laboratory protocols listed in Table 8-2. This program primarily measures four parameters related to water quality: dissolved oxygen, fecal coliform, chlorophyll a, and secchi depth. These parameters have been used by the City to identify historical and spatial trends in water quality throughout New York Harbor. Secchi depth and chlorophyll a have been monitored since 1986; DO and fecal coliform have been monitored since before 1972. Recently, enterococci analysis has been added to the program. Except for secchi depth and pathogens, each parameter is collected and analyzed at surface and bottom locations, which are three feet from the surface and bottom, respectively, to eliminate influences external to the water column chemistry itself, such as wind and precipitation influences near the surface or benthic and near-bottom suspended sediments and aquatic vegetation near the bottom. Pathogens are analyzed in surface samples only. DEP regularly samples 33 open water stations annually, which is supplemented each year with approximately 20 rotating tributary stations or periodic special stations sampled in coordination with capital projects, planning, changes in facility operation, or in response to regulatory changes.

Table 8-2. Current Harbor Survey Laboratory Protocols

Parameter	Method
Ammonia (as N)	EPA 350.1
Chlorophyll 'a'	EPA 445.0, modified for the Welschmeyer Method
Dissolved Oxygen	SM 4500-O C, Azide Modification (Winkler Method)
Dissolved Silica	SM 18-19 4500-Si D or USGS I-2700-85

Parameter	Method
Enterococcus	EPA Method 1600, Membrane Filter
Fecal Coliform	SM 18-20 9222D, Membrane Filter
Nitrate (as N)	EPA 353.2 or SM 18-20 4500-NO3 F
Orthophosphate (as P)	EPA 365.1
Ph	SM 4500-H B, Electrometric Method
Total Kjeldahl Nitrogen	EPA 351.2
Total Phosphorus	EPA 365.4
Total Suspended Solids	SM 18-20 2540D
Notes: SM – Standard Methods for the Examination of Water and Wastewater; EPA – EPA's Sampling and Analysis Methods. Field instrumentation also includes an SBE 911 Sealogger CTD which collects salinity, temperature, and conductivity, among other parameters.	

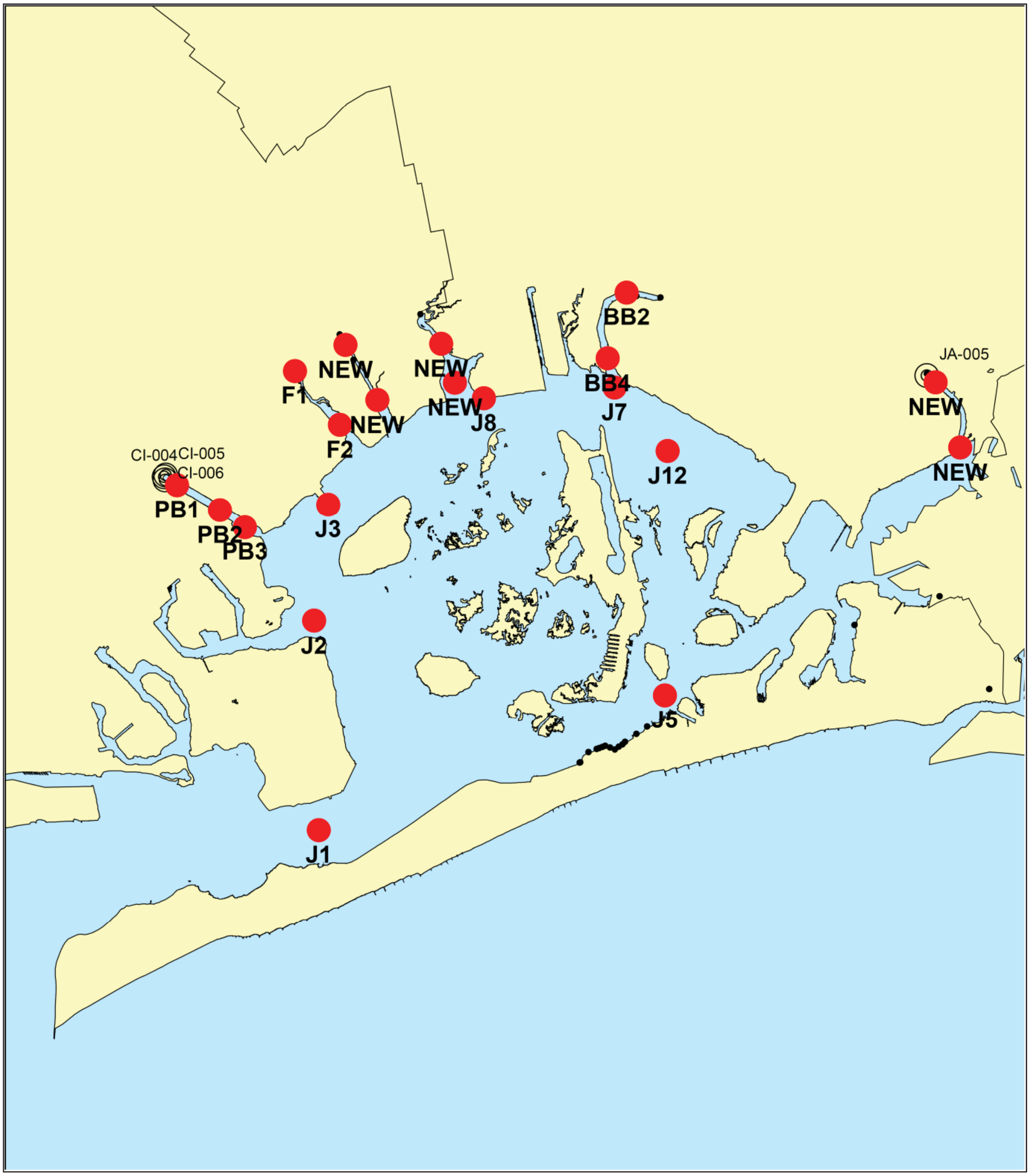
The following locations are either currently sampled or proposed to be sampled under the Post-Construction Compliance Monitoring Program:

- Jamaica Bay – 7 Current Stations (J1, J2, J3, J5, J7, J8, J12)
- Fresh Creek – 2 Stations (F1, F5)
- Hendrix Creek – 2 Proposed Stations
- Spring Creek – 2 Proposed Stations
- Bergen Basin – 2 Current Stations (BB2, BB4)
- Thurston Basin – 2 Proposed Stations

These 17 stations (plus three additional stations in Paerdegat Basin as part of a separate WB/WS Facility Plan) will serve as the Jamaica Bay and CSO Tributaries post-construction monitoring sites as shown in Figure 8–1. All stations related to the Jamaica Bay and CSO Tributaries post-construction compliance monitoring program will be sampled a minimum of twice per month from May through September and monthly during the remainder of the year.

Data collected during this program will be used primarily to verify the North Channel Model. The North Channel Model was developed from the Jamaica Eutrophication Model (JEM). The hydrodynamic and chemical kinetic processes are computed in the same manner as JEM, but the North Channel Model was constructed specifically to quantify water quality in Spring Creek, Fresh Creek, and Hendrix Creek, so it has a much higher resolution in these areas. The calibrated North Channel Model will be used to measure compliance, and will be verified annually with the post-construction compliance monitoring data collected.

Because the data will be used in this manner, the data collected will be evaluated for its utility in model verification during each annual cycle of compliance monitoring, and stations may be added, eliminated, or relocated depending on this evaluation. Similarly, the parameters measured will be evaluated for their utility and appropriateness for verifying the receiving water model calibration. At a minimum, the program will collect those parameters with numeric WQS (i.e., DO, fecal coliform, and enterococci). In addition, moored instrumentation may be added or substituted at one or more of these locations if continuous monitoring is determined to be beneficial to model verification, or if logistical considerations preclude the routine operation of the program (navigational limits, laboratory issues, etc.).



Post-Construction Compliance Monitoring Locations

8.2.2 Floatables Monitoring Program

The Jamaica Bay and CSO Tributaries WB/WS Facility Plan Interim Post-Construction Compliance Monitoring Program incorporates by reference the City-Wide Comprehensive CSO Floatables Plan Modified Facility Planning Report (DEP, 2005a) and Addendum 1 – Pilot Floatables Monitoring Program (December 2005) to the Floatables Plan. These documents contain a conceptual framework for the monitoring of floatables conditions in New York Harbor and a work plan for the ongoing pilot program to develop and test the monitoring methodology envisioned in the framework before the program transitions to full scale in 2008. The objectives set forth in the Floatables Plan provides a metric for LTCP performance, and floatables monitoring will be conducted in conjunction with post-construction compliance monitoring with regard to staffing, timing, and location of monitoring sites. The program will include the collection of basic floatables presence / absence data from monitoring sites throughout the harbor that will be used to rate and track floatables conditions, correlate rating trends to floatables control programs where applicable, and trigger investigations into the possible causes of consistently poor ratings should they occur. Actions based on the floatables monitoring data and investigations could include short-term remediation in areas where monitored floatables conditions create acute human or navigation hazards and, as appropriate, longer-term remediation actions and modifications to the WB/WS Facility Plan if monitored floatables trends indicate impairment of waters relative to their intended uses.

8.2.3 Meteorological Conditions

The performance of any WB/WS Facility Plan cannot be fully evaluated without a detailed analysis of precipitation, including the intensity, duration, total rainfall volume, and precipitation event distribution that led to an overflow or, conversely, the statistical bounds within which the plan component may be expected to control CSO completely. DEP has established 1988 as representative of long-term average conditions and therefore uses it for analyzing facilities where "typical" conditions (rather than extreme conditions) serve as the basis for design. The comparison of rainfall records at JFK airport from 1988 to the long-term rainfall record is shown in Table 8-3, and includes the return period for 1988 conditions.

In addition to its aggregate statistics indicating that 1988 was representative of overall long-term average conditions, 1988 also includes critical rainfall conditions during both recreational and shell fishing periods. Further, the average storm intensity for 1988 is greater than one standard deviation from the mean so that using 1988 as a design rainfall year would be conservative with regard to water quality impacts since CSOs and stormwater discharges are driven primarily by rainfall intensity. However, considering the complexity and stochastic nature of rainfall, selection of any year as "typical" is ultimately qualitative, and performance is not expected to simply correlate to annual rainfall volume or any other single statistic. The performance of the plan and the response of waterbodies with respect to widely varying precipitation conditions will be evaluated with respect to observed rainfall.

Table 8-3. Rainfall Statistics, JFK International Airport, 1988 and Long-Term Average

Statistic	1970-2002 Median	1988	
		Value	Return Period (years)
Total Volume (inches)	39.4	40.7	2.6
Intensity, (in/hr)	0.057	0.068	11.3
Number of Storms	112	100	1.1
Storm Duration	6.08	6.12	2.1

Multiple sources of rainfall data will be compiled as part of the final City-Wide Post-Construction Monitoring Program. On an interim basis, however, the primary source of rainfall data will be from JFK Airport and from any DEP gauges that may be available. The use of NEXRAD cloud reflectivity data as proposed in the WB/WS Facility Plan will be limited to testing implementation techniques until its utility is fully understood. Any data sets determined to be of limited value in the analysis of compliance may be discontinued.

8.2.4 Analyses

The performance of the WB/WS Facility Plan will be evaluated on an annual basis using a landside mathematical computer model as approved by NYSDEC. In addition, DEP believes that the analysis of water quality compliance is best accomplished using computer modeling supported and verified with a water quality monitoring program. Modeling has several advantages over monitoring:

1. Modeling provides a comprehensive vertical, spatial, and temporal coverage that cannot reasonably be equaled with a monitoring program;
2. Modeling provides the data volume necessary to compute aggregate statistical compliance values, such as a geometric mean, an absolute limit (e.g., “never-less-than” or “not-to-exceed”), or a cumulative statistic (e.g., the 66-day deficit-duration standard for dissolved oxygen to be promulgated by NYSDEC in the near future);
3. Discrete grab sampling for data collection is necessarily biased to locations and periods of logistical advantage, such as navigable waters, safe weather conditions, daylight hours, etc.; and
4. Quantification of certain chemical parameters must be performed in a laboratory setting which either (a) complicates the use of a smaller sampling vessel that is necessary to access shallower waters not navigable by a vessel with on-board laboratory facilities or (b) limits the number sampling locations that can be accessed due to holding times and other laboratory quality assurance requirements if remote laboratory (non-vessel mounted) facilities are used.

The InfoWorks collection system model of the Jamaica Bay and CSO Tributaries service area was developed under the LTCP project based in part on historical models used in facility planning. InfoWorks is a state-of-the-art modeling package that includes the ability to represent retention tank dynamics and other sophisticated aspects of performance. Overflow volumes will be quantitatively analyzed on a monthly basis to isolate any periods of performance issues and their impact on water quality. Water quality modeling re-assessment will be conducted every two years based on the previous two years water quality field data. Modeling conditions will be based on the hydrodynamic and meteorological conditions for the study year, documented operational issues that may have impacted the facility performance, and water quality boundary conditions based on the Harbor Survey data from Jamaica Bay. Results will be compared to the Harbor Survey data collected to validate the water quality modeling system, and performance will be expressed in a quantitative attainment level for applicable numerical criteria based on the receiving water model. Should this analysis indicate that progress towards the desired results is not being made, the analysis will:

- Re-verify all model inputs, collected data and available QA/QC reports;
- Consult with operations personnel to ensure unusual operational problems (e.g., screening channel o/s, pump repair, etc.) were adequately documented;
- Evaluate specific periods of deviations from modeled performance;
- Confirm that all operational protocols were implemented, and that these protocols are sufficient to avoid operationally-induced underperformance;
- Re-evaluate protocols as higher frequency and routine problems reveal themselves; and finally
- Revise protocols as appropriate and conduct Use Attainability Analysis (UAA) and if necessary, revise LTCP.

Because of the dynamic nature of water quality standards and approaches to non-compliance conditions, a period of ten years of operation will be necessary to generate the minimal amount of data necessary to perform meaningful statistical analyses for water quality standards review and for any formal UAA that may be indicated. Following completion of the tenth annual report, a more detailed evaluation of the capability of the WB/WS Facility Plan to achieve the desired water quality goals will take place, with appropriate weight given to the various issues identified during the evaluations documented in the annual reports. If it is determined that the desired results are not achieved, DEP will revisit the feasibility of cost-effective improvements. Alternately, the water quality standards revision process may commence with a UAA that would likely rely in part on the findings of the post-construction compliance monitoring program. The approach to future improvements beyond the 10-year post-construction monitoring program will be dictated by the findings of that program as well as the input from NYSDEC SPDES permit and CSO Consent Order administrators. This schedule is not intended to contradict the 5-year cycle used for updating SPDES permits.

8.2.5 Reporting

Post-construction compliance monitoring will be added to the annual BMP report submitted by DEP in accordance with their SPDES permits. The monitoring report will include an overview of the performance of the WB/WS Facility Plan. Verification and refinement of the model framework as necessary will be documented, and modeling results will be presented to assess water quality impacts in lieu of high-resolution sampling.

In addition to the information to be provided in the Annual BMP Report, DEP will submit a summary of the monitoring and modeling, including the data, once every five years. NYSDEC has acknowledged that the variability in precipitation dynamics may require more than five successive years of data to statistically validate the models used for evaluating compliance, but have nonetheless stated that this information will be used to identify areas of significant water quality non-compliance and gaps in the water quality modeling, and measure progress with the LTCP goals. They have also stated that they intend to verify the 1988 rainfall data as the "average" year.

8.3 OPERATIONAL PLAN

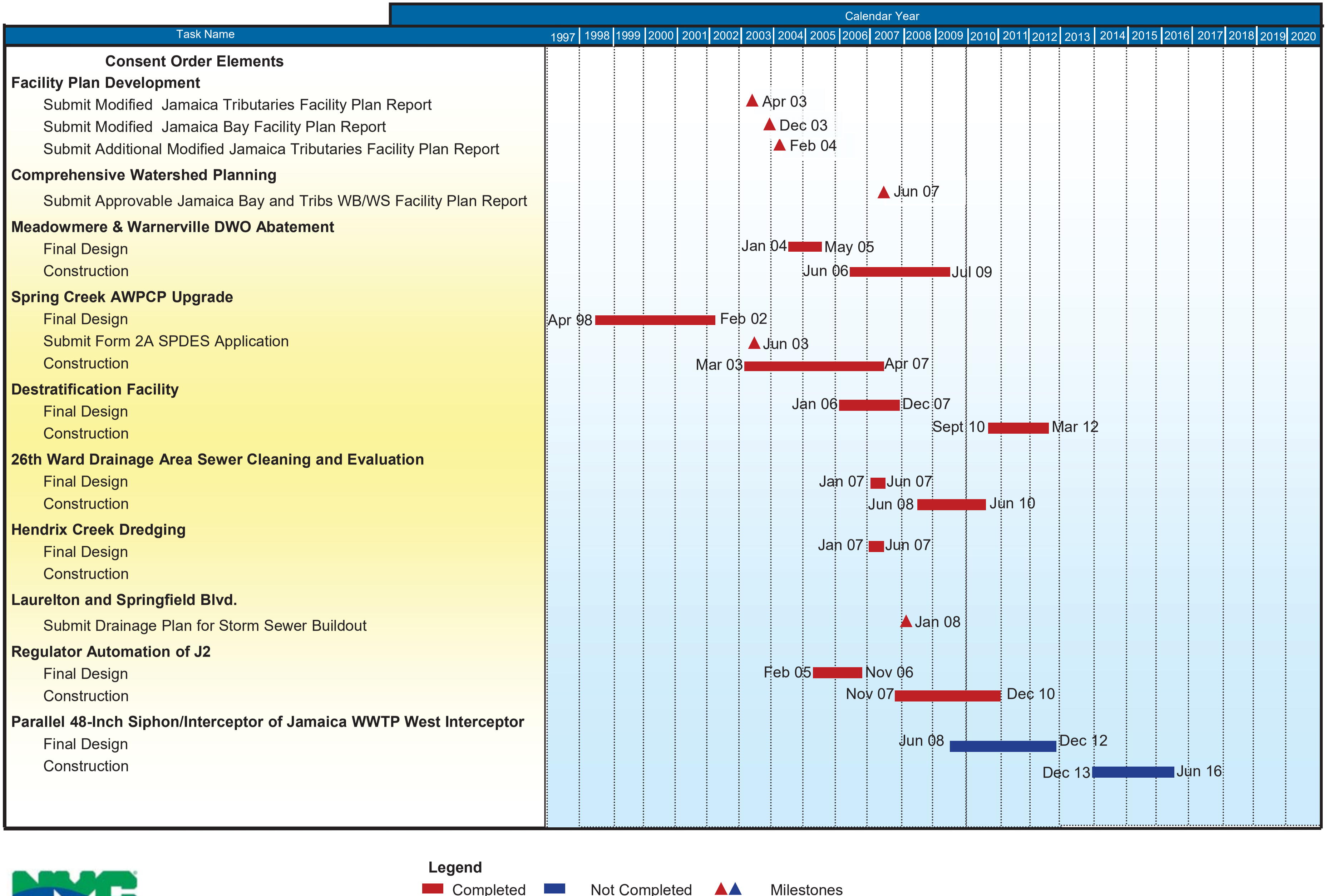
USEPA guidance specifies that municipalities should be required to develop and document programs for operating and maintaining the components of their combined sewer systems (EPA, 1995a). Once a long-term control plan has been approved, the municipality's operation and maintenance program should be modified to incorporate the facilities and operating strategies associated with selected controls.

The majority of the components of the WB/WS Facility Plan, as presented herein, are in the conceptual and/or preliminary design stages of planning and implementation. Operational plans for the facilities have not yet been developed. This WB/WS Facility Plan requires review by the NYSDEC for acceptance prior to implementing the plan as a long-term control plan. As such, the operational plan will be developed following NYSDEC review of the WB/WS Facility Plan and after all components are designed.

Upon implementation of the WB/WS Plan elements, DEP intends to operate the facilities as designed. However, it is both environmentally responsible and fiscally prudent to be responsive to changing and unforeseen limitations and conditions. An adaptive management approach will be employed to accomplish this flexibility. Post-construction compliance monitoring (described in Section 8.2) may trigger a sequence of more detailed investigations that, depending on the findings, could culminate in corrective actions. During the first nine post-construction years, the analysis will ultimately determine whether the performance of the CSO controls was adequate. If the performance is unacceptable, the finding will be verified, the causes will be identified, and reasonable corrective actions will be taken. Modifications and retrofits that are implemented and demonstrate improvement will be documented through the issuance of an LTCP update, subject to NYSDEC approval.

8.4 SCHEDULE

Figure 8-2 shows the implementation schedule for this WB/WS Facility Plan, along with relevant aspects of the programmatic controls and post-construction compliance monitoring schedules. It should be noted that elements shown in this schedule address the implementation of the recommended WB/WS Facility Plan elements only. As noted in the Order on Consent (Section III.C.2) "once the Department approves a Drainage Specific LTCP, the approved

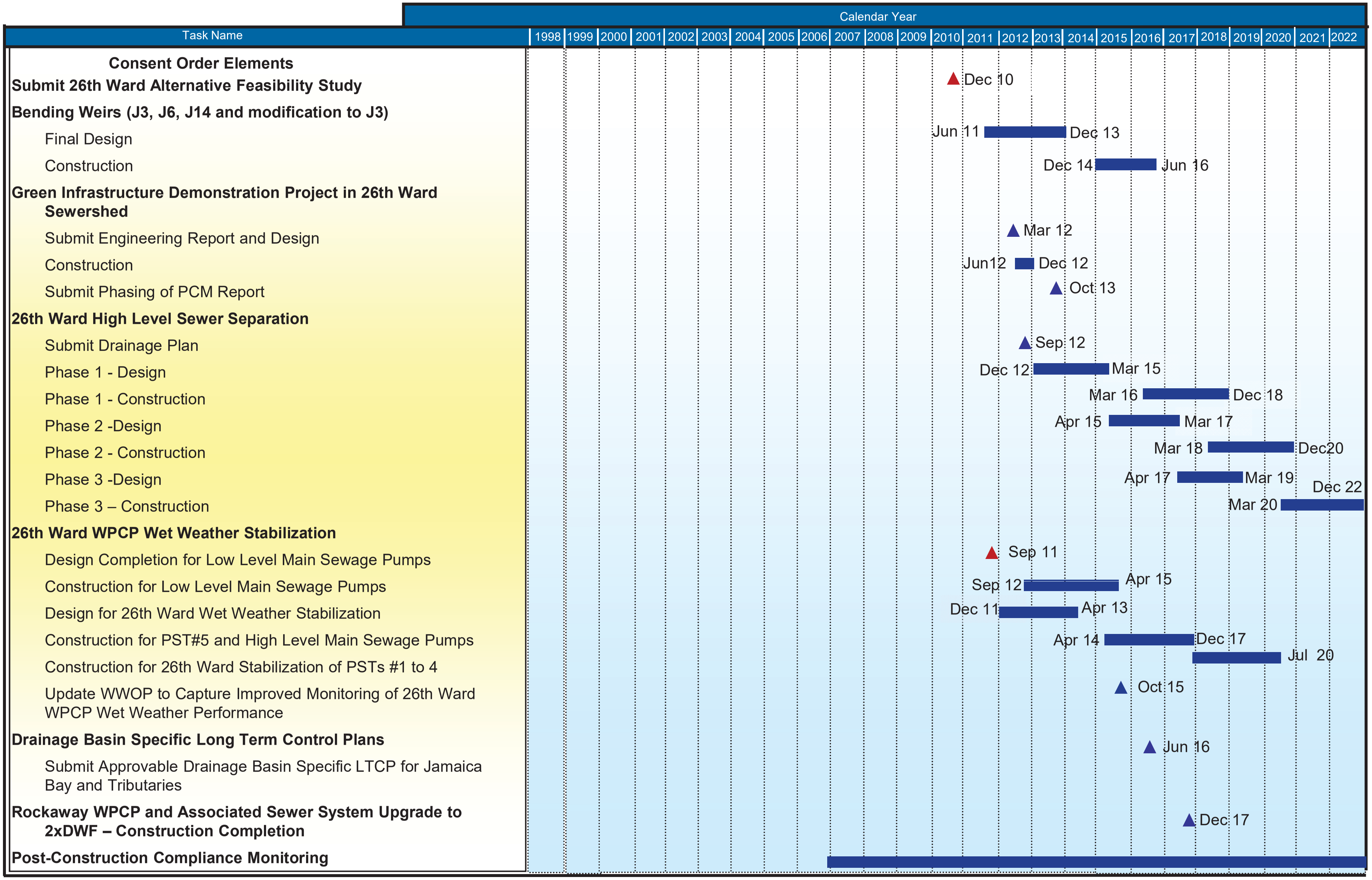


Environmental Protection

Jamaica Bay and CSO Tributaries Waterbody/Watershed Facility Plan

Schedule

FIGURE 8-2



Legend

Completed | Not Completed | Milestones

NYC Environmental Protection

Schedule (Cont)

FIGURE 8-2 (cont.)

Drainage Specific LTCP is hereby incorporated by reference, and made an enforceable part of this Order". As such, a schedule will be incorporated by reference only when this WB/WS Facility Plan is further developed and submitted as an LTCP in accordance with dates presented in Appendix A of the Order on Consent.

8.5 CONSISTENCY WITH FEDERAL CSO POLICY

The Jamaica Bay and CSO Tributaries WB/WS Facility Plan was developed so that it satisfies the requirements of the Federal CSO Control Policy. Through extensive water quality and sewer system modeling, data collection, community involvement and engineering analysis, DEP has adopted a plan that incorporates the findings of two decades of inquiry to achieve the highest reasonably attainable use of Jamaica Bay. This WB/WS Facility Plan addresses each of the nine minimum elements of long-term CSO control as defined by federal policy and shown in Table 8-4. The CSO Consent Order requires submission of a Jamaica Bay LTCP in June 2016.

Table 8-4. Nine Elements of Long-Term CSO Control

Element	Report Section	Summary
1. Characterization, Monitoring, and Modeling of the Combined Sewer System	3.0	Addressed during facility planning (1980s, 1990s), and supplemented during the USA Project (2000-2001), and current WWFP development (2006).
2. Public Participation	6.0	The WWFP was developed with active involvement from the affected public and other stakeholders during plan development and environmental quality assessments.
3. Consideration of Sensitive Areas	4.0	There are no sensitive areas identified within Flushing Bay that are directly impacted by CSO discharges.
4. Evaluation of Alternatives	7.0	A wide range of alternatives were considered.
5. Cost/Performance Considerations	7.0	Knee of the curve analyses were performed that compared % CSO reduction and receiving water quality improvement with cost.
6. Operational Plan	8.0	DEP will continue to satisfy the operational requirements of the BMPs for CSO control, including the 26th Ward, Rockaway and Jamaica Bay WWTP Wet Weather Operating Plans. The BMPs satisfy the nine minimum control requirement of federal CSO policy. DEP will also continue implementation of other programmatic controls.
7. Maximizing Treatment at the Existing WWTP	7.0	Both the Bowery Bay and Tallman Island WWTPs will be upgraded to treat two times the design dry weather flows.
8. Implementation Schedule	8.0	Facility plan complete and all components operational within 21 years after approval of WB/WS facility plan by DEC
9. Post-Construction Compliance Monitoring	8.0	Constructed facilities will be monitored per SPDES requirements; Monitoring data will be used to assess effectiveness, to optimize facility performance, and to trigger adaptive management alternatives.

8.6 ANTICIPATED WATER QUALITY IMPROVEMENTS

The proposed WB/WS Facility Plan will reduce the number and volume of CSO discharges compared to the Baseline conditions for the CSO tributaries. This reduction in CSO discharges will lead to improved water quality and aesthetic conditions, resulting in Hendrix and Spring Creeks achieving the Class I total and fecal coliform standards 100 percent of the time in the middle and mouth reaches, where infrequent secondary contact recreation activities may occur. In addition, Hendrix Creek and Spring Creek would attain total and fecal coliform secondary contact criteria along their entire lengths during summer/bathing season. Fresh Creek complies with total coliform standards 100 percent of the time and fecal coliform standards 90 percent of the time. Increases in dissolved oxygen over the Baseline condition will occur as well; however, 100 percent DO compliance will not be achieved at all times throughout Fresh Creek, Hendrix Creek and Spring Creek. This reduction in CSO discharges will lead to improved water quality and aesthetic conditions in Bergen and Thurston Basins. Bergen Basin will achieve the Class I total and fecal coliform standards 82 percent and 75 percent of the time respectively, while Thurston Basin will achieve total and fecal coliform standards 100 percent of the time throughout its length. Bergen and Thurston Basins are restricted areas and should not have primary or secondary contact activities conducted within them.

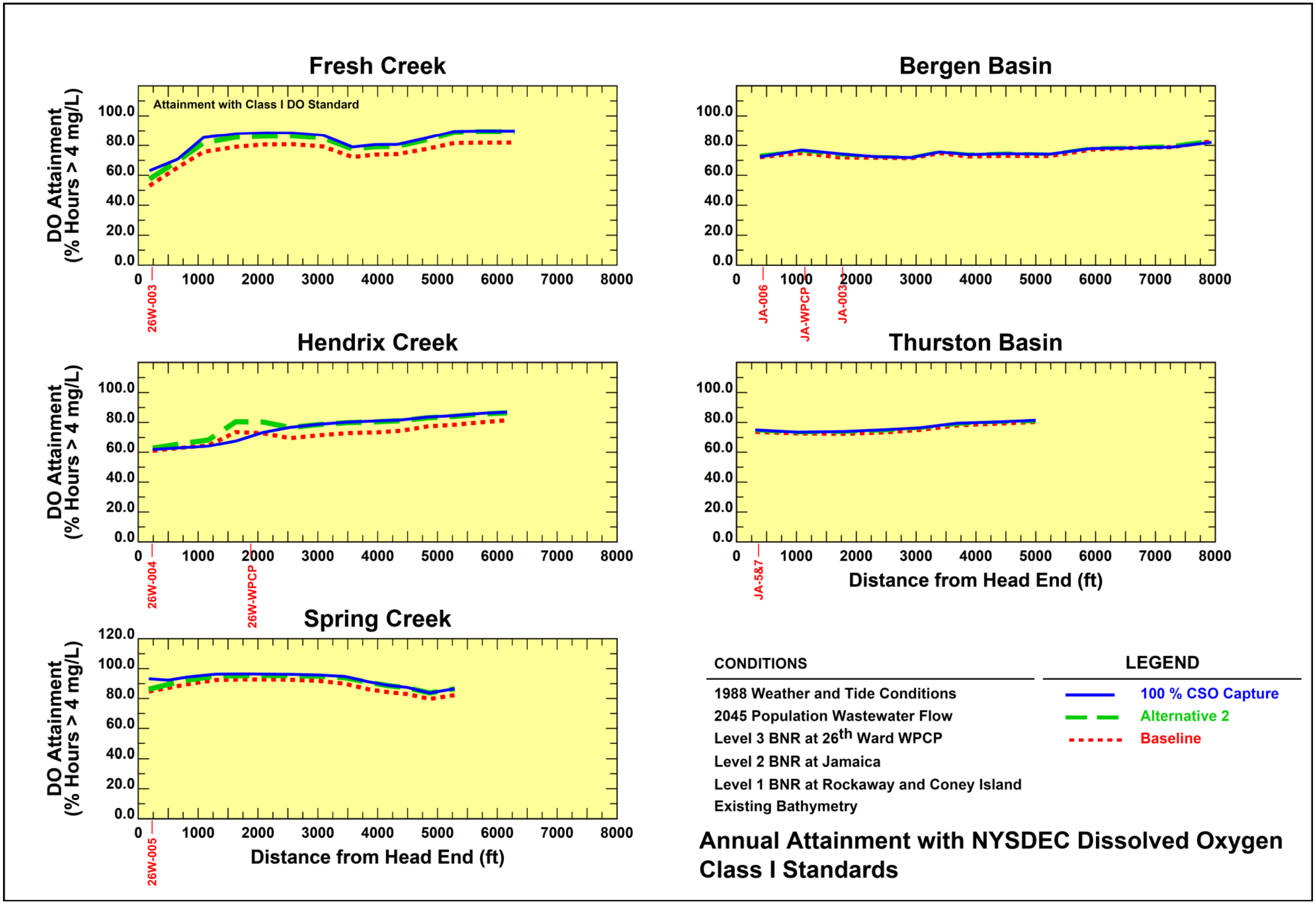
The current Class I designation of the CSO tributaries is not currently being supported due to the existing presence of combined sewer overflows, CSO sediment mounds, stormwater discharges, and WWTP discharges. The selected alternatives of the WB/WS Facility Plan will mitigate the CSO issues and improve water quality and aesthetic conditions in the tributaries. Implementation of the WB/WS Facility Plan is expected to result in the highest fish and aquatic life uses that can be reasonably attained.

Attainment of DEC water-quality standards in Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin and Thurston Basin are presented in Figures 8-3 through 8-5, and are summarized in Table 8-5 as well.

Table 8-5. Water Quality Benefits in 26th Ward WWTP Drainage Area

	Baseline Condition			WB/WS Facility Plan		
Waterbody	Dissolved Oxygen*	Total Coliform*	Fecal Coliform*	Dissolved Oxygen*	Total Coliform*	Fecal Coliform*
Fresh Creek	57%	75%	75%	58%	100%	92%
Hendrix Creek	61%	100%	100%	63%	100%	100%
Spring Creek	87%	100%	100%	86%	100%	100%
Bergen Basin	72%	67%	67%	73%	83%	75%
Thurston Basin	63%	92%	92%	75%	100%	100%
Note: 1. Laurelton Ave HLSS project is included in these projections						

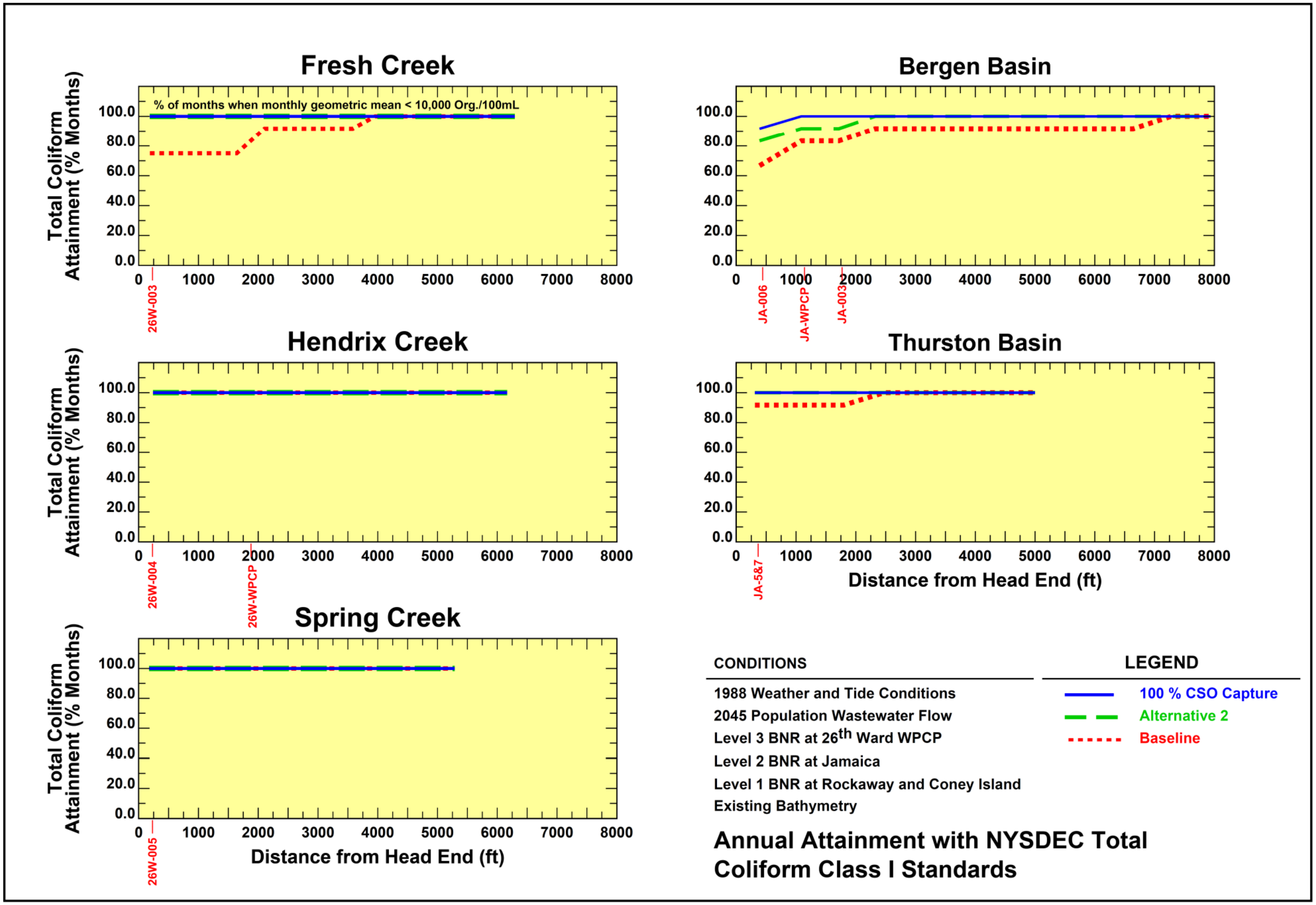
The technical evaluations conducted herein indicate that completely eliminating all CSO discharges in order to strictly meet narrative criteria for aesthetics and to enhance riparian uses can only be attained by completely abating CSO's and relocating or capturing and treating all WWTP discharges. The levels of aesthetic use attained by the selected alternatives of the



NYC Environmental Protection

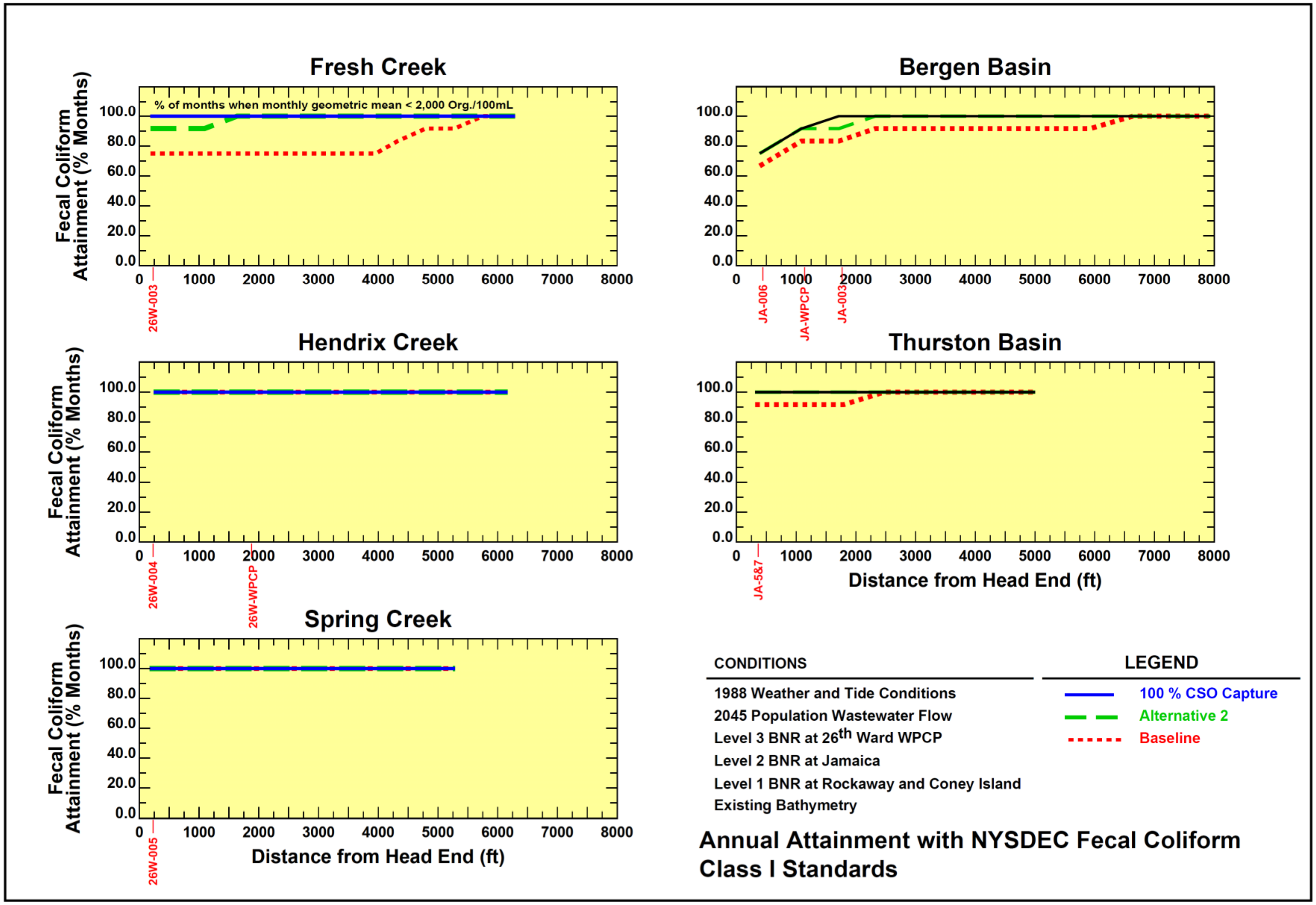
Attainment with NYSDEC Class I Dissolved Oxygen Standards

FIGURE 8-3



Annual Attainment with NYSDEC Total Coliform Class I Standards

FIGURE 8-4



Annual Attainment with NYSDEC Fecal Coliform Class I Standards

FIGURE 8-5

WB/WS Facility Plan represent a cost-effective plan for achieving the highest reasonably attainable aesthetic use.

8.7 GREEN STRATEGY ASSESSMENTS AND IMPLEMENTATION

The *NYC Green Infrastructure Plan*, as described in section 5.8, includes five key components: construct cost effective grey infrastructure; optimize the existing wastewater system through interceptor cleaning and other maintenance measures; control runoff from 10 percent of impervious surfaces through green infrastructure; institute an adaptive management approach to better inform decisions moving forward; and engage stakeholders in the development/implementation of these green strategies.

As part of the LTCP process, DEP will evaluate green infrastructure in combination with other LTCP strategies to better understand the extent to which green infrastructure would provide incremental benefits and would be cost-effective. DEP models will be refined by including new data collected from green infrastructure pilots, new impervious cover data and extending predictions to ambient water quality for the development of the LTCP. Based on these evaluations, and in combination with cost effective grey infrastructure, DEP will reassess the green infrastructure strategy.

9.0. Water Quality Standards Review

The Jamaica Bay and CSO Tributaries WB/WS Facility Plan is a component of the DEP's CSO LTCP. This Plan is being prepared in a manner fully consistent with USEPA's CSO Control Policy, the Wet Weather Water Quality Act of 2000 and applicable USEPA guidance.

As noted in Section 1.2 and as stated in the Clean Water Act (CWA), it is a national goal to achieve "fishable/swimmable" water quality in the nation's waters wherever attainable. The CSO policy also reflects the CWA's objectives to achieve high water quality standards (WQS) by controlling CSO impacts, but the policy recognizes the site-specific nature of CSOs and their impacts and provides the necessary flexibility to tailor controls to local situations. The key principles of the CSO policy were developed to ensure that CSO controls are cost-effective and meet the objectives of the CWA. In doing so, the policy provides flexibility to municipalities to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements. The policy also provides for the review and revision, as appropriate, of water quality standards when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs.

In 2001, USEPA published guidance for coordinating CSO long-term planning with water quality standards reviews. This guidance re-affirmed that USEPA regulations and guidance provide States with the opportunity to adapt their WQS to reflect site-specific conditions related to CSOs. The guidance encouraged the States to define more explicitly their recreation and aquatic life uses and then, if appropriate, modify the criteria accordingly to protect the designated uses.

The Jamaica Bay and CSO Tributaries Waterbody/Watershed Facility Plan was developed in a manner consistent with the CSO policy and applicable guidance. Specifically, cost-effectiveness evaluations were performed for CSO load reduction evaluations using long-term rainfall records. Baseline and Waterbody/Watershed Facility Plan receiving water impact evaluations were performed for average annual rainfall conditions consistent with CSO policy guidance. The plan developed from following USEPA regulations and guidance results in substantial benefits. However, it does not fully attain the "fishable/swimmable" goal. Accordingly, DEP expects to further evaluate additional CSO controls in the LTCP resulting in water quality benefits.

9.1. WATER QUALITY STANDARDS REVIEW

9.1.1. Numeric Water Quality Standards

New York State waterbody classifications and numerical criteria that are or may become applicable to Jamaica Bay and CSO Tributaries are shown in Table 9-1. The CSO Tributaries of Jamaica Bay (Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin) are classified as Class I at present with best usages of secondary contact recreation and fishing. The Class I dissolved oxygen criterion of never-less-than 4.0 mg/L is considered by NYSDEC to be fully consistent with the "fishable" goal of the CWA. The Class I use of secondary contact recreation, however, is not consistent with the "swimmable" or primary contact use goal of the CWA. Satisfaction of this goal would require reclassification of the CSO Tributaries in Jamaica

Bay to Class SB or SC, suitable for primary contact recreation, which would in turn require more stringent numerical coliform criteria and also increase the minimum dissolved oxygen requirement to never-less-than 5.0 mg/L from 4.0 mg/L.

Table 9-1. New York State Numeric Surface Water Quality Standards (Saline)

		Bacteria (Pathogens)		
Class	**DO (1) (mg/L)**	**Total Coliform(2,5) (per 100 mL)**	**Fecal Coliform(3,5) (per 100 mL)**	**Enterococci(4) (per 100 mL)**
I	≥4.0	≤10,000	≤2,000	NA
SB, SC	≥5.0	≤2,400; ≤5,000	≤200	≤35

Notes: (1) DEP acknowledges that marine DO standards for Class SB,SC waters have been modified since the original draft of this report was completed. To be consistent with previous Waterbody/Watershed Reports, the older marine DO standard is being used. (2) Total coliform criteria are based on monthly geometric means for Class I, and on monthly medians for Classes SB and SC; second criterion for SC and SB is for 80 percent of samples. (3) Fecal coliform criteria are based on monthly geometric means. (4) The enterococci standard is based on monthly geometric means per the USEPA Bacteria Rule and applies to the bathing season. The enterococci coastal recreation water infrequent use reference level (upper 95 percent confidence limit) = 501/100 mL. (5) Per 6 NYCRR 703.4(c), bacteria standards are only applicable when disinfection is practiced. n/a: not applicable.

The open waters of Jamaica Bay are classified as Class SB with best usages of primary and secondary contact recreation and fishing. Class SB waters shall also be suitable for fish propagation and survival. The Class SB waterbody classification is fully consistent with the "fishable/ swimmable" goals of the CWA.

The Interstate Environmental Commission (IEC) waterbody classifications and numerical criteria applicable to waters within the Interstate Environmental District are shown in Table 9-2. Jamaica Bay and CSO Tributaries are classified by IEC as Class A with best intended uses of primary and secondary contact recreation and fish propagation. IEC bacterial standards apply to effluent discharges from municipal and industrial wastewater treatment plants and not to receiving waters.

Table 9-2. Interstate Environmental Commission Classification, Criteria and Best Uses

Class	Dissolved Oxygen	Best Intended Use
A	≥5.0 mg/L	Suitable for all forms of primary and secondary contact recreation and for fish propagation. In designated areas, they also shall be suitable for shellfish harvesting.
B-1	≥4.0 mg/L	Suitable for fishing and secondary contact recreation. They shall be suitable for the growth and maintenance of fish life and other forms of marine life naturally occurring therein, but may not be suitable for fish propagation.
B-2	≥3.0 mg/L	Suitable for passage of anadromous fish and for the maintenance of fish life in a manner consistent with the criteria established in Sections 1.01 and 1.02 of these regulations.

9.1.2. Narrative Water Quality Standards

The New York State and IEC narrative water quality regulations are shown in Table 9-3 and 9-4 respectively. These standards apply to all surface waters, including Jamaica Bay and CSO Tributaries. Note that, in all cases, the narrative water quality standards apply a limit of "no" or "none" and only for selected parameters are these restrictions conditioned on the impairment of waters for their best usages.

Table 9-3. New York State Narrative Water Quality Standards

Parameters	Classes	Standard
Taste-, color-, and odor producing toxic and other deleterious substances	SA, SB, SC, I, SD A, B, C, D	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	SA, SB, SC, I, SD A, B, C, D	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	SA, SB, SC, I, SD A, B, C, D	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	SA, SB, SC, I, SD A, B, C, D	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
Garbage, cinders, ashes, oils, sludge and other refuse	SA, SB, SC, I, SD A, B, C, D	None in any amounts.
Phosphorus and nitrogen	SA, SB, SC, I, SD A, B, C, D	None in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages.

Table 9-4. Interstate Environmental Commission Narrative Regulations

Classes	Regulation
A, B-1, B-2	All waters of the Interstate Environmental District (whether of Class A, Class B, or any subclass thereof) shall be of such quality and condition that they will be free from floating solids, settleable solids, oil, grease, sludge deposits, color or turbidity to the extent that none of the foregoing shall be noticeable in the water or deposited along the shore or on aquatic substrata in quantities detrimental to the natural biota; nor shall any of the foregoing be present in quantities that would render the waters in question unsuitable for use in accordance with their respective classifications.
A, B-1, B-2	No toxic or deleterious substances shall be present, either alone or in combination with other substances, in such concentrations as to be detrimental to fish or inhibit their natural migration or that will be offensive to humans or which would produce offensive tastes or odors or be unhealthful in biota used for human consumption.
A, B-1, B-2	No sewage or other polluting matters shall be discharged or permitted to flow into, or be placed in, or permitted to fall or move into the waters of the District, except in conformity with these regulations.

9.1.3. Attainment of Currently Applicable Numeric Water Quality Standards

Section 8.1 summarizes water quality modeling analyses which were performed to evaluate attainment of water quality standards under Baseline and Waterbody/Watershed (WB/WS) Facility Plan conditions. The results of these analyses are summarized graphically in Appendix G and in tabular form in Table 9-5 through Table 9-15 for the various numerical criteria for dissolved oxygen and bacteria for current and fishable/swimmable classifications for both Jamaica Bay and its CSO Tributaries.

CSO Tributaries of Jamaica Bay

Table 9-5 summarizes the projected percentage annual attainment of dissolved oxygen for current NYSDEC Class I and IEC Class A criteria for Baseline and WB/WS Facility Plan conditions at the head end, mid-creek and mouth of each of the Jamaica Bay CSO Tributaries. For Class I, the WB/WS Facility Plan results in 58, 73 and 75 percent attainment of the dissolved oxygen criterion in Fresh Creek, Bergen Basin and Thurston Basin, respectively. Attainment of dissolved oxygen criterion on an annual basis in Hendrix Creek is 63 percent at the head and 87 percent at the mouth of the creek for the WB/WS Facility Plan. Annual dissolved oxygen criterion attainment in Spring Creek is 86 percent and 87 percent at the head and mouth, respectively, and 95 percent at mid-creek for the WB/WS Facility Plan.

The CSO tributaries of Jamaica Bay are classified Class A by IEC. For Baseline conditions on an annual basis, IEC Class A dissolved oxygen criterion, minimum of 5.0 mg/L, is attained 29 to 60 percent in Fresh Creek, 21 to 64 percent in Hendrix Creek, 65 to 73 percent in Spring Creek, 62 to 72 percent in Bergen Basin, and 55 to 71 percent in Thurston Basin. For the W/WS Facility Plan, the attainment of the Class A dissolved oxygen criterion is attained 51 to 81 percetn in Fresh Creek, 58 to 70 percent in Hendrix Creek, 77 to 85 percent in Spring Creek, 64 to 73 percent in Bergen Basin, and 64 to 72 percent in Thurston Basin.

Table 9-6 summarizes attainment of the Class I total coliform secondary contact recreation criterion (monthly geometric mean less than 10,000 per 100 mL) on an annual basis and during the recreation season for the Baseline and WB/WS Facility Plan. Under Baseline conditions for the design year, Hendrix and Spring Creeks attain Class I total coliform criterion 100 percent of the time. For the Baseline, attainment ranges from 67 percent to 92 percent at the head of Fresh Creek, Bergen Basin, and Thurston Basin. At the mouths of these tributaries, Baseline attainment is 100 percent. The secondary contact recreation Class I total coliform criterion is expected to be fully attained in all Jamaica Bay tributaries for the WB/WS Facility Plan conditions on an annual basis except for the head end of Bergen Basin where annual attainment is 83 percent. During the recreation season (June through August), 100 percent attainment of the Class I total coliform criterion is calculated for all of the tributaries under both Baseline and WB/WS Facility Plan conditions.

Table 9-7 summarizes attainment of the Class I fecal coliform secondary contact recreation criterion (monthly geometric mean less than 2,000 per 100 mL) on an annual basis and during the recreation season for the Baseline and WB/WS Facility Plan. Under Baseline conditions for the design year, Hendrix Creek and Spring Creek attain the Class I fecal coliform criterion 100 percent of the time. For the Baseline, attainment ranges from 67 percent to 92 percent at the head of Fresh Creek, Bergen Basin, and Thurston Basin. At the mouths of these tributaries, Baseline attainment is 100 percent.

Table 9-5. Annual Attainment of Class I and IEC Class A Dissolved Oxygen Criteria for Design Year - Jamaica CSO Tributaries

Location		Class I (≥ 4.0mg/L) Annual Percent Attainment		IEC Class A (≥5.0 mg/L) Annual Percent Attainment	
		Baseline	WB/WS FP	Baseline	WB/WS FP
Fresh Creek	Head	57	58	29	51
	Mid-Creek	79	85	55	77
	Mouth	82	89	60	81
Hendrix Creek	Head	61	63	21	58
	Mid-Creek	70	77	52	67
	Mouth	82	87	64	79
Spring Creek	Head	87	86	70	77
	Mid-Creek	93	95	73	85
	Mouth	83	87	65	78
Bergen Basin	Head	72	73	62	64
	Mid-Creek	75	76	67	67
	Mouth	79	80	72	73
Thurston Basin	Head	63	75	55	64
	Mid-Creek	72	75	65	66
	Mouth	79	81	71	72

Table 9-6. Annual Attainment of Class I Total Coliform Criterion for Design Year - Jamaica CSO Tributaries

Location		Class I (GM ≤ 10,000)			
		Annual Percent Attainment		Recreation Season Percent Attainment	
		Baseline	WB/WS FP	Baseline	WB/WS FP
Fresh Creek	Head	75	100	100	100
	Mid-Creek	92	100	100	100
	Mouth	100	100	100	100
Hendrix Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Spring Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Bergen Basin	Head	67	83	100	100
	Mid-Creek	92	100	100	100
	Mouth	100	100	100	100
Thurston Basin	Head	92	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100

Table 9-7. Annual Attainment of Class I Fecal Coliform Criterion for Design Year - Jamaica CSO Tributaries

Location		Class I (GM ≤ 10,000)			
		Annual Percent Attainment		Recreation Season Percent Attainment	
		Baseline	WB/WS FP	Baseline	WB/WS FP
Fresh Creek	Head	75	92	100	100
	Mid-Creek	75	100	100	100
	Mouth	100	100	100	100
Hendrix Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Spring Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Bergen Basin	Head	67	75	100	100
	Mid-Creek	92	100	100	100
	Mouth	100	100	100	100
Thurston Basin	Head	92	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100

The WB/WS Facility Plan results in an annual 100 percent attainment of the secondary contact recreation Class I fecal coliform criterion for Hendrix Creek and Spring Creek. Annual attainment is 75 percent at the head of Fresh Creek, 50 percent at the head of Thurston Basin and 58 percent at the head of Bergen Basin. During the recreation season (June through August), the WB/WS Facility Plan results in 100 percent attainment of Class I fecal coliform criterion for the design year for all of the tributaries. The WB/WS Facility Plan results in full secondary contact use attainment for fecal coliform criterion during the design year recreation season throughout all of the CSO Tributaries of Jamaica Bay.

Open Water Regions of Jamaica Bay

Table 9-8 summarizes the calculated percent annual attainment of dissolved oxygen for current Class SB and IEC Class A criteria for Baseline and WB/WS Facility Plan conditions at a number of locations throughout Jamaica Bay along a north transect, a south transect, and at Rockaway Inlet. Both the North and South Transects begin at the same location in Rockaway Inlet near the lower New York Harbor. The North Transect parallels the north shore of the Bay. Locations near the mouth of Paerdegat Basin, Spring Creek, and Bergen Basin are included in Table 9-8. The transect goes through Grassy Bay and ends near JFK Airport. The South Transect parallels the south shore of Jamaica Bay. Locations in Beach Channel, Grass Hassock Channel, and at Head of Bay (near the mouth of Thurston Basin) are included in Table 9-8.

Dissolved oxygen criterion (never less than 5.0 mg/L) attainment is close to 100 percent along the North Transect on an annual basis. Near the Grassy Bay/JFK Airport, annual attainment of the dissolved oxygen criterion is approximately 79 percent for both Baseline and WB/WS Facility Plan conditions. Full annual attainment of the dissolved oxygen criterion is projected for the South Transect for the WB/WS Facility Plan except in the Head of Bay section of Jamaica Bay where attainment with the Class SB dissolved oxygen criterion for the design year conditions is approximately 95 percent.

Table 9-8. Annual Attainment for Class SB/SC and IEC Class A Dissolved Oxygen Criteria for Design Year - Jamaica Bay

Location		Class SB/SC and IEC Class A (≥ 5.0 mg/L) Annual Percent Attainment	
		Baseline	WB/WS FP
North Transect	Paerdegat Basin	100	100
	Spring Creek	99	99
	Bergen Basin	95	95
	Grassy Bay & JFK	79	79
South Transect	Beach Channel	100	100
	Grass Hassock Channel	99	99
	Head of Bay	93	95
Rockaway Inlet		100	100

Table 9-9 summarizes the projected percentage annual attainment of total coliform criteria for Class SB/SC primary contact recreation (monthly median less than 2,400 per 100 mL and 80% of values less than 5,000 per 100 mL). As shown, 100 percent annual attainment is calculated throughout Jamaica Bay under both Baseline and WB/WS Facility Plan for design year conditions. Complete attainment of the Class SB/SC total coliform criteria is calculated during the recreation season as summarized on Table 9-10. Jamaica Bay, therefore, meets the primary contact recreation, "swimmable" use goal of the CWA for the design year condition as measured by total coliform.

Table 9-11 summarizes the projected percentage annual and recreation season attainment of Class SB/SC primary contact recreation fecal coliform criterion (monthly geometric mean less than 200 per 100 mL). As shown, complete attainment is expected annually throughout Jamaica Bay under both Baseline and WB/WS Facility Plan for design year conditions. Complete attainment of the Class SB/SC fecal coliform criteria is also calculated during the recreation season. Jamaica Bay, therefore, meets the primary contact recreation, "swimmable" use goal of the CWA for the design year condition as measured by fecal coliform.

Table 9-12 summarizes the projected attainment of the enterococci criterion which is applicable to Jamaica Bay for primary contact water use (geometric mean less than 35 per 100 mL). It is noted that the attainment values shown on Table 9-12 are for the three month period of June, July and August as the enterococci criteria were developed for the bathing season. The seasonal geometric mean enterococci criterion is expected to be fully attained under both Baseline and WB/WS Facility Plan conditions. In addition to the enterococci criterion, USEPA has defined a reference level of enterococci for infrequent use in coastal recreation waters of 501 per 100 mL (upper 95% confidence limit). The WB/WS Facility Plan results in enterococci below the 501 reference level 100 percent of the time throughout Jamaica Bay. This is an improvement in enterococci levels from Baseline conditions when the infrequent reference level of 501 was exceeded approximately seven percent of the time along the North Transect and four percent of the time in Head of Bay.

Table 9-9. Annual Attainment of Class SB/SC Total Coliform Criteria for Design Year - Jamaica Bay

		Class SB/SC – Annual			
		Median < 2,400 Percent Attainment		80th Percentile < 5,000 Percent Attainment	
Location		**Baseline**	**WB/WS FP**	**Baseline**	**WB/WS FP**
North Transect	Paerdegat Basin	100	100	100	100
	Spring Creek	100	100	100	100
	Bergen Basin	100	100	100	100
	Grassy Bay & JFK	100	100	100	100
South Transect	Beach Channel	100	100	100	100
	Grass Hassock Channel	100	100	100	100
	Head of Bay	100	100	100	100
Rockaway Inlet		100	100	100	100

Table 9-10. Recreation Season Attainment of Class SB/SC Total Coliform Criteria for Design Year - Jamaica Bay

		Class SB/SC – Recreation Season			
		Median < 2,400 Percent Attainment		80th Percentile < 5,000 Percent Attainment	
Location		**Baseline**	**WB/WS FP**	**Baseline**	**WB/WS FP**
North Transect	Paerdegat Basin	100	100	100	100
	Spring Creek	100	100	100	100
	Bergen Basin	100	100	100	100
	Grassy Bay & JFK	100	100	100	100
South Transect	Beach Channel	100	100	100	100
	Grass Hassock Channel	100	100	100	100
	Head of Bay	100	100	100	100
Rockaway Inlet		100	100	100	100

Table 9-11. Annual Attainment of Class SB/SC Fecal Coliform Criteria for Design Year - Jamaica Bay

		Class SB/SC (GM ≤ 200)			
		Annual Percent Attainment		Recreation Season Percent Attainment	
Location		**Baseline**	**WB/WS FP**	**Baseline**	**WB/WS FP**
North Transect	Paerdegat Basin	100	100	100	100
	Spring Creek	100	100	100	100
	Bergen Basin	100	100	100	100
	Grassy Bay & JFK	100	100	100	100
South Transect	Beach Channel	100	100	100	100
	Grass Hassock Channel	100	100	100	100
	Head of Bay	100	100	100	100
Rockaway Inlet		100	100	100	100

Table 9-12. Recreation Season Attainment of Class SB/SC Enterococci Criteria for Design Year - Jamaica Bay

Location		Class SB/SC – Recreation Season: GM ≤ 35 Percent Attainment		Infrequent Use Reference Level Percent of Time < 501	
		Baseline	WB/WS FP	Baseline	WB/WS FP
North Transect	Paerdegat Basin	100	100	93	100
	Spring Creek	100	100	96	100
	Bergen Basin	100	100	96	100
	Grassy Bay & JFK	100	100	99	100
South Transect	Beach Channel	100	100	100	100
	Grass Hassock Channel	100	100	100	100
	Head of Bay	100	100	99	100
Rockaway Inlet		100	100	100	100

9.1.4. Attainment of Narrative Water Quality Standards

Table 9-3 summarizes NYSDEC narrative water quality standards applicable to all waters of the New York State, including Jamaica Bay, Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin. The existing CSO and stormwater discharges contribute materials that affect some of the listed parameters to a degree; oil, floating substances, and floatable materials (refuse) will continue to be discharged, though to a much lesser extent.

The WB/WS Facility Plan is projected to greatly reduce the discharge of these materials to Jamaica Bay and the Jamaica CSO Tributaries, but will not completely eliminate the discharge. Plan elements are anticipated to result in reduction of CSOs and an increase in wet weather flow capture are expected to reduce the discharge of the parameters of concern by at least 60 percent from Baseline conditions based on volumetric capture. Heavy solids that would settle near the CSO outfalls will be virtually eliminated and floatable materials will be substantially reduced since greater than 90 percent of the wet weather flow volume generated in the Jamaica Bay sewershed will receive preliminary treatment. Consequently, the adverse impacts of the current CSO discharges will be substantially diminished although not completely eliminated as required by the narrative standards. Additionally, best management practices applied to the separate stormwater discharges also cannot completely eliminate impacts from that source but will reduce loadings to the extent feasible.

The WB/WS Facility Plan, although not completely eliminating all of the parameters of concern, will virtually eliminate odors, reduce the deposition of organic solids and floatable materials and restore the aesthetic uses of Jamaica Bay and CSO Tributaries to the maximum extent practicable.

9.1.5. Attainability of Potential Future Standards

Those areas designated Class SB/SC would not be subject to a potential future standard because this is the highest standard NYSDEC has and is consistent with the fishable and swimmable goals of the CWA. NYSDEC also considers Class I dissolved oxygen standards consistent with the “fishable” goal of the CWA; however, the Class I secondary contact use is not considered by NYSDEC to be consistent with the "swimmable" CWA goal. Therefore, a standards reclassification would not be necessary for full fishable use in the Jamaica Bay CSO Tributaries Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin, but would be necessary for these CSO Tributaries of Jamaica Bay to be fully supportive of primary contact use, and it would be necessary to attain the Class SB/SC criteria for total and fecal coliform, the enterococci criterion and the USEPA enterococcus reference level. Tables 9-13 through Table 9-15 summarize projected attainability of these potential criteria.

Table 9-13 presents the attainability of Class SB/SC primary contract criteria for total coliform. The monthly median value and the upper limit criteria are expected to be attained under both Baseline and WB/WS Facility Plan conditions in Fresh Creek, Hendrix Creek and Spring Creek. The attainability of the monthly median value and the upper limit criteria are expected to be improved by the WB/WS Facility Plan for the other two tributaries on an annual basis. During the recreation season, the SB/SC total coliform criteria are attained in Fresh, Hendrix and Spring Creeks, but not in Bergen and Thurston Basins.

The attainability of Class SB/SC fecal coliform criteria for the CSO tributaries is summarized in Table 9-14. On an annual basis, the WB/WS Facility Plan improves the attainability of the Class SB/SC fecal coliform criteria in Fresh Creek, Hendrix Creek and Spring Creek, such that, full attainment is reached. In Bergen and Thurston Basins the WB/WS Facility Plan improves the annual of the Class SB/SC fecal coliform criteria over Baseline, but does not result in full attainment of the criteria. The WB/WS Facility Plan does not improve attainment in Bergen and Thurston Basins very much for the recreation season.

Table 9-13. Attainability of Class SB/SC
Total Coliform Criteria for Design Year - Jamaica CSO Tributaries

		Class SB/SC							
		Annual				Recreation Season			
		Median < 2,400 Percent Attainment		80th Percentile < 5,000 Percent Attainment		Median < 2,400 Percent Attainment		80th Percentile < 5,000 Percent Attainment	
Location		Baseline	WB/WS FP	Baseline	WB/WS FP	Baseline	WB/WS FP	Baseline	WB/WS FP
Fresh Creek	Head	100	100	0	0	100	100	0	100
	Mid-Creek	100	100	0	100	100	100	0	100
	Mouth	100	100	100	100	100	100	100	100
Hendrix Creek	Head	100	100	100	100	100	100	100	100
	Mid-Creek	100	100	100	100	100	100	100	100
	Mouth	100	100	100	100	100	100	100	100
Spring Creek	Head	100	100	100	100	100	100	100	100
	Mid-Creek	100	100	100	100	100	100	100	100
	Mouth	100	100	100	100	100	100	100	100
Bergen Basin	Head	17	17	0	0	67	67	0	0
	Mid-Creek	58	75	25	33	67	67	67	67
	Mouth	75	92	25	58	100	100	67	67
Thurston Basin	Head	58	67	8	17	67	67	33	67
	Mid-Creek	67	92	25	50	67	100	67	67
	Mouth	75	92	33	67	100	100	67	67

Table 9-14. Attainability of Class SB/SC Fecal Coliform Criteria for Design Year - Jamaica CSO Tributaries

Location		Class SB/SC (GM ≤ 200) Annual Percent Attainment Baseline	Annual Percent Attainment WB/WS FP	Recreation Season Percent Attainment Baseline	Recreation Season Percent Attainment WB/WS FP
Fresh Creek	Head	0	100	100	100
	Mid-Creek	0	100	100	100
	Mouth	100	100	100	100
Hendrix Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Spring Creek	Head	100	100	100	100
	Mid-Creek	100	100	100	100
	Mouth	100	100	100	100
Bergen Basin	Head	8	8	33	33
	Mid-Creek	25	42	67	67
	Mouth	33	67	67	100
Thurston Basin	Head	16	42	67	67
	Mid-Creek	33	42	67	67
	Mouth	50	67	100	100

Table 9-15 summarizes the projected attainability of enterococci criteria that could be applied to the Jamaica Bay CSO Tributaries for primary contact water use. The attainment values shown are for the three month period of June, July, and August. The table shows that 100 percent attainment of the seasonal geometric mean throughout Fresh Creek and Spring Creek is expected under WB/WS Facility Plan conditions. The enterococci levels in the Jamaica CSO Tributaries are less than 501, the USEPA infrequent use coastal recreation reference level (upper 95% confidence limit), 59 to 95 percent of the time. As with fecal coliform, the modeling projects that 100 percent elimination of CSO discharges to the Jamaica CSO Tributaries would not completely attain the infrequent use reference level due to the continuing stormwater discharges.

Table 9-15. Attainability of Class SB/SC Enterococcus Criteria for Design Year - Jamaica CSO Tributaries

Location		Class SB/SC – Recreation Season			
		GM ≤ 35 Percent Attainment		Infrequent Use Reference Level Percent of Time < 501	
		Baseline	WB/WS FP	Baseline	WB/WS FP
Fresh Creek	Head	0	100	72	83
	Mid-Creek	0	100	75	84
	Mouth	100	100	81	91
Hendrix Creek	Head	100	100	93	93
	Mid-Creek	100	100	93	94
	Mouth	100	100	91	95
Spring Creek	Head	100	100	84	85
	Mid-Creek	100	100	86	88
	Mouth	100	100	89	94
Bergen Basin	Head	0	0	58	59
	Mid-Creek	0	0	74	78
	Mouth	100	100	83	85
Thurston Basin	Head	0	0	70	72
	Mid-Creek	0	100	77	79
	Mouth	100	100	80	84

9.1.6. Water Uses Restored

Fish and Aquatic Life Protection Use

Table 9-5 presents the expected improvements in dissolved oxygen in Jamaica CSO Tributaries to be attained by the WB/WS Facility Plan as compared to Baseline conditions for current NYSDEC and IEC dissolved oxygen criteria. The Plan results in some improvement in attainment of the DO criteria in the tributaries.

Greater than 95 percent attainment of the Class SB dissolved oxygen criterion is expected in most of Jamaica Bay as summarized in Table 9-8. This is considered to be a high level of attainment in terms of the protection of fish and aquatic life, various forms of which spawn throughout almost the entire year. Modeling calculations demonstrate that the dissolved oxygen excursions that are projected to occur are not primarily caused by CSO. Complete CSO reduction does not result in 100 percent attainment of the Class SB dissolved oxygen criterion at all locations in Jamaica Bay. The depression of dissolved oxygen in the eastern area of Jamaica Bay is related to a number of factors. The primary factors contributing to low dissolved oxygen are the eutrophic conditions in the bay resulting from nitrogen discharges from the four WWTPs, carbon (BOD) discharges from these WWTPs, and poor circulation. The poor circulation in the eastern portion of the bay is due to constricted channels in North Channel and Beach Channel as well as the depth of the borrow pits in Grassy Bay and Grass Hassock Channel. CSOs and stormwater are relatively minor contributors to the DO deficit in the open waters of Jamaica Bay.

Primary and Secondary Contact Recreation Use

Table 9-6 and Table 9-7 present the expected attainment of the secondary contact recreation criterion currently applicable to Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin. The WB/WS Facility Plan results in 100 percent attainment of secondary contact recreation use during the recreation season and essentially throughout the year. Slight exceptions to 100 percent attainment are noted at the head end section of Bergen Basin (for total and coliform), and Fresh Creek (for fecal coliform) during non-recreation months.

Table 9-9 through Table 9-12 show projected attainment of current primary contact recreation criteria for Jamaica Bay. Full annual attainment of total coliform and fecal coliform is expected. There is 100 percent attainment of enterococci criteria and 100 percent of enterococci are less than the USEPA infrequent use reference level throughout the Bay. The "swimmable" goal of the CWA is achieved in Jamaica Bay for the design year WB/WS Facility Plan conditions.

Table 9-13 through Table 9-15 present the expected attainability of potential Class SB/SC primary contact criteria in the Jamaica CSO Tributaries. Complete compliance with primary contact recreation total and fecal coliform criteria is not projected annually for WB/WS Facility Plan for Bergen and Thurston Basins. However, the total and fecal coliform results presented indicate that the WB/WS Facility Plan may achieve water quality supportive of primary contact for one to three months of the three-month summer recreation period. Similarly, the enterococci primary contact criterion is attained at many locations, and the USEPA infrequent use reference level (less than 501 per 100 mL) is attained 59 to 95 percent of the time in the CSO Tributaries.

Aesthetic Use

As discussed in Section 9.1.4, the WB/WS Facility Plan will not completely eliminate all regulated parameters in the NYSDEC narrative water quality standards to zero discharge levels, but will significantly reduce the volumetric discharge of such substances. Settleable solids will be substantially reduced by the WWTP, sewer system and related improvements. The effect of floatable materials from CSOs will be curtailed by the proposed netting floatables controls and the effect of narrative materials from stormwater inputs will be reduced to the maximum extent practicable. Accordingly, the aesthetic conditions in Jamaica Bay should improve to a level consistent with the other attained water uses. Aesthetic conditions in the Jamaica CSO Tributaries are expected to improve to be consistent with the nature of the adjacent shoreline uses. Odors associated with exposed CSO sediment mounds in Hendrix Creek will be virtually eliminated by the dredging program in this waterbody.

9.1.7. Practical Considerations

Section 9.1.3 describes the improvement in the level of attainment of the NYSDEC Class I, Class SB/SC and IEC Class A dissolved oxygen criteria which is expected to result from the WB/WS Facility Plan. Modeling shows that not even 100 percent elimination of all CSO discharges would attain the dissolved oxygen criterion at all times due to continuing stormwater and WWTP discharges and poor mixing in the tributaries.

In the months during which DO criterion excursions are expected, it should be noted that any adverse impact on fish larvae propagation may be limited. Fish larvae spawning in the CSO tributaries of Jamaica Bay will be exchanged with, and transported to, Jamaica Bay waters where dissolved oxygen will be greater in most areas. The organisms will, therefore, not be continuously exposed to dissolved oxygen which may be depressed below the criterion. Consequently, the impact on larval survival will be less than expected based on laboratory studies where organisms are confined and exposed continuously to the same depressed dissolved oxygen level. The high degree of both larval transport and dissolved oxygen variability resulting from the tidal exchange between the CSO Tributaries and Jamaica Bay suggest that the ecosystem should be considered in its entirety rather than by individual waterbody for evaluating fish and aquatic life protection.

Section 9.1.3 also notes that during the summer recreation season, water quality in the Jamaica CSO Tributaries may be supportive of the swimmable (primary contact recreation) goal of the CWA during one or two of the three summer recreation season months. However, swimming should not be considered as a best use of the CSO Tributaries due to periodic overflows, continuing stormwater discharges, and the physically restrictive nature and location of the tributaries. In addition, National Park Service rules for Jamaica Bay prohibit swimming. It is also noted that the bacteriological criteria for Jamaica Bay and Jamaica CSO Tributaries are not applicable under State Water Quality Regulations unless disinfection is practiced to protect primary contact as a best use.

9.2. WATER QUALITY STANDARDS REVISION

9.2.1. Overview of Use Attainability and Recommendations

Section 9.1 summarizes the expected levels of attainment of the current and potential water quality standards for Jamaica Bay and CSO Tributaries based on modeling calculations. For Fresh Creek, Bergen Basin, and Thurston Basin, the WB/WS Facility Plan results in full attainment of aquatic life protection. The attainment of the aquatic life use in CSO tributaries can be expected to be greater than that suggested by the attainment of numerical criteria during the summer period due to the limited larval residence time in the CSO tributaries and organism transport to Jamaica Bay. The aquatic life use in Jamaica Bay is fully supported at Class SB/SC dissolved oxygen levels throughout most of the Bay. For the Bay areas where Class SB/SC dissolved oxygen is not fully attained the cause is primarily due to continuing stormwater discharges, eutrophication effects due to WWTP effluent nutrient loads, and poor circulation rather than CSOs.

For recreational activity, the currently designated uses of secondary contact recreation in the Jamaica CSO Tributaries and primary contact recreation in Jamaica Bay are expected to be fully attained under WB/WS Facility Plan conditions. Further, numerical water quality conditions suitable to support primary contact may be attained possibly during a month or two of the summer recreation season in most of the CSO Tributaries for all relevant bacteriological indicators, although bathing and swimming activities would not be considered the best use. Indeed, bathing and swimming are not permitted in Jamaica Bay by the National Park Service.

As a result of the water quality conditions and uses expected to be attained in Jamaica Bay and CSO Tributaries as a result of the WB/WS Facility Plan, it is recommended that the current waterbody classifications be retained at this time, Class I in Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin and Class SB in Jamaica Bay, i.e. the water use goals for Class I in the Jamaica CSO Tributaries and Class SB in Jamaica Bay are expected to be achieved, either numerically or for practical purposes, once the WB/WS Facility Plan is constructed and operational. However, the attainment of the designated uses, while expected, should be demonstrated from long-term post-construction water quality monitoring data and numerical modeling.

As noted previously, expected levels of water quality criteria compliance are based on modeling calculations which are subject to some level of uncertainty. In addition, calculations are based on a typical year with an average amount of annual rainfall. Therefore, it is recommended that the actual improvements in water quality conditions resulting from the WB/WS Facility Plan be assessed from the multi-year long-term post-construction monitoring program described in Section 8.5 of the WB/WS Facility Plan report. Data collected by the monitoring program will be used to determine whether the current Class I and Class SB uses are supported as expected, as well as whether water quality supports other levels of usage that may indicate the need for reclassification, such as assigning Class SC to one or more of the Jamaica CSO Tributaries currently designated Class I. It should be noted that non-attainment of the CWA "fishable/swimmable" goals may require a Use Attainability Analysis and subsequent water quality standards revision.

As described in this report, modeling calculations indicate that complete attainment of the Class I dissolved oxygen criterion, and all of the Class SB/SC criteria on an annual basis, both numerical and narrative, cannot be achieved in any of the Jamaica CSO Tributaries through the abatement of CSO discharges. In Jamaica Bay, complete attainment of the Class SB/SC dissolved oxygen criteria throughout the entire Bay cannot be achieved even with 100 percent CSO reduction. The water quality based effluent limit (WQBEL) of zero annual overflows is neither cost-effective nor consistent with CSO policy. Therefore, until the long-term post-construction monitoring program is completed for Jamaica Bay and CSO Tributaries to document conditions actually attained, it is recommended that a variance to the WQBEL be applied for, and approved, for the Jamaica Bay and CSO Tributaries/WS Facility Plan for appropriate effluent variables.

9.2.2. NYSDEC Requirements for Variances to Effluent Limitations

The requirements for variances to water quality based effluent limitations are described in Section 702.17 of NYSDEC's Water Quality Regulations. The following is an abbreviated summary of the variance requirements which are considered applicable to Jamaica Bay and CSO Tributaries. The lettering and numbering are those used in Section 702.17.

(a) The department may grant, to a SPDES permittee, a variance to a water quality-based effluent limitation included in a SPDES permit.

(1) A variance applies only to the permittee identified in such variance and only to the pollutant specified in the variance. A variance does not affect or require the department to modify a corresponding standard or guidance value.

(5) A variance term shall not exceed the term of the SPDES permit. Where the term of the variance is the same as the permit, the variance shall stay in effect until the permit is reissued, modified or revoked.

(b) A variance may be granted if the requester demonstrates that achieving the effluent limitation is not feasible because:

(1) Naturally occurring pollutant concentrations prevent attainment of the standard or guidance value;

(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent attainment, unless these conditions may be compensated for by the discharge of sufficient volume of effluent to enable the standard or guidance value to be met without violating water conservation requirements.

(3) human-caused conditions or sources of pollution prevent attainment of the standard or guidance value and cannot be remedied or would cause more environmental damage to correct them to leave in place.

(4) Dams, diversions or other types of hydrologic modifications preclude attainment of the standard or guidance value, and it is not feasible to restore the waterbody to its original condition or to operate such modification in a way that would result in such attainment.

(5) Physical conditions related to the natural features of the waterbody, such as the lack of a proper substrate cover, flow, depth, pools, riffles, and the like, unrelated to chemical water quality, preclude attainment of the standard or guidance value; or

(6) Controls more stringent than those required by section 754.1(a)(1) and (2) of this Title would result in substantial and widespread economic and social impact.

(c) In addition to the requirements of subdivision (b) of this section, the requestor shall also characterize, using adequate and sufficient data and principles, any increased risk to human health and the environment associated with granting the variance compared with attainment of the standard or guidance value absent the variance, and demonstrate to the satisfaction of the department that the risk will not adversely affect the public health, safety and welfare.

(d) The requestor shall submit a written application for a variance to the department. The application shall include:

(1) all relevant information demonstrating that achieving the effluent limitation is not feasible based on subdivision (b) of this section; and

(2) All relevant information demonstrating compliance with the conditions is subdivision (c) of this section.

(e) Where a request for a variance satisfies the requirements of this section, the department shall authorize the variance through the SPDES permit. The variance request shall be available to the public for review during the public notice period for the

permit. The permit shall contain all conditions needed to implement the variance. Such conditions shall, at minimum, include:

(1) Compliance with an initial effluent limitation that, at the time the variance is granted represents the level currently achievable by the requestor, and that is no less stringent than that achieved under the previous permit where applicable.

(2) that reasonable progress be made toward achieving the effluent limitations based on the standard or guidance value, including, where reasonable, an effluent limitation more stringent than the initial effluent limitations;

(3) Additional monitoring, biological studies and pollutant minimization measures as deemed necessary by the department.

(4) when the duration of a variance is shorter than the duration of a permit, compliance with an effluent limitation sufficient to meet the underlying standard or guidance value, upon the expiration of the variance; and

(5) A provision that allows the department to reopen and modify the permit for revisions to the variance.

(g) A variance may be renewed, subject to the requirements of this section. As part of any renewal application, the permittee shall again demonstrate that achieving the effluent limitation is not feasible based on the requirements of this section.

(i) The department will make available to the public a list of every variance that has been granted and that remains in effect.

9.2.3. Manner of Compliance with the Variance Requirements

Subdivision (a) authorizes NYSDEC to grant a variance to a "water quality based effluent limitation…included in a SPDES permit." It is understood that the Jamaica Bay and CSO Tributaries WB/WS Facility Plan, when referenced in the 26th Ward and Jamaica WWTP SPDES permits along with other presumed actions necessary to attain water quality standards, can be interpreted as the equivalent of an "effluent limitation" in accordance with the "alternative effluent control strategies" provision of Section 302(a) of the CWA.

Subdivision (a)(1) indicates that a variance will apply only to a specific permittee, in this case, DEP, and only to the pollutant specified in the variance. It is understood that "pollutant" can be interpreted in the plural, and one application and variance can be used for one or more relevant pollutants. In Jamaica Bay and CSO Tributaries, a variance would be needed for the following pollutants: oxygen demanding substances (BOD for dissolved oxygen attainment in Hendrix and Spring Creeks), and effluent constituents covered by narrative water quality standards (suspended, colloidal and settleable solids; oil and floating substances). A variance for bacteriological criteria would not be requested as the Jamaica Bay and CSO Tributaries WB/WS Facility Plan is expected to attain Class I and Class SB requirements within the constraints of modeling uncertainty.

Subdivision (b) requires the permittee to demonstrate that achieving the water quality based effluent limitation is not feasible due to a number of factors. It is noted that these factors are the same as those in 40 CFR 131.10(g) which indicate federal requirements for a UAA. As with the federal regulations, it is assumed that any one of the six factors is justification for the granting of a variance. If a UAA is required, it is anticipated that the applicability of two of the six factors cited in Subdivision (b): (3) human caused conditions and (4) hydrologic modifications would provide the basis of the analysis.

Subdivision (c) requires the applicant to demonstrate to the department any increased risk to human health associated with granting of the variance compared with attainment of the water quality standards absent the granting of the variance. As noted above, the variance application is needed for suspended, colloidal and settleable solids, and oil and floating substances in the periodic overflows from the 26th Ward and Jamaica WWTP CSO and stormwater outfalls. These substances pose no significant risk to human health. Further, as described above in Section 9.1.4, a 60 percent volumetric reduction is expected from Baseline CSO loadings to the Jamaica Bay system, with additional capture of floatables from netting facilities. As summarized above in Section 9.1, the Jamaica Bay and CSO Tributaries WB/WS Facility Plan is expected to achieve the current Class I secondary contact recreation in Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin and Class SB primary contact criteria in the open water regions of Jamaica Bay. Therefore, no variance is requested for bacteriological conditions. The Jamaica Bay and CSO Tributaries WB/WS Facility Plan will achieve a relatively high level of attainment of the current Class I DO criterion in the CSO Tributaries, and for the reasons described above in Section 9.1.5 and Section 9.1.6, very limited risk to the environment is expected absent attainment of the standard.

Subdivision (d) of the variance regulations requires that the requestor submit a written application for a variance to NYSDEC which includes all relevant information pertaining to Subdivisions (b) and (c). DEP will submit a variance application for the Jamaica Bay and CSO Tributaries WB/WS Facility Plan to NYSDEC six months before the plan is placed in operation. The application will be accompanied by the Jamaica Bay and CSO Tributaries WB/WS Facility Plan report, the Jamaica Bay and CSO Tributaries WB/WS Facility Plan Use Attainability Evaluation, and all other supporting documentation pertaining to Subdivisions (b) and (c) and as required by any other subdivisions of the variance requirements.

Subdivision (e) stipulates that approved variances be authorized through the appropriate SPDES permit, be available to the public for review and contain a number of conditions:

- It is assumed that the initial effluent limitation achievable by the permittee at the time the variance becomes effective, after WB/WS Facility Plan construction, will be based upon the performance characteristics of the WB/WS Facility Plan as agreed upon between NYSDEC and DEP. These interim operational conditions will be based on the WB/WS Facility Plan's design specifications. It is expected that a fact sheet outlining the basis for the WQBEL and interim operational conditions will be appended to the SPDES permits.
- It is assumed that the requirement for demonstration of reasonable progress after construction as required in the permit will include DEP activities such as implementation of the long-term monitoring program and additional waterbody improvement projects as delineated in Section 5 of this WB/WS Facility Plan report. Such actions and projects include: 14 best management practices, the City-wide CSO plan for floatables abatement, other long-term CSO control planning activities which

may affect Jamaica Bay and CSO Tributaries, various Jamaica Bay water quality improvement projects, and various ecosystem restoration activities. These activities are also required under section (3) of the Subdivision.

- It is assumed that the SPDES permits authorizing the Jamaica Bay and CSO Tributaries WB/WS Facility Plan variance will contain a provision that allows the department to reopen and modify the permit for revisions to the variance.

Subdivision (g) indicates that a variance may be renewed. It is anticipated that a variance for the Jamaica Bay and CSO Tributaries WB/WS Facility Plan would require renewals to allow for sufficient long-term monitoring to assess the degree of water quality standards compliance. As appropriate, a variance renewal application will be submitted 180 days before SPDES permit expiration.

At the completion of the variance period(s), it is expected that the results of the long-term monitoring program will demonstrate each of the following:

- The degree to which the WB/WS Facility Plan attains the current Class I and Class SB classification water quality criteria and uses;
- The degree to which the WB/WS Facility Plan achieves water quality criteria consistent with the fishable/swimmable goals of the CWA, whether any new cost-effective technology is available to enhance the WB/WS Facility Plan performance, if needed, whether Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, or Thurston Basin should be reclassified, or whether a UAA should be approved.

In this manner, the approval of a WQBEL variance for Jamaica Bay and CSO Tributaries together with an appropriate long-term monitoring program can be considered as a step toward a determination of the following:

- Can Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, or Thurston Basin be reclassified in a manner which is wholly or partially compatible with the fishable/swimmable goals of the Clean Water Act. Or,
- Is a UAA needed for Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, or Thurston Basin and for which water quality criteria?

Although current waterbody classification for Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin is Class I, not wholly compatible with the goals of the Clean Water Act and would normally require reclassification or a UAA in the State's triennial review obligation, it is considered to be more appropriate to proceed with the more deliberative variance approval/monitoring procedure outlined above. The recommended procedure will determine actual improvements resulting from WB/WS Facility Plan implementation, enable a proper determination for the appropriate waterbody classification for Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin, and perhaps avoid unnecessary, repetitive and possibly contradictory rulemaking.

9.2.4. Future Considerations

Urban Tributary Classification

The long-term monitoring program recommended for Jamaica Bay, Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin, and ultimately for other confined waterbodies throughout the City may indicate that the highest attainable uses are not compatible with the use goals of the Clean Water Act and State Water Quality Regulations. It is therefore recommended that consideration be given to the development of a new waterbody classification in NYSDEC Water Quality Regulations, that being "Urban Tributary."

The Urban Tributary classification would have the following attributes:

- Recognition of wet weather conditions in the designation of uses and water quality criteria;
- Application to urban confined waterbodies which satisfy any of the UAA criteria enumerated in 40CFR131.10(g);
- Definition of required baseline water uses;
- Fish and aquatic life survival (if attainable); and
- Secondary contact recreation (if attainable).

Other attainable higher uses would be waterbody-specific and dependent upon the effectiveness of the site-specific WB/WS Facility Plan and LTCP based upon knee-of-the-curve considerations, technical feasibility and ease of implementation.

The Urban Tributary classification could be implemented through the application of a generic UAA procedure for confined urban waterbodies based on the criteria of 40 CFR 131.10(g). This procedure could avoid the necessity for repeated UAAs on different waterbodies with similar characteristics. Those waterbodies which comply with the designation criteria can be identified at one time, and the reclassification completed in one rulemaking.

If either of the designated baseline uses of fish and aquatic life survival and secondary contact recreation did not appear to be attainable in a particular setting, then a site-specific UAA would be required.

Narrative Criteria

The recommendation for a WQBEL variance for the Jamaica Bay and CSO Tributaries WB/WS Facility Plan would apply with regard to the narrative water quality criteria previously cited as well as to the Class I water quality criterion for dissolved oxygen for Hendrix and Spring Creeks. However, a broad issue remains with the practical ability to attain the requirements of the narrative criteria in situations where wet weather discharges are unavoidable and will occasionally occur after controls. Therefore, it is recommended that NYSDEC review the application of the narrative criteria, provide for a wet weather exclusion with demonstrated need, or make all narrative criteria conditional upon the impairment of waters for their best usage.

Synopsis

Although this WB/WS Facility Plan is expected to result in improvements to the water quality in Jamaica Bay and CSO Tributaries, it is not expected to completely attain all applicable water quality criteria. As such, the SPDES Permit for the 26th Ward and Jamaica WWTPs may require a WQBEL variance for the Jamaica Bay and CSO Tributaries WB/WS Facility Plan if contravention of some criteria continues to occur. If water quality criteria are demonstrated to be unrealistic after a period of monitoring, DEP would request reclassification of portions of Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, or Thurston Basin based on a UAA. Until the recommended UAAs and required regulatory processes are completed, the current NYSDEC classification should be retained, i.e., Class I for Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin, and Thurston Basin, and Class SB for Jamaica Bay.

NO TEXT ON THIS PAGE

10.0. References

Adams, D.A., J.S. O'Connor, S.W. Weisberg. 1998. Sediment Quality of the NY/NJ Harbor System. An Investigation under the Regional Environmental Monitoring and Assessment Program (REMAP), March 1998.

Allee, et al. 1994. Final Environmental Impact Statement for the Paerdegat Basin Water Quality Facility Plan, prepared by Hazen and Sawyer, P.C., Allee King Rosen & Fleming, Inc., HydroQual, Inc., and Historical Perspectives, Inc. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering and Office of Environmental Planning, March 1994.

Aller, R.C. 1982. The effects of macrobenthos on chemical properties of marine sediment and overlying water. Animal-Sediment Relations. The Biogenic Alteration of Sediments. Plenum Press, New York. pp.53-102.

"A Thumbnail View" by Vincent F. Seyfried and Jon A. Peterson History Department, Queens College/CUNY.

"A Walk Around Brooklyn With David Hartman and Historian Barry Lewis," Thirteen/WNET 450 West 33rd Street, New York, NY 10001.

Blanchard, Peter, Buffer the Bay Revisited, An Updated Report on Jamaica Bay's Open Shoreline and Uplands, The Trust for Public Land in conjunction with the New York Audubon Society, Capital Cities/ABC.

Bopp, R.F., H.J. Simpson, S. N. Chillrud, and D.W. Robinson. 1993. Sediment-derived chronologies of persistent contaminants in Jamaica Bay - historical trends in contamination of estuarine and coastal sediments. Estuaries 16(3B): 608-616.

Buckley, L. J. 1984. RNA-DNA ratio: an index of larval fish growth in the sea. Marine Biology 80: 291-298.

Buckley, L., E. Caldarone, and T.L. Ong. 1999. RNA/DNA ratio and other nucleic acid-based indicators for growth and condition of marine fishes. Hydrobiologia 401: 265-277.

Cornwell, J.C. and M. Owens. 1998. Sediment biogeochemical processes in Jamaica Bay, New York. Final Report to HydroQual, Inc., Mahwah, NJ. Horn Point Laboratory, University of Maryland Center for Environmental Science.

Cosper, E.M., A. West, and W.S. Kim. 1989. A comparison of plankton and primary productivity in the waters of the waters of the Gateway National Recreation Area: A final data report to the National Park Service, Gateway National Recreation Area, Brooklyn, NY.

Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. 103 pp.

Day, J.W., C.A.S. Hall, W.M. Kemp and A. Yanez-Aranciba. 1989. Estuarine Ecology. John Wiley & Sons, New York, NY, USA. 558 pp.

Dean, T.A. and V.J. Bellis. 1975. Seasonal and Spatial Distribution of Epifauna in the Pamlico River Estuary, North Carolina. Journal of Elisha Mitchell Scientific Society 91(1): 1-12.

Diaz, R.J. and R. Rosenberg. 1995. Marine benthic hypoxia: a review of its ecological effects and the behavioral responses of benthic macrofauna. Oceanography and Marine Biology: An Annual Review, 33: 245-303.

DiToro, D.M. and J.J. Fitzpatrick. 1993. Chesapeake Bay Sediment Flux Model. Prepared for the USACE Waterways Experiment Station, Environmental Laboratory, Vicksburg, Mississippi by HydroQual, Inc., Mahwah, NJ.

EDR, Environmental Data Resources, 440 Wheelers Farm Road, Milford, Connecticut, 06461.

EEA, Inc. 1997. Jamaica Bay Eutrophication Study: Biological Productivity Study. Draft Prepared for the New York City Department of Environmental Protection, December 1997.

ENSR Consulting. 1999. East River Repowering Project at the East River Generating Station, New York, NY, September 1999.

Farley, P.P., October 1920, Jamaica Bay, Brooklyn Engineers Club, Paper no. 169

Franz D. R. and W. H. Harris. 1985. Benthos Study: A final report to the National Parks Service. Jamaica Bay Wildlife Refuge (GNRA), New York.

Gosner, K.L. 1978. "A Field Guide to the Atlantic Seashore." Peterson Field Guides. Houghton Mifflin Company. New York.

Great Lakes – Upper Mississippi River Board. 2004. Recommended Standards for Wastewater Facilities – Policies for the Design, Review, and approval of Plans and Specifications for Wastewater Collection and Treatment Facilities. Report of the Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004 edition..

Hazen and Sawyer Engineers. 1981. Newtown Creek Water Pollution Control Plant Final Report Monitoring program (May – October 1980). Prepared for the New York City Department of Environmental Protection.

Hazen and Sawyer. 1989. Paerdegat Basin Water Quality Facility Plan Draft Task Reports 2.5 and 3.4: Receiving Water Conditions. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, .

Hazen and Sawyer. 1991. Paerdegat Basin Water Quality Facility Plan, Draft Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, September 1991.

Hazen and Sawyer. 1994. Public Participation for the Paerdegat Basin Water Quality Facility Planning Project. Prepared for the City of New York Department of Environmental Protection, February 1994.

Hazen and Sawyer. 1999. Evaluation of Supplemental Aeration for the Paerdegat Basin Water Quality Facility Project. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, February 1999.

Hazen and Sawyer. 2004. Paerdegat Basin Water Quality Facility Plan, Modified CSO Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, April 2003; revised February 2004.

Houghton, R, G. Gordon, and B. Huber. 2002. Dye Tracer Experiments in Jamaica Bay. Prepared for Gateway National Recreation Area by Columbia Earth Institute.

Houghton, Robert, Gordon, Arnold, and Bruce Huber, Integrated Reconnaissance of the Physical and Biogeochemical Characteristics of Jamaica Bay, Columbia Earth Institute, 2000.

HydroQual . 1993. Sources, Fate and Control of Floatable Materials in New York Harbor (Final Report). Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, December, 1993.

HydroQual. 1995. Floatables Pilot Program - Evaluation f Non-Structural Methods to Control Combined and Storm Sewer Floatable Materials (Final Report). Prepared for the City of New York Department of Environmental Protection, January, 1995.

HydroQual. 2000a. Paerdegat Basin Field Sampling and Analysis Program, Years 2000-2001. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2000b. Develop and Evaluate Alternatives - Task 6.0 Technical Memorandum. Prepared for the City of New York Department of Environmental Engineering, June 2000.

HydroQual. 2001a. Jamaica Bay Field Sampling and Analysis Program, Years 2001-2002. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2001b. Ichthyoplankton Field Sampling and Analysis Program, Year 2001. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2001d. Use and Standards Attainment Project Field and Laboratory Standard Operating Procedures. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual, 2001e, Use and Standards Attainment Project, Preliminary Waterbody/Watershed Characterization Report.

HydroQual. 2002. A water quality model for Jamaica Bay: Calibration of the Jamaica Bay Eutrophication Model (JEM). Prepared for the City of New York Department of Environmental Protection under subcontract to O'Brien & Gere.

HydroQual Engineers and Scientists, P.C. 2002. Use and Standards Attainment (USA) Project Year 2002 Supplemental Aquatic Life Characterization of East River and Jamaica Bay Field Sampling and Analysis Program (FSAP). For the City of New York Department of Environmental Protection Bureau of Environmental Engineering.

HydroQual. 2003. Model Evaluation Group (MEG) Peer Review of the Jamaica Bay Eutrophication Model (JEM). Under subcontract to O'Brien and Gere Engineers, Inc. For the City of New York Department of Environmental Protection. New York, New York.

HydroQual. 2004. Calibrated Rainman Model Report, March 2004.

Hyland, J., I. Karakassis, P. Magni, A. Petrov and J. Shine. 2000. Ad hoc Benthic Indicator Group – Results of Initial Planning Meeting. Intergovernmental Oceanographic Commission (IOC) Technical Series No. 57. SC-2000/WS/60. United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France.

Jamaica Bay Ecological Research and Restoration Team (JABERRT). 2002. Final Report. Division Natural Resources, Gateway National Recreation Area, NY & NJ

Kuropat, C., R. Mercaldo-Allen, E. Caldarone, R. Goldberg, B. Phelan, and F. Thurberg. 2002. Evaluation of RNA concentration as an indicator of growth in young-of-the-year winter flounder Pseudopleuronectes americanus and tautog Tautoga onitis. Mar. Ecol. Prog. Ser. 230:265-274.

Lerberg, S.B., A.F. Holland, and D.M. Sanger. 2000. Responses of tidal creek macrobenthic communities to the effects of watershed development. Estuaries. 23:838-853.

Levandowsky, M. 1994. An Investigation of Water Discoloration and Odor in Paerdegat Basin, a Tributary of Jamaica Bay, During the Summer of 1994. Haskins Laboratories, Pace University, New York, NY.

Malcolm Pirnie. 2004. Coney Island Water Pollution Control Plant Conceptual Design -Evaluation of BNR Upgrades (Draft Report). Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, July 2004.

Michael, G.Y. and T.F. Moore. 1997. A suggested framework for conducting UAAs and interpreting results. Project 91-NPS-1. Prepared for the Water Environment Research Foundation.

"The Neighborhoods of Brooklyn," Yale University Press, 1998.

New York City Department of Environmental Protection, 1994, Jamaica Bay Comprehensive Watershed Management Plan.

New York City Department of City Planning, Land Use and Zoning Data, Downloaded from Website, February 13, 2006.

New York City Department of City Planning, New York City Population Projections by Age/Sex & Borough, 2000-2030, Report, December 2006. Downloaded from website http://www.nyc.gov/html/dcp/html/census/popproj.shtml

New York City Department of Parks and Recreation, downloaded from website January 18, 2006.

New York City Department of Environmental Protection, 1994, Jamaica Bay Comprehensive Watershed Management Plan

New York City Department of Environmental Protection (NYCDEP). 1997. CSO Abatement in the City of New York: Report on Meeting the Nine Minimum CSO Control Standards.

New York City Department of Environmental Protection (NYCDEP). 1998. Blue Heron, Arbutus Creek, and Lemon Creek/Sandy Brook Watershed Drainage Plans, Final Environmental Impact Statement, CEQR No. 97DEP026. Prepared by NY City Department of Environmental Protection with the assistance of AKRF, Inc., Hazen and Sawyer, PC, Hydroqual, Inc., Environmental Concern, Inc., Historical Perspectives, Inc. and Center for Watershed Protection.

New York City Department of Environmental Protection (NYCDEP). 2002. 2002 New York Harbor Water Quality Report.

New York City Department of Environmental Protection (NYCDEP). 2004. The Bronx River Waterbody/Watershed Facility Plan.

New York City Department of Environmental Protection (NYCDEP). 2004. New York Harbor Water Quality Regional Summary.

New York City Department of Environmental Protection (NYCDEP). 2007. Draft Jamaica Bay Watershed Protection Plan, Volume 1.

New York City Department of Environmental Protection (NYCDEP). 2007. Draft Jamaica Bay Watershed Protection Plan, Volume 2.

New York State Department of Environmental Conservation (NYSDEC). 2005. Response to Comments on the 2004 Administrative Consent Order for Implementation of the Combined Sewer Overflow Abatement Program in New York City (Final Version), January 14, 2005.

New York State Department of State. 1992. Significant Coastal Fish and Wildlife Habitat Program: Jamaica Bay. Division of Coastal Resources and Waterfront Revitalization, Albany, NY.

New York State Department of Transportation and Metropolitan Transit Authority (NYS DOT and MTA). 2004. Second Avenue Subway in the Borough of Manhattan, New York County, NY. Final Environmental Impact Statement. Chapter 15.

Novotny, V., et al. 1997. A Comprehensive UAA Technical Reference. Project 91-NPS-1. Prepared for the Water Environment Research Foundation.

O'Brien & Gere, 1993. Jamaica Bay Combined Sewer Overflow Facility Planning Project.

O'Brien & Gere, 2003, Jamaica Bay Combined Sewer Overflow Abatement Facility Planning Project.

O'Brien & Gere Engineers, Inc. Jamaica Bay Eutrophication Project Study, NYCDEP, November 2003.

O'Brien & Gere. 1994. Fresh Creek CSO Facility Plan. Prepared for the City of New York Department of Environmental Protection.

O'Brien & Gere, 2006. Comprehensive Jamaica Bay Water Quality Plan.

Office of the Mayor. 2005. New York City Industrial Policy: Protecting and Growing New York City's Industrial Job Base, January 2005.

Pearson, T.H. and R. Rosenberg. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanography and Marine Biology Annual Review 16: 229-311.

Plan for the Brooklny Waterfront, 1994, Department of City Planning, City of New York.

Peterson, W.T. and H.G. Dam. 1989. Hydrography and Plankton of Jamaica Bay (Internal Report). Marine Sciences Research Center, State University of New York at Stony Brook.

Reish, D. J. 1979. Bristle worms (Annelida: Polychaeta). Pp. 78-15. In: C. W. Hart & S. L. Fuller (Eds.). Pollution Ecology of Estuarine Invertebrates. Academic Press. New York.
Tanacredi, J.T., M.P. Schreibman, and G.W. Frame. 2002. Jamaica Bay Research and Restoration Team (JABERRT), Final Report.

Tanguay, L.H., The Geologic History of Rockaway Barrier Beach, New York, Department of Earth and Environmental Science, CW Post Campus of Long Island University Brookville, NY 11548

U.S. Army Corps of Engineers. 1997. Jamaica Bay Navigational Channels and Shoreline Environmental Surveys Final Report. New York District, NY

U.S. Environmental Protection Agency (USEPA), 1994. Seminars, Combined Sewer Overflow Control, EPA-625-K-94-003, Office of Research and Development, Washington, DC, July 1994.

U.S. Environmental Protection Agency (USEPA), 1995. Combined Sewer Overflows, Guidance for Long Term Control Plan, EPA-832-B-95-002, Office of Water, Washington, DC, September 1995.

U.S. Environmental Protection Agency (USEPA), 1995a. Combined Sewer Overflows, Guidance for Nine Minimum Controls, EPA 832-B-95-003

U.S. Environmental Protection Agency (USEPA), 1995b. Combined Sewer Overflows, Guidance for Permit Writers, EPA 832-B-95-008

U.S. Environmental Protection Agency (USEPA), 1997. Technical Guidance Manual For Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication, EPA 823 B 97 002. Office of Water, Washington, DC, March, 1997.

U.S. Environmental Protection Agency (USEPA), 2000a. Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras, EPA 822 R 00 012. Office of Water, Washington, DC, November 2000.

U.S. Environmental Protection Agency (USEPA), 2001. Guidance: Coordinating CSO Long Term Planning With Water Quality Standards Reviews, EPA 833 R 01 002, Office of Water, Washington, DC, July 2001.

U.S. Environmental Protection Agency (USEPA), 2004. Water Quality Standards for Coastal and Great Lakes Recreation Waters (Final Rule). 69 FR 220, pp. 67218-67243, November 16, 2004.

U.S. Fish and Wildlife Service. 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. USFWS, Southern New England – New York Bight Coastal Ecosystems Program, Charlestown, RI.

The Wave, Newspaper since 1893, 88-08 Rockaway Beach Boulevard, Rockaway Beach, NY 11693-0097 Downloaded from website August 2005.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An Estuarine Benthic Index of Biotic Integrity (B-IBI) for Chesapeake Bay. Estuaries, 20 (1): 149-158.

Weiss, H.M. 1995. Marine Animals of Southern New England and New York. State Geological and Natural History Survey of Connecticut. Department of Environmental Protection.

West-Valle, A.S., C.J. Decker, and R.L. Swanson. 1992. Use Impairments of Jamaica Bay. Marine Sciences Research Center, University of New York, Stony Brook. May 1992.

Wikipedia, the free encyclopedia, Copyright (C) 2000, 2001, 2002 Free Software Foundation, Inc., 51 Franklin St., Fifth Floor, Boston, MA 02110-1301. Retrieved February 13, 2006, from http://en.wikipedia.org/wiki/List_of_Queens_ neighborhoods.

Wildish, D. and D. Kristmanson. 1997. Benthic Suspension Feeders and Flow. Cambridge University Press: NY.

Zappala, S. 2001. Growth and Development of Epibenthic and Benthic Communities Associated with Waterfront Shipping Piers of the Upper Bay of New York Harbor. Masters Thesis.

NO TEXT ON THIS PAGE

11.0. Glossary

A Posteriori Classification: A classification based on the results of experimentation.

A Priori Classification: A classification made prior to experimentation.

ACO: Administrative Consent Order

Activated Sludge: The product that results when primary effluent is mixed with bacteria-laden sludge and then agitated and aerated to promote biological treatment, speeding the breakdown of organic matter in raw sewage undergoing secondary waste treatment.

Acute Toxicity: The ability of a substance to cause severe biological harm or death soon after a single exposure or dose. Also, any poisonous effect resulting from a single short-term exposure to a toxic substance (see chronic toxicity, toxicity).

Administrative Consent Order (ACO): A legal agreement between a regulatory authority and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. It describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

Administrative Law Judge (ALJ): An officer in a government agency with quasi-judicial functions including conducting hearings, making findings of fact, and making recommendations for resolution of disputes concerning the agency's actions.

Advanced Treatment: A level of wastewater treatment more stringent than secondary treatment; requires an 85-percent reduction in conventional pollutant concentration or a significant reduction in non-conventional pollutants. Sometimes called tertiary treatment.

Advanced Wastewater Treatment: Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. (See primary, secondary treatment.)

Advection: Bulk transport of the mass of discrete chemical or biological constituents by fluid flow within receiving water. Advection describes the mass transport due to the velocity, or flow, of the waterbody. Example: The transport of pollution in a river: the motion of the water carries the polluted water downstream.

ADWF: Average Dry Weather Flow

Aeration: A process that promotes biological degradation of organic matter in water. The process may be passive (as when waste is exposed to air), or active (as when a mixing or bubbling device introduces the air). Exposure to additional air may be by means of natural of engineered systems.

Aerobic: Environmental conditions characterized by the presence of dissolved oxygen; used to describe biological or chemical processes that occur in the presence of oxygen.

Algae: Simple rootless plants that live floating or suspended in sunlit water or may be attached to structures, rocks or other submerged surfaces. Algae grow in proportion to the amount of available nutrients. They can affect water quality adversely since their biological activities can appreciably affect pH and low dissolved oxygen of the water. They are food for fish and small aquatic animals.

Algal Bloom: A heavy sudden growth of algae in and on a body of water which can affect water quality adversely and indicate potentially hazardous changes in local water chemistry. The growth results from excessive nutrient levels or other physical and chemical conditions that enable algae to reproduce rapidly.

ALJ: Administrative Law Judge

Allocations: Allocations are that portion of receiving water's loading capacity that is attributed to one of its existing or future sources (non-point or point) of pollution or to natural background sources. (Wasteload allocation (WLA) is that portion of the loading capacity allocated to an existing or future point source and a load allocation (LA) is that portion allocated to an existing or future non-point source or to a natural background source. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

Ambient Water Quality: Concentration of water quality constituent as measured within the waterbody.

Ammonia (NH_3): An inorganic form of nitrogen, is contained in fertilizers, septic system effluent, and animal wastes. It is also a product of bacterial decomposition of organic matter. NH3-N becomes a concern if high levels of the un-ionized form are present. In this form NH3-N can be toxic to aquatic organisms.

Anaerobic: Environmental condition characterized by zero oxygen levels. Describes biological and chemical processes that occur in the absence of oxygen. Anoxia. No dissolved oxygen in water.

Anthropogenic: Pertains to the [environmental] influence of human activities.

Antidegradation: Part of federal water quality requirements. Calls for all existing uses to be protected, for deterioration to be avoided or at least minimized when water quality meets or exceeds standards, and for outstanding waters to be strictly protected.

Aquatic Biota: Collective term describing the organisms living in or depending on the aquatic environment.

Aquatic Community: An association of interacting populations of aquatic organisms in a given waterbody or habitat.

Aquatic Ecosystem: Complex of biotic and abiotic components of natural waters. The aquatic ecosystem is an ecological unit that includes the physical characteristics (such as flow or velocity and depth), the biological community of the water column and benthos, and the chemical characteristics such as dissolved solids, dissolved oxygen, and nutrients. Both living and nonliving components of the aquatic ecosystem interact and influence the properties and status of each component.

Aquatic Life Uses: A beneficial use designation in which the waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.

Assemblage: An association of interacting populations of organisms in a given waterbody (e.g., fish assemblage or benthic macro-invertebrate assemblage).

Assessed Waters: Waters that states, tribes and other jurisdictions have assessed according to physical, chemical and biological parameters to determine whether or not the waters meet water quality standards and support designated beneficial uses.

Assimilation: The ability of a body of water to purify itself of pollutants.

Assimilative Capacity: The capacity of a natural body of water to receive wastewaters or toxic materials without deleterious efforts and without damage to aquatic life or humans who consume the water. Also, the amount of pollutant load that can be discharged to a specific waterbody without exceeding water quality standards. Assimilative capacity is used to define the ability of a waterbody to naturally absorb and use a discharged substance without impairing water quality or harming aquatic life.

Attribute: Physical and biological characteristics of habitats which can be measured or described.

Average Dry Weather Flow (ADWF): The average non-storm flow over 24 hours during the dry months of the year (May through September). It is composed of the average dry weather inflow/infiltration.

Bacteria: (Singular: bacterium) Microscopic living organisms that can aid in pollution control by metabolizing organic matter in sewage, oil spills or other pollutants. However, some types of bacteria in soil, water or air can also cause human, animal and plant health problems. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Measured in number of bacteria organisms per 100 milliliters of sample (No./mL or #/100 mL).

BASINS: Better Assessment Science Integrating Point and Non-point Sources

BEACH: Beaches Environmental Assessment and Coastal Health

Beaches Environmental Assessment and Coastal Health (BEACH): The BEACH Act requires coastal and Great Lakes States to adopt the 1986 USEPA Water Quality Criteria for Bacteria and to develop and implement beach monitoring and notification plans for bathing beaches.

Benthic: Refers to material, especially sediment, at the bottom of an aquatic ecosystem. It can be used to describe the organisms that live on, or in, the bottom of a waterbody.

Benthic Macroinvertebrates: See benthos.

Benthos: Animals without backbones, living in or on the sediments, of a size large enough to be seen by the unaided eye, and which can be retained by a U.S. Standard No. 30 sieve (28 openings/in, 0.595-mm openings). Also referred to as benthic macroinvertebrates, infauna, or macrobenthos.

Best Available Technology (BAT): The most stringent technology available for controlling emissions; major sources of emissions are required to use BAT, unless it can be demonstrated that it is unfeasible for energy, environmental, or economic reasons.

Best Management Practice (BMP): Methods, measures or practices that have been determined to be the most effective, practical and cost effective means of preventing or reducing pollution from non-point sources.

Better Assessment Science Integrating Point and Non-point Sources (BASINS): A computer tool that contains an assessment and planning component that allows users to organize and display geographic information for selected watersheds. It also contains a modeling component to examine impacts of pollutant loadings from point and non-point sources and to characterize the overall condition of specific watersheds.

Bioaccumulation: A process by which chemicals are taken up by aquatic organisms and plants directly from water as well as through exposure via other routes, such as consumption of food and sediment containing the chemicals.

Biochemical Oxygen Demand (BOD): A measure of the amount of oxygen per unit volume of water required to bacterially or chemically breakdown (stabilize) the organic matter in water. Biochemical oxygen demand measurements are usually conducted over specific time intervals (5,10,20,30 days). The term BOD generally refers to a standard 5-day BOD test. It is also considered a standard measure of the organic content in water and is expressed as mg/L. The greater the BOD, the greater the degree of pollution.

Bioconcentration: A process by which there is a net accumulation of a chemical directly from water into aquatic organisms resulting from simultaneous uptake (e.g., via gill or epithelial tissue) and elimination. In other words, the accumulation of a chemical in tissues of a fish or other organism to levels greater than the surrounding medium.

Biocriteria: A combination of narrative and numerical measures, such as the number and kinds of benthic, or bottom-dwelling, insects living in a stream, that describe the biological condition (structure and function) of aquatic communities inhabiting waters of a designated aquatic life use. Biocriteria are regulatory-based biological measurements and are part of a state’s water quality standards.

Biodegradable: A substance or material that is capable of being decomposed (broken down) by natural biological processes.

Biodiversity: Refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the biological structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species and genes.

Biological Assemblage: A group of phylogenetically (e.g., fish) or ecologically (e.g., benthic macroinvertebrates) related organisms that are part of an aquatic community.

Biological Assessment or Bioassessment: An evaluation of the condition of a waterbody using biological surveys and other direct measures of the resident biota of the surface waters, in conjunction with biological criteria.

Biological Criteria or Biocriteria: Guidelines or benchmarks adopted by States to evaluate the relative biological integrity of surface waters. Biocriteria are narrative expressions or numerical values that describe biological integrity of aquatic communities inhabiting waters of a given classification or designated aquatic life use.

Biological Indicators: Plant or animal species or communities with a narrow range of environmental tolerances that may be selected for monitoring because their absence or presence and relative abundances serve as barometers of environmental conditions.

Biological Integrity: The condition of the aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by community structure and function.

Biological Monitoring or Biomonitoring: Multiple, routine biological surveys over time using consistent sampling and analysis methods for detection of changes in biological condition.

Biological Nutrient Removal (BNR): The removal of nutrients, such as nitrogen and/or phosphorous during wastewater treatment.

Biological Oxygen Demand (BOD): An indirect measure of the concentration of biologically degradable material present in organic wastes. It usually reflects the amount of oxygen consumed in five days by biological processes breaking down organic wastes.

Biological Survey or Biosurvey: Collecting, processing and analyzing representative portions of an estuarine or marine community to determine its structure and function.

Biological Magnification: Refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers and lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the food chain. he result of the processes of bioconcentration and bioaccumulation by which tissue concentrations of bioaccumulated chemicals increase as the chemical passes up through two or more trophic levels in the food chain. (See bioaccumulation.)

Biota: Plants, animals and other living resources in a given area.

Biotic Community: A naturally occurring assemblage of plants and animals that live in the same environment and are mutually sustaining and interdependent.

BMP: Best Management Practice

BNR: Biological Nutrient Removal

BOD: Biological Oxygen Demand; Biochemical Demand

Borrow Pit: See Subaqueous Borrow Pit.

Brackish: Water with salt content ranging between that of sea water and fresh water; commonly used to refer to Oligohaline waters.

Brooklyn Sewer Datum (BSD): Coordinate system and origins utilized by surveyors in the Borough of Brooklyn, New York City.

BSD: Brooklyn Sewer Datum

CAC: Citizens Advisory Committee

Calcareous: Pertaining to or containing calcium carbonate; Calibration; The process of adjusting model parameters within physically defensible ranges until the resulting predictions give a best possible fit to observed data.

Calibration: The process of adjusting model parameters within physically defensible ranges until the resulting predictions give a best possible fit to observed data.

CALM: Consolidated Assessment and Listing Methodology

Capital Improvement Program (CIP): A budget and planning tool used to implement non-recurring expenditures or any expenditure for physical improvements, including costs for: acquisition of existing buildings, land, or interests in land; construction of new buildings or other structures, including additions and major alterations; construction of streets and highways or utility lines; acquisition of fixed equipment; landscaping; and similar expenditures.

Capture: The total volume of flow collected in the combined sewer system during precipitation events on a system-wide, annual average basis (not percent of volume being discharged).

Catch Basin: (1) A buried chamber, usually built below curb grates seen at the curbline of a street, to relieve street flooding, which admits surface water for discharge into the sewer system and/or a receiving waterbody. (2) A sedimentation area designed to remove pollutants from runoff before being discharged into a stream or pond.

Carbonaceous Biochemical Oxygen Demand ($CBOD_5$): The amount of oxygen required to oxidize any carbon containing matter present in water in five days.

CATI: Computer Assisted Telephone Interviews

$CBOD_5$: Carbonaceous Biochemical Oxygen Demand

CEA: Critical Environmental Area

CEQR: City Environmental Quality Review

CERCLIS: Comprehensive Environmental Response, Compensation and Liability Information System

CFR: Code of Federal Regulation

Channel: A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channelization: Straightening and deepening streams so water will move faster or facilitate navigation - a tactic that can interfere with waste assimilation capacity, disturb fish and wildlife habitats, and aggravate flooding.

Chemical Oxygen Demand (COD): A measure of the oxygen required to oxidize all compounds, both organic and inorganic, in water.

Chlorination: The application of chlorine to drinking water, sewage, or industrial waste to disinfect or to oxidize undesirable compounds. Typically employed as a final process in water and wastewater treatment.

Chrome+6 (Cr+6): Chromium is a steel-gray, lustrous, hard metal that takes a high polish, is fusible with difficulty, and is resistant to corrosion and tarnishing. The most common oxidation states of chromium are +2, +3, and +6, with +3 being the most stable. +4 and +5 are relatively rare. Chromium compounds of oxidation state 6 are powerful oxidants.

Chronic Toxicity: The capacity of a substance to cause long-term poisonous health effects in humans, animals, fish and other organisms (see acute toxicity).

CIP: Capital Improvement Program

Citizens Advisory Committee (CAC): Committee comprised of various community stakeholders formed to provide input into a planning process.

City Environmental Quality Review (CEQR): CEQR is a process by which agencies of the City of New York review proposed discretionary actions to identify the effects those actions may have on the environment.

Clean Water Act (CWA): The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The CWA contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the Total maximum Daily Load (TMDL) program.

Coastal Waters: Marine waters adjacent to and receiving estuarine discharges and extending seaward over the continental shelf and/or the edge of the U.S. territorial sea.

Coastal Zone Boundary (CZB): Generally, the part of the land affected by its proximity to the sea and that part of the sea affected by its proximity to the land as the extent to which man's land-based activities have a measurable influence on water chemistry and marine ecology. Specifically, New York's Coastal zone varies from region to region while incorporating the following conditions: The inland boundary is approximately 1,000 feet from the shoreline of the mainland. In urbanized and developed coastal locations the landward boundary is approximately 500 feet from the mainland's shoreline, or less than 500 feet where a roadway or railroad line runs parallel to the shoreline at a distance of under 500 feet and defines the boundary. In locations where major state-owned lands and facilities or electric power generating facilities abut the shoreline, the boundary extends inland to include them. In some areas, such as Long Island Sound and the Hudson River Valley, the boundary may extend inland up to 10,000 feet to encompass significant coastal resources, such as areas of exceptional scenic value, agricultural ore recreational lands, and major tributaries and headlands.

Coastal Zone: Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or whose uses and ecology are affected by the sea.

COD: Chemical Oxygen Demand

Code of Federal Regulations (CFR): Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (references as 40 CFR) lists most environmental regulations.

Coliform Bacteria: Common name for Escherichia coli that is used as an indicator of fecal contamination of water, measured in terms of coliform count. (See Total Coliform Bacteria)

Coliforms: Bacteria found in the intestinal tract of warm-blooded animals; used as indicators of fecal contamination in water.

Collection System: Pipes used to collect and carry wastewater from individual sources to an interceptor sewer that will carry it to a treatment facility.

Collector Sewer: The first element of a wastewater collection system used to collect and carry wastewater from one or more building sewers to a main sewer. Also called a lateral sewer.

Combined Sewage: Wastewater and storm drainage carried in the same pipe.

Combined Sewer Overflow (CSO): Discharge of a mixture of storm water and domestic waste when the flow capacity of a sewer system is exceeded during rainstorms. CSOs discharged to receiving water can result in contamination problems that may prevent the attainment of water quality standards.

Combined Sewer Overflow Event: The discharges from any number of points in the combined sewer system resulting from a single wet weather event that do not receive minimum treatment (i.e., primary clarification, solids disposal, and disinfection, where appropriate). For example, if a storm occurs that results in untreated overflows from 50 different CSO outfalls within the combined sewer system (CSS), this is considered one overflow event.

Combined Sewer System (CSS): A sewer system that carries both sewage and storm-water runoff. Normally, its entire flow goes to a waste treatment plant, but during a heavy storm, the volume of water may be so great as to cause overflows of untreated mixtures of storm water and sewage into receiving waters. Storm-water runoff may also carry toxic chemicals from industrial areas or streets into the sewer system.

Comment Period: Time provided for the public to review and comment on a proposed USEPA action or rulemaking after publication in the Federal Register.

Community: In ecology, any group of organisms belonging to a number of different species that co-occur in the same habitat or area; an association of interacting assemblages in a given waterbody. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake.

Compliance Monitoring: Collection and evaluation of data, including self-monitoring reports, and verification to show whether pollutant concentrations and loads contained in permitted discharges are in compliance with the limits and conditions specified in the permit.

Compost: An aerobic mixture of decaying organic matter, such as leaves and manure, used as fertilizer.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS): Database that contains information on hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation. The database includes sites that are on the National Priorities List or being considered for the List.

Comprehensive Waterfront Plan (CWP): Plan proposed by the Department of City Planning that provides a framework to guide land use along the city's entire 578-mile shoreline in a way that recognizes its value as a natural resource and celebrates its diversity. The plan presents a long-range vision that balances the needs of environmentally sensitive areas and the working port with opportunities for waterside public access, open space, housing and commercial activity.

Computer Assisted Telephone Interviews (CATI): CATI is the use of computers to automate and control the key activities of a telephone interview.

Conc: Abbreviation for "Concentration".

Concentration: Amount of a substance or material in a given unit volume of solution. Usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Consolidated Assessment and Listing Methodology (CALM): USEPA framework for states and other jurisdictions to document how they collect and use water quality data and information for environmental decision making. The primary purposes of these data analyses are to determine the extent that all waters are attaining water quality standards, to identify waters that are impaired and need to be added to the 303(d) list, and to identify waters that can be removed from the list because they are attaining standards.

Contamination: Introduction into the water, air and soil of microorganisms, chemicals, toxic substances, wastes or wastewater in a concentration that makes the medium unfit for its next intended use.

Conventional Pollutants: Statutorily listed pollutants understood well by scientists. These may be in the form or organic waste, sediment, acid, bacteria, viruses, nutrients, oil and grease, or heat.

Cost-Benefit Analysis: A quantitative evaluation of the costs, which would be incurred by implementing an alternative versus the overall benefits to society of the proposed alternative.

Cost-Share Program: A publicly financed program through which society, as a beneficiary of environmental protection, allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The producer pays the remainder of the costs.

Cr+6: Hexavalent chromium

Critical Condition: The combination of environmental factors that results in just meeting water quality criterion and has an acceptably low frequency of occurrence.

Critical Environmental Area (CEA): A CEA is a specific geographic area designated by a state or local agency as having exceptional or unique environmental characteristics. In establishing a CEA, the fragile or threatened environmental conditions in the area are identified so that they will be taken into consideration in the site-specific environmental review under the State Environmental Quality Review Act.

Cross-Sectional Area: Wet area of a waterbody normal to the longitudinal component of the flow.

Cryptosporidium: A protozoan microbe associated with the disease cryptosporidiosis in man. The disease can be transmitted through ingestion of drinking water, person-to-person contact, or other pathways, and can cause acute diarrhea, abdominal pain, vomiting, fever and can be fatal. (See protozoa).

CSO: Combined Sewer Overflow

CSS: Combined Sewer System

Cumulative Exposure: The summation of exposures of an organism to a chemical over a period of time.

Clean Water Act (CWA): Federal law stipulating actions to be carried out to improve water quality in U.S. waters.

CWA: Clean Water Act

CWP: Comprehensive Waterfront Plan

CZB: Coastal Zone Boundary

DDWF: design dry weather flow

Decay: Gradual decrease in the amount of a given substance in a given system due to various sink processes including chemical and biological transformation, dissipation to other environmental media, or deposition into storage areas.

Decomposition: Metabolic breakdown of organic materials; that releases energy and simple organics and inorganic compounds. (See Respiration)

Degradable: A substance or material that is capable of decomposition; chemical or biological.

Delegated State: A state (or other governmental entity such as a tribal government) that has received authority to administer an environmental regulatory program in lieu of a federal counterpart.

Demersal: Living on or near the bottom of a body of water (e.g., mid-water and bottom-dwelling fish and shellfish, as opposed to surface fish).

Department of Sanitation of New York (DSNY): New York City agency responsible for solid waste and refuse disposal in New York City

Design Capacity: The average daily flow that a treatment plant or other facility is designed to accommodate.

Design Dry Weather Flow (DDWF): The flow basis for design of New York City wastewater treatment plants. In general, the plants have been designed to treat 1.5 times this value to full secondary treatment standards and 2.0 times this value, through at least primary settling and disinfection, during stormwater events.

Designated Uses: Those water uses specified in state water quality standards for a waterbody, or segment of a waterbody, that must be achieved and maintained as required under the Clean Water Act. The uses, as defined by states, can include cold-water fisheries, natural fisheries, public water supply, irrigation, recreation, transportation, or mixed uses.

Deoxyribonucleic Acid (DNA): The genetic material of living organisms; the substance of heredity. It is a large, double-stranded, helical molecule that contains genetic instructions for growth, development, and replication.

Destratification: Vertical mixing within a lake or reservoir to totally or partially eliminate separate layers of temperature, plant, or animal life.

Deterministic Model: A model that does not include built-in variability: same input will always equal the same output.

Die-Off Rate: The first-order decay rate for bacteria, pathogens, and viruses. Die-off depends on the particular type of waterbody (i.e., stream, estuary , lake) and associated factors that influence mortality.

Dilution: Addition of less concentrated liquid (water) that results in a decrease in the original concentration.

Direct Runoff: Water that flows over the ground surface or through the ground directly into streams, rivers, and lakes.

Discharge Permits (NPDES): A permit issued by the USEPA or a state regulatory agency that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water; it also includes a compliance schedule for achieving those limits. It is called the NPDES because the permit process was established under the National Pollutant Discharge Elimination System, under provisions of the Federal Clean Water Act.

Discharge: Flow of surface water in a stream or canal or the outflow of ground water from a flowing artesian well, ditch, or spring. It can also apply to discharges of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

Discriminant Analysis: A type of multivariate analysis used to distinguish between two groups.

Disinfect (Disinfected): A water and wastewater treatment process that kills harmful microorganisms and bacteria by means of physical, chemical and alternative processes such as ultraviolet radiation.

Disinfectant: A chemical or physical process that kills disease-causing organisms in water, air, or on surfaces. Chlorine is often used to disinfect sewage treatment effluent, water supplies, wells, and swimming pools.

Dispersion: The spreading of chemical or biological constituents, including pollutants, in various directions from a point source, at varying velocities depending on the differential instream flow characteristics.

Dissolved Organic Carbon (DOC): All organic carbon (e.g., compounds such as acids and sugars, leached from soils, excreted from roots, etc) dissolved in a given volume of water at a particular temperature and pressure.

Dissolved Oxygen (DO): The dissolved oxygen freely available in water that is vital to fish and other aquatic life and is needed for the prevention of odors. DO levels are considered a most important indicator of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatments are generally designed to ensure adequate DO in waste-receiving waters. It also refers to a measure of the amount of oxygen available for biochemical activity in a waterbody, and as an indicator of the quality of that water.

Dissolved Solids: The organic and inorganic particles that enter a waterbody in a solid phase and then dissolve in water.

DNA: deoxyribonucleic acid

DO: dissolved oxygen

DOC: Dissolved Organic Carbon

Drainage Area or Drainage Basin: An area drained by a main river and its tributaries (see Watershed).

Dredging: Dredging is the removal of mud from the bottom of waterbodies to facilitate navigation or remediate contamination. This can disturb the ecosystem and cause silting that can kill or harm aquatic life. Dredging of contaminated mud can expose biota to heavy metals and other toxics. Dredging activities are subject to regulation under Section 404 of the Clean Water Act.

Dry Weather Flow (DWF): Hydraulic flow conditions within a combined sewer system resulting from one or more of the following: flows of domestic sewage, ground water infiltration, commercial and industrial wastewaters, and any other non-precipitation event related flows (e.g., tidal infiltration under certain circumstances).

Dry Weather Overflow: A combined sewer overflow that occurs during dry weather flow conditions.

DSNY: Department of Sanitation of New York

DWF: Dry weather flow

Dynamic Model: A mathematical formulation describing the physical behavior of a system or a process and its temporal variability. Ecological Integrity. The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes.

E. Coli: Escherichia Coli.

Ecoregion: Geographic regions of ecological similarity defined by similar climate, landform, soil, natural vegetation, hydrology or other ecologically relevant variables.

Ecosystem: An interactive system that includes the organisms of a natural community association together with their abiotic physical, chemical, and geochemical environment.

Effects Range-Low: Concentration of a chemical in sediment below which toxic effects were rarely observed among sensitive species (10th percentile of all toxic effects).

Effects Range-Median: Concentration of a chemical in sediment above which toxic effects are frequently observed among sensitive species (50th percentile of all toxic effects).

Effluent: Wastewater, either municipal sewage or industrial liquid waste that flows out of a treatment plant, sewer or outfall untreated, partially treated, or completely treated.

Effluent Guidelines: Technical USEPA documents which set effluent limitations for given industries and pollutants.

Effluent Limitation: Restrictions established by a state or USEPA on quantities, rates, and concentrations in wastewater discharges.

Effluent Standard: See effluent limitation.

EIS: Environmental Impact Statement

EMAP: Environmental Monitoring and Assessment Program

EMC: Event Mean Concentration

Emergency Planning and Community Right-to-Know Act of 1986, The (SARA Title III): Law requiring federal, state and local governments and industry, which are involved in either emergency planning and/or reporting of hazardous chemicals, to allow public access to information about the presence of hazardous chemicals in the community and releases of such substances into the environment.

Endpoint: An endpoint is a characteristic of an ecosystem that may be affected by exposure to a stressor. Assessment endpoints and measurement endpoints are two distinct types of endpoints that are commonly used by resource managers. An assessment endpoint is the formal expression of a valued environmental characteristic and should have societal relevance. A measurement endpoint is the expression of an observed or measured response to a stress or disturbance. It is a measurable environmental characteristic that is related to the valued environmental characteristic chosen as the assessment endpoint. The numeric criteria that are part of traditional water quality standards are good examples of measurement endpoints.

Enforceable Requirements: Conditions or limitations in permits issued under the Clean Water Act Section 402 or 404 that, if violated, could result in the issuance of a compliance order or initiation of a civil or criminal action under federal or applicable state laws.

Enhancement: In the context of restoration ecology, any improvement of a structural or functional attribute.

Enteric: Of or within the gastrointestinal tract.

Enterococci: A subgroup of the fecal streptococci that includes S. faecalis and S. faecium. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10°C and 45°C. Enterococci are a valuable bacterial indicator for determining the extent of fecal contamination of recreational surface waters.

Environment: The sum of all external conditions and influences affecting the development and life of organisms.

Environmental Impact Statement (EIS): A document required of federal agencies by the National Environmental Policy Act for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and cites alternative actions.

Environmental Monitoring and Assessment Program (EMAP): The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources.

Epibenthic: Those animals/organisms located at the surface of the sediments on the bay bottom, generally referring to algae.

Epibenthos: Those animals (usually excluding fishes) living on the top of the sediment surface.

Epidemiology: All the elements contributing to the occurrence or non-occurrence of a disease in a population; ecology of a disease.

Epifauna: Benthic animals living on the sediment or on and among rocks and other structures.

EPMC: Engineering Program Management Consultant

Escherichia Coli: A subgroup of the fecal coliform bacteria. E. coli is part of the normal intestinal flora in humans and animals and is, therefore, a direct indicator of fecal contamination in a waterbody. The O157 strain, sometimes transmitted in contaminated waterbodies, can cause serious infection resulting in gastroenteritis. (See Fecal coliform bacteria)

Estuarine Number: Nondimensional parameter accounting for decay, tidal dispersion, and advection velocity. Used for classification of tidal rivers and estuarine systems.

Estuarine or Coastal Marine Classes: Classes that reflect basic biological communities and that are based on physical parameters such as salinity, depth, sediment grain size, dissolved oxygen and basin geomorphology.

Estuarine Waters: Semi-enclosed body of water which has a free connection with the open sea and within which seawater is measurably diluted with fresh water derived from land drainage.

Estuary: Region of interaction between rivers and near-shore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife (see wetlands).

Eutrophication: A process in which a waterbody becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen and changes in the composition of plants and animals in the waterbody. This occurs naturally, but can be exacerbated by human activity which increases nutrient inputs to the waterbody.

Event Mean Concentration (EMC): Input data, typically for urban areas, for a water quality model. EMC represents the concentration of a specific pollutant contained in stormwater runoff coming from a particular land use type within a watershed.

Existing Use: Describes the use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).

Facility Plan: A planning project that uses engineering and science to address pollution control issues and will most likely result in the enhancement of existing water pollution control facilities or the construction of new facilities.

Facultative: Capable of adaptive response to varying environments.

Fecal Coliform Bacteria: A subset of total coliform bacteria that are present in the intestines or feces of warm-blooded animals. They are often used as indicators of the sanitary quality of water. They are measured by running the standard total coliform test at an elevated temperature (44.5EC). Fecal coliform is approximately 20 percent of total coliform. (See Total Coliform Bacteria)

Fecal Streptococci: These bacteria include several varieties of streptococci that originate in the gastrointestinal tract of warm-blooded animals such as humans (Streptococcus faecalis) and domesticated animals such as cattle (Streptococcus bovis) and horses (Streptococcus equinus).

Feedlot: A confined area for the controlled feeding of animals. The area tends to concentrate large amounts of animal waste that cannot be absorbed by the soil and, hence, may be carried to nearby streams or lakes by rainfall runoff.

FEIS: Final Environmental Impact Statement

Field Sampling and Analysis Program (FSAP): Biological sampling program undertaken to fill-in ecosystem data gaps in New York Harbor.

Final Environmental Impact Statement (FEIS): A document that responds to comments received on the Draft EIS and provides updated information that has become available after publication of the Draft EIS.

Fish Kill: A natural or artificial condition in which the sudden death of fish occurs due to the introduction of pollutants or the reduction of the dissolved oxygen concentration in a waterbody.

Floatables: Large waterborne materials, including litter and trash, that are buoyant or semi-buoyant and float either on or below the water surface. These materials, which are generally man-made and sometimes characteristic of sanitary wastewater and storm runoff, may be transported to sensitive environmental areas such as bathing beaches where they can become an aesthetic nuisance. Certain types of floatables also cause harm to marine wildlife and can be hazardous to navigation.

Flocculation: The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules that eventually settle out of suspension.

Flux: Movement and transport of mass of any water quality constituent over a given period of time. Units of mass flux are mass per unit time.

FOIA: Freedom of Information Act

FOIL: Freedom of Information Law

Food Chain: A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

Freedom of Information Act (FOIA): A federal statute which allows any person the right to obtain federal agency records unless the records (or part of the records) are protected from disclosure by any of the nine exemptions in the law.

FSAP: Field Sampling and Analysis Program

gallons per day (gpd): unit of measure of flow

gallons per day per square foot (gpd/sq ft): unit of measure of settling tank overflow rate

gallons per minute (gpm): unit of measure

Gastroenteritis: An inflammation of the stomach and the intestines.

General Permit: A permit applicable to a class or category of discharges.

Geochemical: Refers to chemical reactions related to earth materials such as soil, rocks, and water.

Geographical Information System (GIS): A computer system that combines database management system functionality with information about location. In this way it is able to capture, manage, integrate, manipulate, analyze and display data that is spatially referenced to the earth's surface.

Giardia lamblia: Protozoan in the feces of humans and animals that can cause severe gastrointestinal Ailments. It is a common contaminant of surface waters. (See protozoa).

GIS: Geographical Information System

Global Positioning System (GPS): A GPS comprises a group of satellites orbiting the earth (24 are now maintained by the U.S. Government) and a receiver, which can be highly portable. The receiver can generate accurate coordinates for a point, including elevation, by calculating its own position relative to three or more satellites that are above the visible horizon at the time of measurement.

gpd: Gallons per Day

gpd/sq ft: gallons per day per square foot

gpm: Gallons per minute

GPS: Global Positioning System

Gradient: The rate of decrease (or increase) of one quantity with respect to another; for example, the rate of decrease of temperature with depth in a lake.

Groundwater: The supply of fresh water found beneath the earth's surface, usually in aquifers, which supply wells and springs. Because groundwater is a major source of drinking water, there is growing concern over contamination from leaching agricultural or industrial pollutants and leaking underground storage tanks.

H_2S: Hydrogen Sulfide

Habitat Conservation Plans (HCPs): As part of the Endangered Species Act, Habitat Conservation Plans are designed to protect a species while allowing development. HCP's give the U.S. Fish and Wildlife Service the authority to permit "taking" of endangered or threatened species as long as the impact is reduced by conservation measures. They allow a landowner to determine how best to meet the agreed-upon fish and wildlife goals.

Habitat: A place where the physical and biological elements of ecosystems provide an environment and elements of the food, cover and space resources needed for plant and animal survival.

Halocline: A vertical gradient in salinity.

HCP: Habitat Conservation Plan

Heavy Metals: Metallic elements with high atomic weights (e.g., mercury, chromium, cadmium, arsenic, and lead); can damage living things at low concentrations and tend to accumulate in the food chain.

High Rate Treatment (HRT): A traditional gravity settling process enhanced with flocculation and settling aids to increase loading rates and improve performance.

Holding Pond: A pond or reservoir, usually made of earth, built to store polluted runoff.

Holoplankton: An aggregate of passively floating, drifting or somewhat motile organisms throughout their entire life cycle; Hot spot locations in waterbodies or sediments where hazardous substances have accumulated to levels which may pose risks to aquatic life, wildlife, fisheries, or human health.

HRT: High Rate Treatment

Hydrogen Sulfide (H_2S): A flammable, toxic, colorless gas with an offensive odor (similar to rotten eggs) that is a byproduct of degradation in anaerobic conditions.

Hydrology: The study of the distribution, properties, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypoxia: The condition of low dissolved oxygen in aquatic systems (typically with a dissolved oxygen concentration less than 3.0 mg/L).

Hypoxia/Hypoxic Waters: Waters with dissolved oxygen concentrations of less than 2 ppm, the level generally accepted as the minimum required for most marine life to survive and reproduce.

I/I: Inflow/Infiltration

Index of Biotic Integrity: A fish community assessment approach that incorporates the zoogeographic, ecosystem, community and population aspects of fisheries biology into a single ecologically-based index of the quality of a water resource.

IBI: Indices of Biological Integrity

IDNP: Illegal Dumping Notification Program

IEC: Interstate Environmental Commission

IFCP: Interim Floatables Containment Program

Illegal Dumping Notification Program (IDNP): New York City program wherein the NYCDEP field personnel report any observed evidence of illegal shoreline dumping to the Sanitation Police section of DSNY, who have the authority to arrest dumpers who, if convicted, are responsible for proper disposal of the material.

Impact: A change in the chemical, physical or biological quality or condition of a waterbody caused by external sources.

Impaired Waters: Waterbodies not fully supporting their designated uses.

Impairment: A detrimental effect on the biological integrity of a waterbody caused by an impact.

Impermeable: Impassable; not permitting the passage of a fluid through it.

In situ: Measurements taken in the natural environment.

in.: Abbreviation for "Inches".

Index Period: A sampling period, with selection based on temporal behavior of the indicator(s) and the practical considerations for sampling.

Indicator Organism: Organism used to indicate the potential presence of other (usually pathogenic) organisms. Indicator organisms are usually associated with the other organisms, but are usually more easily sampled and measured.

Indicator Taxa or Indicator Species: Those organisms whose presence (or absence) at a site is indicative of specific environmental conditions.

Indicator: Measurable quantity that can be used to evaluate the relationship between pollutant sources and their impact on water quality. Abiotic and biotic indicators can provide quantitative information on environmental conditions.

Indices of Biological Integrity (IBI): A usually dimensionless numeric combination of scores derived from biological measures called metrics.

Industrial Pretreatment Programs (IPP): Program mandated by USEPA to control toxic discharges to public sewers that are tributary to sewage treatment plants by regulating Significant Industrial Users (SIUs). NYCDEP enforces the IPP through Chapter 19 of Title 15 of the Rules of the City of New York (Use of Public Sewers).

Infauna: Animals living within submerged sediments. (See benthos.)

Infectivity: Ability to infect a host. Infiltration. 1. Water other than wastewater that enters a wastewater system and building sewers from the ground through such means as defective pipes, pipe joints, connections or manholes. (Infiltration does not include inflow.) 2. The gradual downward flow of water from the ground surfaces into the soil.

Infiltration: The penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Infiltration/Inflow (I/I): The total quantity of water entering a sewer system from both infiltration and inflow.

Inflow: Water other than wastewater that enters a wastewater system and building sewer from sources such as roof leaders, cellar drains, yard drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm drains and sanitary sewers, catch basins, cooling towers, stormwaters, surface runoff, street wash waters or drainage. (Inflow does not include infiltration.)

Influent: Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant.

Initial Mixing Zone: Region immediately downstream of an outfall where effluent dilution processes occur. Because of the combined effects of the effluent buoyancy, ambient stratification, and current, the prediction of initial dilution can be involved.

Insolation: Exposure to the sun's rays.

Instream Flow: The amount of flow required to sustain stream values, including fish, wildlife, and recreation.

Interceptor Sewers: Large sewer lines that, in a combined system, collect and carry sewage flows from main and trunk sewers to the treatment plant for treatment and discharge. The sewer has no building sewer connections. During some storm events, their capacity is exceeded and regulator structures relieve excess flow to receiving waters to prevent flooding basements, businesses and streets.

Interim Floatables Containment Program (IFCP): A New York City Program that includes containment booms at 24 locations, end-of-pipe nets, skimmer vessels that pick up floatables and transports them to loading stations.

Interstate Environmental Commission (IEC): The Interstate Environmental Commission is a joint agency of the States of New York, New Jersey, and Connecticut. The IEC was established in 1936 under a Compact between New York and New Jersey and approved by Congress. The State of Connecticut joined the Commission in 1941. The mission of the IEC is to protect and enhance environmental quality through cooperation, regulation, coordination, and mutual dialogue between government and citizens in the tri-state region.

Intertidal: The area between the high- and low-tide lines.

IPP: Industrial Pretreatment Programs

Irrigation: Applying water or wastewater to land areas to supply the water and nutrient needs of plants.

JABERRT: Jamaica Bay Ecosystem Research and Restoration Team

Jamaica Bay Ecosystem Research and Restoration Team (JABERRT): Team established by the Army Corps of Engineers to conduct a detailed inventory and biogeochemical characterization of Jamaica Bay for the 2000-2001 periods and to compile the most detailed literature search established.

Jamaica Eutrophication Model (JEM): Model developed for Jamaica Bay in 1996 as a result of a cost-sharing agreement between the NYCDEP and US Army Corps of Engineers.

JEM: Jamaica Eutrophication Model

JFK: John F. Kennedy Interntional Airport

Karst Geology: Solution cavities and closely-spaced sinkholes formed as a result of dissolution of carbonate bedrock.

Knee-of-the-Curve: The point where the incremental change in the cost of the control alternative per change in performance of the control alternative changes most rapidly.

KOTC: Knee-of-the-Curve

Kurtosis: A measure of the departure of a frequency distribution from a normal distribution, in terms of its relative peakedness or flatness.

LA: Load Allocation

Land Application: Discharge of wastewater onto the ground for treatment or reuse. (See irrigation)

Land Use: How a certain area of land is utilized (examples: forestry, agriculture, urban, industry).

Landfill: A large, outdoor area for waste disposal; landfills where waste is exposed to the atmosphere (open dumps) are now illegal; in constructed landfills, waste is layered, covered with soil, and is built upon impermeable materials or barriers to prevent contamination of surroundings.

lb/day/cf: pounds per day per cubic foot

lbs/day: pounds per day

LC: Loading Capacity

Leachate: Water that collects contaminants as it trickles through wastes, pesticides, or fertilizers. Leaching can occur in farming areas, feedlots, and landfills and can result in hazardous substances entering surface water, groundwater, or soil.

Leaking Underground Storage Tank (LUST): An underground container used to store gasoline, diesel fuel, home heating oil, or other chemicals that is damaged in some way and is leaking its contents into the ground; may contaminate groundwater.

LID: Low Impact Development

LID-R: Low Impact Development - Retrofit

Limiting Factor: A factor whose absence exerts influence upon a population or organism and may be responsible for no growth, limited growth (decline) or rapid growth.

Littoral Zone: The intertidal zone of the estuarine or seashore; i.e., the shore zone between the highest and lowest tides.

Load Allocation (LA): The portion of receiving water's loading capacity that is attributed either to one of its existing or future non-point sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and non-point source loads should be distinguished. (40 CFR 130.2(g))

Load, Loading, Loading Rate: The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in mass per unit time.

Loading Capacity (LC): The greatest amount of loading that water can receive without violating water quality standards.

Long-Term Control Plan (LTCP): A document developed by CSO communities to describe existing waterway conditions and various CSO abatement technologies that will be used to control overflows.

Low-Flow: Stream flow during time periods where no precipitation is contributing to runoff to the stream and contributions from groundwater recharge are low. Low flow results in less water available for dilution of pollutants in the stream. Due to the limited flow, direct discharges to the stream dominate during low flow periods. Exceedences of water quality standards during low flow conditions are likely to be caused by direct discharges such as point sources, illicit discharges, and livestock or wildlife in the stream.

Low Impact Development (LID): A sustainable storm water management strategy implemented in response to burgeoning infrastructural costs of new development and redevelopment projects, more rigorous environmental regulations, concerns about the urban heat island effect, and the impacts of natural resources due to growth and development. The LID strategy controls water at the source—both rainfall and storm water runoff—which is known as 'source-control' technology. It is a decentralized system that distributes storm water across a project site in order to replenish groundwater supplies rather than sending it into a system of storm drain pipes and channelized networks that control water downstream in a large storm water management facility. The LID approach promotes the use of various devices that filter water and infiltrate water into the ground. It promotes the use of roofs of buildings, parking lots, and other horizontal surfaces to convey water to either distribute it into the ground or collect it for reuse.

Low Impact Development – Retrofit (LID-R): Modification of an existing site to accomplish LID goals.

LTCP: Long-Term CSO Control Plan

LUST: leaking underground storage tank

Macrobenthos: Benthic organisms (animals or plants) whose shortest dimension is greater than or equal to 0.5 mm. (See benthos.)

Macrofauna: Animals of a size large enough to be seen by the unaided eye and which can be retained by a U.S. Standard No. 30 sieve (28 meshes/in, 0.595-mm openings).

Macro-invertebrate: Animals/organism without backbones (Invertebrate) that is too large to pass through a No. 40 Screen (0.417mm) but can be retained by a U.S. Standard No. 30 sieve (28 meshes/in, 0.595-mm openings). The organism size is of sufficient size for it to be seen by the unaided eye and which can be retained

Macrophytes: Large aquatic plants that may be rooted, non-rooted, vascular or algiform (such as kelp); including submerged aquatic vegetation, emergent aquatic vegetation, and floating aquatic vegetation.

Major Oil Storage Facilities (MOSF): Onshore facility with a total combined storage capacity of 400,000 gallons or more of petroleum and/or vessels involved in the transport of petroleum on the waters of New York State.

Margin of Safety (MOS): A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by USEPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).

Marine Protection, Research and Sanctuaries Act of 1972, The Ocean Dumping Act: Legislation regulating the dumping of any material in the ocean that may adversely affect human health, marine environments or the economic potential of the ocean.

Mass Balance: A mathematical accounting of substances entering and leaving a system, such as a waterbody, from all sources. A mass balance model for a waterbody is useful to help understand the relationship between the loadings of a pollutant and the levels in the water, biota and sediments, as well as the amounts that can be safely assimilated by the waterbody.

Mass Loading: The quantity of a pollutant transported to a waterbody.

Mathematical Model: A system of mathematical expressions that describe the spatial and temporal distribution of water quality constituents resulting from fluid transport and the one, or more, individual processes and interactions within some prototype aquatic ecosystem. A mathematical water quality model is used as the basis for wasteload allocation evaluations.

Mean Low Water (MLW): A tidal level. The average of all low waters observed over a sufficiently long period.

Median Household Income (MHI): The median household income is one measure of average household income. It divides the household income distribution into two equal parts: one-half of the cases fall below the median household income, and one-half above it.

Meiofauna: Small interstitial; i.e., occurring between sediment particles, animals that pass through a 1-mm mesh sieve but are retained by a 0.1-mm mesh.

Memorandum of Understanding (MOU): An agreement between two or more public agencies defining the roles and responsibilities of each agency in relation to the other or others with respect to an issue over which the agencies have concurrent jurisdiction.

Meningitis: Inflammation of the meninges, especially as a result of infection by bacteria or viruses.

Meroplankton: Organisms that are planktonic only during the larval stage of their life history.

Mesohaline: The estuarine salinity zone with a salinity range of 5-18-ppt.

Metric: A calculated term or enumeration which represents some aspect of biological assemblage structure, function, or other measurable characteristic of the biota that changes in some predictable way in response to impacts to the waterbody.

mf/L: Million fibers per liter – A measure of concentration.

MG: Million Gallons – A measure of volume.

mg/L: Milligrams Per Liter – A measure of concentration.

MGD: Million Gallons Per Day – A measure of the rate of water flow.

MHI: Median Household Income

Microgram per liter (ug/L): A measure of concentration

Microorganisms: Organisms too small to be seen with the unaided eye, including bacteria, protozoans, yeasts, viruses and algae.

Milligrams per liter (mg/L): This weight per volume designation is used in water and wastewater analysis. 1 mg/L = 1 ppm.

milliliters (mL): A unit of length equal to one thousandth (10^{-3}) of a meter, or 0.0394 inch.

Million fibers per liter (mf/L): A measure of concentration.

million gallons (MG): A unit of measure used in water and wastewater to express volume. To visualize this volume, if a good-sized bath holds 50 gallons, so a million gallons would be equal to 20,000 baths.

million gallons per day (MGD): Term used to express water-use data. Denotes the volume of water utilized in a single day.

Mitigation: Actions taken to avoid, reduce, or compensate for the effects of environmental damage. Among the broad spectrum of possible actions are those which restore, enhance, create, or replace damaged ecosystems.

Mixing Zone: A portion of a waterbody where water quality criteria or rules are waived in order to allow for dilution of pollution. Mixing zones have been allowed by states in many NPDES permits when discharges were expected to have difficulty providing enough treatment to avoid violating standards for the receiving water at the point of discharge.

mL: milliliters

MLW: mean low water

Modeling: An investigative technique using a mathematical or physical representation of a system or theory, usually on a computer, that accounts for all or some of its known properties. Models are often used to test the effect of changes of system components on the overall performance of the system.

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Monte Carlo Simulation: A stochastic modeling technique that involves the random selection of sets of input data for use in repetitive model runs. Probability distributions of receiving water quality concentrations are generated as the output of a Monte Carlo simulation.

MOS: Margin of Safety

MOSF: major oil storage facilities

MOU: Memorandum of Understanding

MOUSE: Computer model developed by the Danish Hydraulic Institute used to model the combined sewer system.

MS4: municipal separate storm sewer systems

Multimetric Approach: An analysis technique that uses a combination of several measurable characteristics of the biological assemblage to provide an assessment of the status of water resources.

Multivariate Community Analysis: Statistical methods (e.g., ordination or discriminant analysis) for analyzing physical and biological community data using multiple variables.

Municipal Separate Storm Sewer Systems (MS4): A conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) that is 1) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage districts, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges to waters of the United States; 2) Designed or used for collecting or conveying stormwater; 3) Which is not a combined sewer; and 4) Which is not part of a publicly owned treatment works.

Municipal Sewage: Wastes (mostly liquid) originating from a community; may be composed of domestic wastewater and/or industrial discharges.

National Estuary Program: A program established under the Clean Water Act Amendments of 1987 to develop and implement conservation and management plans for protecting estuaries and restoring and maintaining their chemical, physical, and biological integrity, as well as controlling point and non-point pollution sources.

National Marine Fisheries Service (NMFS): A federal agency - with scientists, research vessels, and a data collection system - responsible for managing the nation's saltwater fish. It oversees the actions of the Councils under the Fishery Conservation and Management Act.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Clean Water Act. The program imposes discharge limitations on point sources by basing them on the effluent limitation capabilities of a control technology or on local water quality standards. It prohibits discharge of pollutants into water of the United States unless a special permit is issued by USEPA, a state, or, where delegated, a tribal government on an Indian reservation.

National Priorities List (NPL): USEPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System. USEPA is required to update the NPL at least once a year. A site must be on the NPL to receive money from the Trust Fund for remedial action.

National Wetland Inventory (NWI): The National Wetlands Inventory (NWI) of the U.S. Fish & Wildlife Service produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. The National Wetlands Inventory information is used by Federal, State, and local agencies, academic institutions, U.S. Congress, and the private sector. Congressional mandates in the Emergency Wetlands Resources Act requires the Service to map wetlands, and to digitize, archive and distribute the maps.

Natural Background Levels: Natural background levels represent the chemical, physical, and biological conditions that would result from natural geomorphological processes such as weathering or dissolution.

Natural Waters: Flowing water within a physical system that has developed without human intervention, in which natural processes continue to take place.

Navigable Waters: Traditionally, waters sufficiently deep and wide for navigation; such waters in the United States come under federal jurisdiction and are protected by the Clean Water Act.

New York City Department of City Planning (NYCDCP): New York City agency responsible for the city's physical and socioeconomic planning, including land use and environmental review; preparation of plans and policies; and provision of technical assistance and planning information to government agencies, public officials, and community boards.

New York City Department of Environmental Protection (DEP): New York City agency responsible for addressing the environmental needs of the City's residents in areas including water, wastewater, air, noise and hazmat.

New York City Department of Parks and Recreation (NYCDPR): The New York City Department of Parks and Recreation is the branch of government of the City of New York responsible for maintaining the city's parks system, preserving and maintaining the ecological diversity of the city's natural areas, and furnishing recreational opportunities for city's residents.

New York City Department of Transportation (NYCDOT): New York City agency responsible for maintaining and improving New York City's transportation network.

New York City Economic Development Corporation (NYCEDC): City's primary vehicle for promoting economic growth in each of the five boroughs. NYCEDC works to stimulate investment in New York and broaden the City's tax and employment base, while meeting the needs of businesses large and small. To realize these objectives, NYCEDC uses its real estate and financing tools to help companies that are expanding or relocating anywhere within the city.

New York District (NYD): The local division of the United States Army Corps of Engineers,

New York State Code of Rules and Regulations (NYCRR): Official statement of the policy(ies) that implement or apply the Laws of New York.

New York State Department of Environmental Conservation (DEC): New York State agency that *conserves, improves, and protects New York State's natural resources and environment, and controls water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well being.*

New York State Department of State (NYSDOS): Known as the "keeper of records" for the State of New York. Composed of two main divisions including the Office of Business and Licensing Services and the Office of Local Government Services. The latter office includes the Division of Coastal Resources and Waterfront Revitalization.

NH_3: Ammonia

Nine Minimum Controls (NMC): Controls recommended by the USEPA to minimize CSO impacts. The controls include: (1) proper operation and maintenance for sewer systems and CSOs; (2) maximum use of the collection system for storage; (3) review pretreatment requirements to minimize CSO impacts; (4) maximize flow to treatment facility; (5) prohibit combines sewer discharge during dry weather; (6) control solid and floatable materials in CSOs; (7) pollution prevention; (8) public notification of CSO occurrences and impacts; and, (9) monitor CSOs to characterize impacts and efficacy of CSO controls.

NMC: nine minimum controls

NMFS: National Marine Fisheries Service

No./mL (or #/mL): number of bacteria organisms per milliliter – measure of concentration

NFRAP: No Further Remedial Action Planned

Non-Compliance: Not obeying all promulgated regulations, policies or standards that apply.

Non-Permeable Surfaces: Surfaces which will not allow water to penetrate, such as sidewalks and parking lots.

Non-Point Source (NPS): Pollution that is not released through pipes but rather originates from multiple sources over a relatively large area (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Non-point sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

NPDES: National Pollution Discharge Elimination System

NPL: National Priorities List

NPS: Non-Point Source

Numeric Targets: A measurable value determined for the pollutant of concern which is expected to result in the attainment of water quality standards in the listed waterbody.

Nutrient Pollution: Contamination of water resources by excessive inputs of nutrients. In surface waters, excess algal production as a result of nutrient pollution is a major concern.

Nutrient: Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

NWI: National Wetland Inventory

NYCDCP: New York City Department of City Planning

NYCDEP: New York City Department of Environmental Protection

NYCDOT: New York City Department of Transportation

NYCDPR: New York City Department of Parks and Recreation

NYCEDC: New York City Economic Development Corporation

NYCHPD: New York City Housing, Preservation and Development

NYCRR: New York State Code of Rules and Regulations

NYD: New York District

NYSDEC: New York State Department of Environmental Conservation

NYSDOS: New York State Department of State

O&M: Operation and Maintenance

Oligohaline: The estuarine salinity zone with a salinity range of 0.5-5-ppt.

ONRW: Outstanding National Resource Waters

Operation and Maintenance (O&M): Actions taken after construction to ensure that facilities constructed will be properly operated and maintained to achieve normative efficiency levels and prescribed effluent eliminations in an optimum manner.

Optimal: Most favorable point, degree, or amount of something for obtaining a given result; in ecology most natural or minimally disturbed sites.

Organic Chemicals/Compounds: Naturally occurring (animal or plant-produced or synthetic) substances containing mainly carbon, hydrogen, nitrogen, and oxygen.

Organic Material: Material derived from organic, or living, things; also, relating to or containing carbon compounds.

Organic Matter: Carbonaceous waste (organic fraction) that includes plant and animal residue at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population originating from domestic or industrial sources. It is commonly determined as the amount of organic material contained in a soil or water sample.

Organic: (1) Referring to other derived from living organisms. (2) In chemistry, any compound containing carbon.

Ortho P: Ortho Phosphorus

Ortho Phosphorus: Soluble reactive phosphorous readily available for uptake by plants. The amount found in a waterbody is an indicator of how much phosphorous is available for algae and plant growth. Since aquatic plant growth is typically limited by phosphorous, added phosphorous especially in the dissolved, bioavailable form can fuel plant growth and cause algae blooms.

Outfall: Point where water flows from a conduit, stream, or drain into receiving water.

Outstanding National Resource Waters (ONRW): Outstanding national resource waters (ONRW) designations offer special protection (i.e., no degradation) for designated waters, including wetlands. These are areas of exceptional water quality or recreational/ecological significance. State antidegradation policies should provide special protection to wetlands designated as outstanding national resource waters in the same manner as other surface waters; see Section 131.12(a)(3) of the WQS regulation and USEPA guidance (Water Quality Standards Handbook (USEPA 1983b), and Questions and Answers on: Antidegradation (USEPA 1985a)).

Overflow Rate: A measurement used in wastewater treatment calculations for determining solids settling. It is also used for CSO storage facility calculations and is defined as the flow through a storage basin divided by the surface area of the basin. It can be thought of as an average flow rate through the basin. Generally expressed as gallons per day per square foot (gpd/sq.ft.).

Oxidation Pond: A relatively shallow body of wastewater contained in an earthen basin; lagoon; stabilization pond.

Oxidation: The chemical union of oxygen with metals or organic compounds accompanied by a removal of hydrogen or another atom. It is an important factor for soil formation and permits the release of energy from cellular fuels.

Oxygen Demand: Measure of the dissolved oxygen used by a system (microorganisms) in the oxidation of organic matter. (See also biochemical oxygen demand)

Oxygen Depletion: The reduction of dissolved oxygen in a waterbody.

PAH: Polycyclic Aromatic Hydrocarbons

Partition Coefficients: Chemicals in solution are partitioned into dissolved and particulate adsorbed phase based on their corresponding sediment-to-water partitioning coefficient.

Parts per Million (ppm): The number of "parts" by weight of a substance per million parts of water. This unit is commonly used to represent pollutant concentrations. Large concentrations are expressed in percentages.

Pathogen: Disease-causing agent, especially microorganisms such as bacteria, protozoa, and viruses.

PCBs: Polychlorinated biphenyls

PCS: Permit Compliance System

PE: Primary Effluent

Peak Flow: The maximum flow that occurs over a specific length of time (e.g., daily, hourly, instantaneous).

Pelagic Zone: The area of open water beyond the littoral zone.

Pelagic: Pertaining to open waters or the organisms which inhabit those waters.

Percent Fines: In analysis of sediment grain size, the percent of fine (.062-mm) grained fraction of sediment in a sample.

Permit Compliance System (PCS): Computerized management information system which contains data on NPDES permit-holding facilities. PCS keeps extensive records on more than 65,000 active water-discharge permits on sites located throughout the nation. PCS tracks permit, compliance, and enforcement status of NPDES facilities.

Permit: An authorization, license, or equivalent control document issued by USEPA or an approved federal, state, or local agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Petit Ponar Grab Sampler: Dredge designed to take samples from all types of benthos sediments on all varieties of waterbody bottoms, except those of the hardest clay. When the jaws contact the bottom they obtain a good penetration with very little sample disturbance. Can be used in both fresh and salt water.

pH: An expression of the intensity of the basic or acid condition of a liquid. The pH may range from 0 to 14, where 0 is most acid, 14 most basic and 7 neutral. Natural waters usually have a pH between 6.5 and 8.5.

Phased Approach: Under the phased approach to TMDL development, load allocations (LAs) and wasteload allocations (WLAs) are calculated using the best available data and information recognizing the need for additional monitoring data to accurately characterize sources and loadings. The phased approach is typically employed when non-point sources dominate. It provides for the implementation of load reduction strategies while collecting additional data.

Photic Zone: The region in a waterbody extending from the surface to the depth of light penetration.

Photosynthesis: The process by which chlorophyll-containing plants make carbohydrates from water, and from carbon dioxide in the air, using energy derived from sunlight.

Phytoplankton: Free-floating or drifting microscopic algae with movements determined by the motion of the water.

Point Source: (1) A stationary location or fixed facility from which pollutant loads are discharged. (2) Any single identifiable source of pollutants including pipes, outfalls, and conveyance channels from either municipal wastewater treatment systems or industrial waste treatment facilities. (3) Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Pollutant: Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. (CWA Section 502(6)).

Pollution: Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Polychaete: Marine worms of the class Polychaeta of the invertebrate worm order Annelida. Polychaete species dominate the marine benthos, with dozens of species present in natural marine environments. These worms are highly diversified, ranging from detritivores to predators, with some species serving as good indicators of environmental stress.

Polychlorinated Biphenyls (PCBs): A group of synthetic polychlorinated aromatic hydrocarbons formerly used for such purposes as insulation in transformers and capacitors and lubrication in gas pipeline systems. Production, sale and new use was banned by law in 1977 following passage of the Toxic Substances Control Act. PCBs have a strong tendency to bioaccumulate. They are quite stable, and therefore persist in the environment for long periods of time. They are classified by USEPA as probable human carcinogens.

Polycyclic Aromatic Hydrocarbons (PAHs): A group of petroleum-derived hydrocarbon compounds, present in petroleum and related materials, and used in the manufacture of materials such as dyes, insecticides and solvents.

Population: An aggregate of interbreeding individuals of a biological species within a specified location.

POTW: Publicly Owned Treatment Plant

pounds per day per cubic foot: lb/day/cf

pounds per day: lbs/day; unit of measure

ppm: parts per million

Precipitation Event: An occurrence of rain, snow, sleet, hail, or other form of precipitation that is generally characterized by parameters of duration and intensity (inches or millimeters per unit of time).

Pretreatment: The treatment of wastewater from non-domestic sources using processes that reduce, eliminate, or alter contaminants in the wastewater before they are discharged into Publicly Owned Treatment Works (POTWs).

Primary Effluent (PE): Partially treated water (screened and undergoing settling) passing from the primary treatment processes a wastewater treatment plant.

Primary Treatment: A basic wastewater treatment method, typically the first step in treatment, that uses skimming, settling in tanks to remove most materials that float or will settle. Usually chlorination follows to remove pathogens from wastewater. Primary treatment typically removes about 35 percent of biochemical oxygen demand (BOD) and less than half of the metals and toxic organic substances.

Priority Pollutants: A list of 129 toxic pollutants including metals developed by the USEPA as a basis for defining toxics and is commonly referred to as “priority pollutants”.\

Probable Total Project Cost (PTPC): Probable Total Project Cost represents the realistic total of all hard costs, soft costs, and ancillary costs associated with a particular CSO abatement technology per the definitions provided in O’Brien & Gere, April 2006. All PTPCs shown in this report are adjusted to July 2005 dollars (ENR CCI = 11667.99).

Protozoa: Single-celled organisms that reproduce by fission and occur primarily in the aquatic environment. Waterborne pathogenic protozoans of primary concern include Giardia lamblia and Cryptosporidium, both of which affect the gastrointestinal tract.

PS: Pump Station or Pumping Station

PTPC: Probable Total Project Cost

Pseudoreplication: The repeated measurement of a single experimental unit or sampling unit, with the treatment of the measurements as if they were independent replicates of the sampling unit.

Public Comment Period: The time allowed for the public to express its views and concerns regarding action by USEPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Publicly Owned Treatment Works (POTW): Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

Pump Station or Pumping Station: Sewer pipes are generally gravity driven. Wastewater flows slowly downhill until it reaches a certain low point. Then pump, or "lift," stations push the wastewater back uphill to a high point where gravity can once again take over the process.

Pycnocline: A zone of marked density gradient.

Q: Symbol for Flow (designation when used in equations)

R.L: Reporting Limit

Rainfall Duration: The length of time of a rainfall event.

Rainfall Intensity: The amount of rainfall occurring in a unit of time, usually expressed in inches per hour.

Raw Sewage: Untreated municipal sewage (wastewater) and its contents.

RCRAInfo: Resource Conservation and Recovery Act Information

Real-Time Control (RTC): A system of data gathering instrumentation used in conjunction with control components such as dams, gates and pumps to maximize storage in the existing sewer system.

Receiving Waters: Creeks, streams, rivers, lakes, estuaries, groundwater formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Red Tide: A reddish discoloration of coastal surface waters due to concentrations of certain toxin producing algae.

Reference Condition: The chemical, physical or biological quality or condition exhibited at either a single site or an aggregation of sites that represents the least impaired condition of a classification of waters to which the reference condition applies.

Reference Sites: Minimally impaired locations in similar waterbodies and habitat types at which data are collected for comparison with test sites. A separate set of reference sites are defined for each estuarine or coastal marine class.

Regional Environmental Monitoring and Assessment Program (REMAP): The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources.

Regulator: A device in combined sewer systems for diverting wet weather flows which exceed downstream capacity to an overflow.

REMAP: Regional Environmental Monitoring and Assessment Program

Replicate: Taking more than one sample or performing more than one analysis.

Reporting Limit (RL): The lowest concentration at which a contaminant is reported.

Residence Time: Length of time that a pollutant remains within a section of a waterbody. The residence time is determined by the streamflow and the volume of the river reach or the average stream velocity and the length of the river reach.

Resource Conservation and Recovery Act Information (RCRAinfo): Database with information on existing hazardous materials sites. USEPA was authorized to develop a hazardous waste management system, including plans for the handling and storage of wastes and the licensing of treatment and disposal facilities. The states were required to implement the plans under authorized grants from the USEPA. The act generally encouraged "cradle to grave" management of certain products and emphasized the need for recycling and conservation.

Respiration: Biochemical process by means of which cellular fuels are oxidized with the aid of oxygen to permit the release of the energy required to sustain life; during respiration, oxygen is consumed and carbon dioxide is released.

Restoration: Return of an ecosystem to a close approximation of its condition prior to disturbance. Re-establishing the original character of an area such as a wetland or forest.

Riparian Zone: The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.

Ribonucleic acid (RNA): RNA is the generic term for polynucleotides, similar to DNA but containing ribose in place of deoxyribose and uracil in place of thymine. These molecules are involved in the transfer of information from DNA, programming protein synthesis and maintaining ribosome structure.

Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Riparian: Relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

RNA: ribonucleic acid

RTC: Real-Time Control

Runoff: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

Safe Drinking Water Act: The Safe Drinking Water Act authorizes USEPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. USEPA, states, and water systems then work together to make sure these standards are met.

Sanitary Sewer Overflow (SSO): When wastewater treatment systems overflow due to unforeseen pipe blockages or breaks, unforeseen structural, mechanical, or electrical failures, unusually wet weather conditions, insufficient system capacity, or a deteriorating system.

Sanitary Sewer: Underground pipes that transport only wastewaters from domestic residences and/or industries to a wastewater treatment plant. No stormwater is carried.

Saprobien System: An ecological classification of a polluted aquatic system that is undergoing self-purification. Classification is based on relative levels of pollution, oxygen concentration and types of indicator microorganisms; i.e., saprophagic microorganisms – feeding on dead or decaying organic matter.

SCADA: Supervisory Control and Data Acquisition

scfm: standard cubic feet per minute

Scoping Modeling: Involves simple, steady-state analytical solutions for a rough analysis of the problem.

Scour: To abrade and wear away. Used to describe the weathering away of a terrace or diversion channel or streambed. The clearing and digging action of flowing water, especially the downward erosion by stream water in sweeping away mud and silt on the outside of a meander or during flood events.

Secchi Disk: Measures the transparency of water. Transparency can be affected by the color of the water, algae and suspended sediments. Transparency decreases as color, suspended sediments or algal abundance increases.

Secondary Treatment: The second step in most publicly owned waste treatment systems in which bacteria consume the organic parts of the waste. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 percent of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment. (See primary, tertiary treatment.)

Sediment Oxygen Demand (SOD): A measure of the amount of oxygen consumed in the biological process that breaks down organic matter in the sediment.

Sediment: Insoluble organic or inorganic material often suspended in liquid that consists mainly of particles derived from rocks, soils, and organic materials that eventually settles to the bottom of a waterbody; a major non-point source pollutant to which other pollutants may attach.

Sedimentation: Deposition or settling of suspended solids settle out of water, wastewater or other liquids by gravity during treatment.

Sediments: Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish and wildlife habitat, and clouding the water so that sunlight cannot reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to wash off the land after rainfall.

Seiche: A wave that oscillates (for a period of a few minutes to hours) in lakes, bays, lagoons or gulfs as a result of seismic or atmospheric disturbances (e.g., "wind tides").

Sensitive Areas: Areas of particular environmental significance or sensitivity that could be adversely affected by discharges, including Outstanding National Resource Waters, National Marine Sanctuaries, waters with threatened or endangered species, waters with primary contact recreation, public drinking water intakes, shellfish beds, and other areas identified by State or Federal agencies.

Separate Sewer System: Sewer systems that receive domestic wastewater, commercial and industrial wastewaters, and other sources but do not have connections to surface runoff and are not directly influenced by rainfall events.

Separate Storm Water System (SSWS): A system of catch basin, pipes, and other components that carry only surface run off to receiving waters.

Septic System: An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent (sludge) that remains after decomposition of the solids by bacteria in the tank; must be pumped out periodically.

SEQRA: State Environmental Quality Review Act

Settleable Solids: Material heavy enough to sink to the bottom of a wastewater treatment tank.

Settling Tank: A vessel in which solids settle out of water by gravity during drinking and wastewater treatment processes.

Sewage: The waste and wastewater produced by residential and commercial sources and discharged into sewers.

Sewer Sludge: Sludge produced at a Publicly Owned Treatment Works (POTW), the disposal of which is regulated under the Clean Water Act.

Sewer: A channel or conduit that carries wastewater and storm-water runoff from the source to a treatment plant or receiving stream. "Sanitary" sewers carry household, industrial, and commercial waste. "Storm" sewers carry runoff from rain or snow. "Combined" sewers handle both.

Sewerage: The entire system of sewage collection, treatment, and disposal.

Sewershed: A defined area that is tributary to a single point along an interceptor pipe (a community connection to an interceptor) or is tributary to a single lift station. Community boundaries are also used to define sewer-shed boundaries.

SF: Square foot, unit of area

Significant Industrial User (SIU): A Significant Industrial User is defined by the USEPA as an industrial user that discharges process wastewater into a publicly owned treatment works and meets at least one of the following: (1) All industrial users subject to *Categorical Pretreatment Standards* under the Code of Federal Regulations - Title 40 (40 CFR) Part 403.6, and CFR Title 40 Chapter I, Subchapter N- Effluent Guidelines and Standards; and (2) Any other industrial user that discharges an average of 25,000 gallons per day or more of process wastewater to the treatment plant (excluding sanitary, non-contact cooling and boiler blowdown wastewater); or contributes a process waste stream which makes up 5 percent or more of any design capacity of the treatment plant; or is designated as such by the municipal Industrial Waste Section on the basis that the industrial user has a reasonable potential for adversely affecting the treatment plants operation or for violating any pretreatment standard or requirement.

Siltation: The deposition of finely divided soil and rock particles upon the bottom of stream and river beds and reservoirs.

Simulation Models: Mathematical models (logical constructs following from first principles and assumptions), statistical models (built from observed relationships between variables), or a combination of the two.

Simulation: Refers to the use of mathematical models to approximate the observed behavior of a natural water system in response to a specific known set of input and forcing conditions. Models that have been validated, or verified, are then used to predict the response of a natural water system to changes in the input or forcing conditions.

Single Sample Maximum (SSM): A maximum allowable enterococci or E. Coli density for a single sample.

Site Spill Identifier List (SPIL): Federal database with information on existing Superfund Sites.

SIU: Significant Industrial User

Skewness: The degree of statistical asymmetry (or departure from symmetry) of a population. Positive or negative skewness indicates the presence of a long, thin tail on the right or left of a distribution respectively.

Slope: The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04); degrees (2 degrees 18 minutes), or percent (4 percent).

Sludge: Organic and Inorganic solid matter that settles to the bottom of septic or wastewater treatment plant sedimentation tanks, must be disposed of by bacterial digestion or other methods or pumped out for land disposal, incineration or recycled for fertilizer application.

SNWA: Special Natural Waterfront Area

SOD: Sediment Oxygen Demand

SOP: Standard Operating Procedure

Sorption: The adherence of ions or molecules in a gas or liquid to the surface of a solid particle with which they are in contact.

SPDES: State Pollutant Discharge Elimination System

Special Natural Waterfront Area (SNWA): A large area with concentrations of important coastal ecosystem features such as wetlands, habitats and buffer areas, many of which are regulated under other programs.

SPIL: Site Spill Identifier List

SRF: State Revolving Fund

SSM: single sample maximum

SSO: Sanitary Sewer Overflow

SSWS: Separate Storm Water System

Stakeholder: One who is interested in or impacted by a project.

Standard Cubic Feet per Minute (SCFM): A standard measurement of airflow that indicates how many cubic feet of air pass by a stationary point in one minute. The higher the number, the more air is being forced through the system. The volumetric flow rate of a liquid or gas in cubic feet per minute. 1 CFM equals approximately 2 liters per second.

State Environmental Quality Review Act (SEQRA): New York State program requiring all local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making. This means these agencies must assess the environmental significance of all actions they have discretion to approve, fund or directly undertake. SEQR requires the agencies to balance the environmental impacts with social and economic factors when deciding to approve or undertake an action.

Standard Operating Procedure (SOP): Document describing a procedure or set of procedures to perform a given operation or evolutions or in reaction to a given event.

State Pollutant Discharge Elimination System (SPDES): New York State has a state program which has been approved by the United States Environmental Protection Agency for the control of wastewater and stormwater discharges in accordance with the Clean Water Act. Under New York State law the program is known as the State Pollutant Discharge Elimination System (SPDES) and is broader in scope than that required by the Clean Water Act in that it controls point source discharges to groundwaters as well as surface waters.

State Revolving Fund (SRF): Revolving funds are financial institutions that make loans for specific water pollution control purposes and use loan repayment, including interest, to make new loans for additional water pollution control activities. The SRF program is based on the 1987 Amendments to the Clean Water Act, which established the SRF program as the CWA's original Construction Grants Program was phased out.

Steady-State Model: Mathematical model of fate and transport that uses constant values of input variables to predict constant values of receiving water quality concentrations.

Storage: Treatment holding of waste pending treatment or disposal, as in containers, tanks, waste piles, and surface impoundments.

STORET: U.S. Environmental Protection Agency (USEPA) national water quality database for STORage and RETrieval (STORET). Mainframe water quality database that includes physical, chemical, and biological data measured in waterbodies throughout the United States.

Storm Runoff: Stormwater runoff, snowmelt runoff, and surface runoff and drainage; rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate lower than rainfall intensity, but instead flows onto adjacent land or waterbodies or is routed into a drain or sewer system.

Storm Sewer: A system of pipes (separate from sanitary sewers) that carries waste runoff from buildings and land surfaces.

Storm Sewer: Pipes (separate from sanitary sewers) that carry water runoff from buildings and land surfaces.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels or pipes into a defined surface water channel, or a constructed infiltration facility.

Stormwater Management Models (SWMM): USEPA mathematical model that simulates the hydraulic operation of the combined sewer system and storm drainage sewershed.

Stormwater Protection Plan (SWPP): A plan to describe a process whereby a facility thoroughly evaluates potential pollutant sources at a site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in stormwater runoff.

Stratification (of waterbody): Formation of water layers each with specific physical, chemical, and biological characteristics. As the density of water decreases due to surface heating, a stable situation develops with lighter water overlaying heavier and denser water.

Stressor: Any physical, chemical, or biological entity that can induce an adverse response.

Subaqueous Burrow Pit: An underwater depression left after the mining of large volumes of sand and gravel for projects ranging from landfilling and highway construction to beach nourishment.

Substrate: The substance acted upon by an enzyme or a fermenter, such as yeast, mold or bacteria.

Subtidal: The portion of a tidal-flat environment that lies below the level of mean low water for spring tides. Normally it is covered by water at all stages of the tide.

Supervisory Control and Data Acquisition (SCADA): System for controlling and collecting and recording data on certain elements of WASA combined sewer system.

Surcharge Flow: Flow in which the water level is above the crown of the pipe causing pressurized flow in pipe segments.

Surface Runoff: Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of non-point source pollutants in rivers, streams, and lakes.

Surface Water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other groundwater collectors directly influenced by surface water.

Surficial Geology: Geology relating to surface layers, such as soil, exposed bedrock, or glacial deposits.

Suspended Loads: Specific sediment particles maintained in the water column by turbulence and carried with the flow of water.

Suspended Solids or Load: Organic and inorganic particles (sediment) suspended in and carried by a fluid (water). The suspension is governed by the upward components of turbulence, currents, or colloidal suspension. Suspended sediment usually consists of particles <0.1 mm, although size may vary according to current hydrological conditions. Particles between 0.1 mm and 1 mm may move as suspended or bedload. It is a standard measure of the concentration of particulate matter in wastewater, expressed in mg/L. Technology-Based Standards. Minimum pollutant control standards for numerous categories of industrial discharges, sewage discharges and for a growing number of other types of discharges. In each industrial category, they represent levels of technology and pollution control performance that the USEPA expects all discharges in that category to employ.

SWEM: System-wide Eutrophication Model

SWMM: Stormwater Management Model

SWPP: Stormwater Protection Plan

System-wide Eutrophication Model (SWEM): Comprehensive hydrodynamic model developed for the New York/New Jersey Harbor System.

Taxa: The plural of taxon, a general term for any of the hierarchical classification groups for organisms, such as genus or species.

TC: Total coliform

TDS: Total Dissolved Solids

Technical and Operational Guidance Series (TOGS): Memorandums that provide information on determining compliance with a standard.

Tertiary Treatment: Advanced cleaning of wastewater that goes beyond the secondary or biological stage, removing nutrients such as phosphorus, nitrogen, and most biochemical oxygen demand (BOD) and suspended solids.

Test Sites: Those sites being tested for biological impairment.

Threatened Waters: Water whose quality supports beneficial uses now but may not in the future unless action is taken.

Three-Dimensional Model (3-D): Mathematical model defined along three spatial coordinates where the water quality constituents are considered to vary over all three spatial coordinates of length, width, and depth.

TKN: Total Kjeldahl Nitrogen

TMDL: Total Maximum Daily Loads

TOC: Total Organic Carbon

TOGS: Technical and Operational Guidance Series

Topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

Total Coliform Bacteria: A particular group of bacteria, found in the feces of warm-blooded animals, that are used as indicators of possible sewage pollution. They are characterized as aerobic or facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°. Note that many common soil bacteria are also total coliforms, but do not indicate fecal contamination. (See also fecal coliform bacteria)

Total Coliform (TC): The coliform bacteria group consists of several genera of bacteria belonging to the family *enterobacteriaceae*. These mostly harmless bacteria live in soil, water, and the digestive system of animals. Fecal coliform bacteria, which belong to this group, are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. If a large number of fecal coliform bacteria (over 200 colonies/100 milliliters (mL) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water. Swimming in waters with high levels of fecal coliform bacteria increases the chance of developing illness (fever, nausea or stomach cramps) from pathogens entering the body through the mouth, nose, ears, or cuts in the skin.

Total Dissolved Solids (TDS): Solids that pass through a filter with a pore size of 2.0 micron or smaller. They are said to be non-filterable. After filtration the filtrate (liquid) is dried and the remaining residue is weighed and calculated as mg/L of Total Dissolved Solids.

Total Kjeldahl Nitrogen (TKN): The sum of organic nitrogen and ammonia nitrogen.

Total Maximum Daily Load (TMDL): The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for non-point sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Total Organic Carbon (TOC): A measure of the concentration of organic carbon in water, determined by oxidation of the organic matter into carbon dioxide (CO2). TOC includes all the carbon atoms covalently bonded in organic molecules. Most of the organic carbon in drinking water supplies is dissolved organic carbon, with the remainder referred to as particulate organic carbon. In natural waters, total organic carbon is composed primarily of nonspecific humic materials.

Total P: Total Phosphorus

Total Phosphorus (Total P): A nutrient essential to the growth of organisms, and is commonly the limiting factor in the primary productivity of surface water bodies. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particle form. Agricultural drainage, wastewater, and certain industrial discharges are typical sources of phosphorus, and can contribute to the eutrophication of surface water bodies. Measured in milligrams per liter (mg/L).

Total Suspended Solids (TSS): See Suspended Solids Toxic Substances. Those chemical substances which can potentially cause adverse effects on living organisms. Toxic substances include pesticides, plastics, heavy metals, detergent, solvent, or any other materials that are poisonous, carcinogenic, or otherwise directly harmful to human health and the environment as a result of dose or exposure concentration and exposure time. The toxicity of toxic substances is modified by variables such as temperature, chemical form, and availability.

Total Volatile Suspended Solids (VSS): Volatile solids are those solids lost on ignition (heating to 550 degrees C.) They are useful to the treatment plant operator because they give a rough approximation of the amount of organic matter present in the solid fraction of wastewater, activated sludge and industrial wastes.

Toxic Pollutants: Materials that cause death, disease, or birth defects in organisms that ingests or absorbs them. The quantities and exposures necessary to cause these effects can vary widely.

Toxicity: The degree to which a substance or mixture of substances can harm humans or animals. Acute toxicity involves harmful effects in an organism through a single or short-term exposure. Chronic toxicity is the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure sometimes lasting for the entire life of the exposed organism.

Treated Wastewater: Wastewater that has been subjected to one or more physical, chemical, and biological processes to reduce its potential of being a health hazard.

Treatment Plant: Facility for cleaning and treating freshwater for drinking, or cleaning and treating wastewater before discharging into a water body.

Treatment: (1) Any method, technique, or process designed to remove solids and/or pollutants from solid waste, waste-streams, effluents, and air emissions. (2) Methods used to change the biological character or composition of any regulated medical waste so as to substantially reduce or eliminate its potential for causing disease.

Tributary: A lower order stream compared to a receiving waterbody. "Tributary to" indicates the largest stream into which the reported stream or tributary flows.

Trophic Level: The functional classification of organisms in an ecological community based on feeding relationships. The first trophic level includes green plants; the second trophic level includes herbivores; and so on.

TSS: Total Suspended Solids

Turbidity: The cloudy or muddy appearance of a naturally clear liquid caused by the suspension of particulate matter. It can be measured by the amount of light that is scattered or absorbed by a fluid.

Two-Dimensional Model (2-D): Mathematical model defined along two spatial coordinates where the water quality constituents are considered averaged over the third remaining spatial coordinate. Examples of 2-D models include descriptions of the variability of water quality properties along: (a) the length and width of a river that incorporates vertical averaging or (b) length and depth of a river that incorporates lateral averaging across the width of the waterbody.

U.S. Army Corps of Engineers (USACE): The United States Army Corps of Engineers, or USACE, is made up of some 34,600 civilian and 650 military men and women. The Corps' mission is to provide engineering services to the United States, including: Planning, designing, building and operating dams and other civil engineering projects ; Designing and managing the construction of military facilities for the Army and Air Force; and, Providing design and construction management support for other Defense and federal agencies

United States Environmental Protection Agency (USEPA): The Environmental Protection Agency (EPA or sometimes USEPA) is an agency of the United States federal government charged with protecting human health and with safeguarding the natural environment: air, water, and land. The USEPA began operation on December 2, 1970. It is led by its Administrator, who is appointed by the President of the United States. The USEPA is not a cabinet agency, but the Administrator is normally given cabinet rank.

U.S. Fish and Wildlife Service (USFWS): The United States Fish and Wildlife Service is a unit of the United States Department of the Interior that is dedicated to managing and preserving wildlife. It began as the U.S. Commission on Fish and Fisheries in the United States Department of Commerce and the Division of Economic Ornithology and Mammalogy in the United States Department of Agriculture and took its present form in 1939.

U.S. Geological Survey (USGS): The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

UAA: Use Attainability Analysis

ug/L: Microgram per liter – A measure of concentration

Ultraviolet Light (UV): Similar to light produced by the sun; produced in treatment processes by special lamps. As organisms are exposed to this light, they are damaged or killed.

ULURP: Uniform Land Use Review Procedure

Underground Storage Tanks (UST): Buried storage tank systems that store petroleum or hazardous substances that can harm the environment and human health if the USTs release their stored contents.

Uniform Land Use Review Procedure (ULURP): New York City program wherein a standardized program would be used to publicly review and approve applications affecting the land use of the city would be publicly reviewed. The program also includes mandated time frames within which application review must take place.

Unstratified: Indicates a vertically uniform or well-mixed condition in a waterbody. (See also Stratification)

URA: Spring Creek Urban Renewal Area

Urban Runoff: Storm water from city streets and adjacent domestic or commercial properties that carries pollutants of various kinds into the sewer systems and receiving waters.

Urban Runoff: Water containing pollutants like oil and grease from leaking cars and trucks; heavy metals from vehicle exhaust; soaps and grease removers; pesticides from gardens; domestic animal waste; and street debris, which washes into storm drains and enters receiving waters.

USA: Use and Standards Attainability Project

USACE: United States Army Corps of Engineers

Use and Standards Attainability Project (USA): A NYCDEP program that supplements existing Harbor water quality achievements. The program involves the development of a four-year, expanded, comprehensive plan (the Use and Standards Attainment or "USA" Project) that is to be directed towards increasing water quality improvements in 26 specific bodies of water located throughout the entire City. These waterbodies were selected by NYCDEP based on the City's drainage patterns and on New York State Department of Environmental Conservation (NYSDEC) waterbody classification standards.

Use Attainability Analysis (UAA): An evaluation that provides the scientific and economic basis for a determination that the designated use of a water body is not attainable based on one or more factors (physical, chemical, biological, and economic) proscribed in federal regulations.

Use Designations: Predominant uses each State determines appropriate for a particular estuary, region, or area within the class.

USEPA: United States Environmental Protection Agency

USFWS: U.S. Fish and Wildlife Service

USGS: United States Geological Survey

UST: underground storage tanks

UV: ultraviolet light

Validation (of a model): Process of determining how well the mathematical representation of the physical processes of the model code describes the actual system behavior.

Verification (of a model): Testing the accuracy and predictive capabilities of the calibrated model on a data set independent of the data set used for calibration.

Viewsheds: The major segments of the natural terrain which are visible above the natural vegetation from designated scenic viewpoints.

Virus: Submicroscopic pathogen consisting of a nucleic acid core surrounded by a protein coat. Requires a host in which to replicate (reproduce).

VSS: Total Volatile Suspended Solids

Wasteload Allocation (WLA): The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).

Wastewater Treatment Plant (WWTP): A facility that receives wastewaters (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewaters to less harmful byproducts; known by the acronyms, STP (sewage treatment plant), POTW (publicly owned treatment works), WPCP (water pollution control plant) and WWTP.

Wastewater Treatment: Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water in order to remove, reduce, or neutralize contaminants.

Wastewater: The used water and solids from a community (including used water from industrial processes) that flows to a treatment plant. Stormwater, surface water and groundwater infiltration also may be included in the wastewater that enters a wastewater treatment plant. The term sewage usually refers to household wastes, but this word is being replaced by the term wastewater.

Water Pollution Control Plant (WPCP): A facility that receives wastewaters (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewaters to less harmful byproducts; known by the acronyms, STP (sewage treatment plant), POTW (publicly owned treatment works), WWTP (wastewater treatment) and WPCP.

Water Pollution: The presence in water of enough harmful or objectionable material to damage water quality.

Water Quality Criteria: Levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water Quality Standard (WQS): State or federal law or regulation consisting of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an antidegradation policy and implementation procedures. Water quality standards protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. Water Quality Standards may include numerical or narrative criteria.

Water Quality: The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.

Water Quality-Based Limitations: Effluent limitations applied to discharges when mere technology-based limitations would cause violations of water quality standards.

Water Quality-Based Permit: A permit with an effluent limit more stringent than technology based standards. Such limits may be necessary to protect the designated uses of receiving waters (e.g., recreation, aquatic life protection).

Waterbody/Watershed (WB/WS) Facility Plan: A predecessor document to the LTCP defined by the Administrative Consent Order. A waterbody/watershed facility plan supports the long-term CSO control planning process by describing the status of implementation of the nine USEPA recommended elements of an LTCP and by providing the technical framework to complete facility planning.

Waterbody Inventory/Priority Waterbody List (WI/PWL): The WI/PWL incorporates monitoring data, information from state and local communities and public participation. The Waterbody Inventory portion refers to the listing of all waters, identified as specific individual waterbodies, within the state that are assessed. The Priority Waterbodies List is the subset of waters in the Waterbody Inventory that have documented water quality impacts, impairments or threats.

Waterbody Segmentation: Implementation of a more systematic approach to defining the bounds of individual waterbodies using waterbody type, stream classification, hydrologic drainage, waterbody length/size and homogeneity of land use and watershed character as criteria.

Waterfront Revitalization Program (WRP): New York City's principal coastal zone management tool. As originally adopted in 1982 and revised in 1999, it establishes the city's policies for development and use of the waterfront and provides the framework for evaluating the consistency of all discretionary actions in the coastal zone with those policies. When a proposed project is located within the coastal zone and it requires a local, state, or federal discretionary action, a determination of the project's consistency with the policies and intent of the WRP must be made before the project can move forward.

Watershed Approach: A coordinated framework for environmental management that focuses public and private efforts on the highest priority problems within hydrologically-defined geographic area taking into consideration both ground and surface water flow.

Watershed: A drainage area or basin that drains or flows toward a central collector such as a stream, river, estuary or bay: the watershed for a major river may encompass a number of smaller watersheds that ultimately combined at a common point.

Weir: (1) A wall or plate placed in an open channel to measure the flow of water. (2) A wall or obstruction used to control flow from settling tanks and clarifiers to ensure a uniform flow rate and avoid short-circuiting.

Wet Weather Flow: Hydraulic flow conditions within a combined sewer system resulting from a precipitation event. Flow within a combined sewer system under these conditions may include street runoff, domestic sewage, ground water infiltration, commercial and industrial wastewaters, and any other non-precipitation event related flows. In a separately sewered system, this type of flow could result from dry weather flow being combined with inflow.

Wet Weather Operating Plan (WWOP): Document required by a permit holder's SPDES permit that optimizes the plant's wet weather performance.

Wetlands: An area that is constantly or seasonally saturated by surface water or groundwater with vegetation adapted for life under those soil conditions, as in swamps, bogs, fens, marshes, and estuaries. Wetlands form an interface between terrestrial (land-based) and aquatic environments; include freshwater marshes around ponds and channels (rivers and streams), brackish and salt marshes.

WI/PWL: Waterbody Inventory/Priority Waterbody List

WLA: Waste Load Allocation

WPCP: Water Pollution Control Plant

WQS: Water Quality Standards

WRP: Waterfront Revitalization Program

WWOP: Wet Weather Operating Plan

WWTP: Wastewater Treatment Plant

Zooplankton: Free-floating or drifting animals with movements determined by the motion of the water.

26th Ward
Wastewater Treatment Plant
Wet Weather Operating Plan

Prepared by:
New York City Department of Environmental Protection
Bureau of Wastewater Treatment

July 2010

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

1.0 INTRODUCTION

The Nitrogen Administrative Order on Consent, DEC Case # CO2-20010131-7 (the "Order") entered into by the City of New York ("City") and the New York State Department of Environmental Conservation ("DEC") was effective as of April 22, 2002. This Order has been superseded by a Consent Judgment, Index No. 04-402174 (Supreme Court New York County, Feinman, J.) effective February 1, 2006 (the "Judgment"). Pursuant to Appendix A of the Order: "Jamaica Bay WPCPs Upgrade Schedule and Compliance Deadlines", the City submitted a Wet Weather Operating Plan ("WWOP") for the 26th Ward Wastewater Treatment Plant ("WWTP") on July 20, 2003. The WWOP describes procedures to maximize treatment during wet weather events while the 26th Ward WWTP is under construction. The WWOP

- specifies procedures for the operation of unit processes to treat maximum flows without materially diminishing effluent quality or destabilizing treatment upon return to dry weather operation;
- establishes process control procedures and set points to maintain stability and efficiency of Biological Nutrient Removal (BNR) Processes;
- specifies the treatment facilities that will be available at the plant during the construction period; and
- is based on operations of process units that are available during the construction period operated at the peak hydraulic loading rate.

The actual process control set points are established by the WWOP. This WWOP will be revised after completion of construction to reflect the operation of the fully upgraded Facility. This document contains the WWOP for the 26th Ward WWTP operation during construction.

1.1 BACKGROUND

The existing 26th Ward WWTP, located on a 57.3-acre site on Flatlands Avenue adjacent to Hendrix Creek in southeast Brooklyn (Figure 1-1) treats wastewater from a 6,000-acre service area that is almost exclusively served by combined sewers. The first sewers in the area were constructed in the late 1800's and more than half of the sewers were in place by the early 1900's. Starrett City, located west of the WWTP, and the Fresh Creek Mental Hygiene Center, located on the east of the WWTP are separately sewered. The entire system is a gravity flow system; there are no pumping stations located in the 26th Ward drainage area. The regulators for the service area are shown in Table 1-1.

Table 1-1. Regulators

Regulator #	Location	Type	Flow Compartment
01	Hendrix Street	Hydraulic	Sluice Gate (84"x 48")
02	Williams Avenue and Flatlands Avenue	Hydraulic	Sluice Gate (84"x 36")
02A	Hegeman Avenue and Louisiana Avenue	Diversion Chamber	Fixed Orifice
02B	Thatford Street and Linden Boulevard	Siphon	Fixed Orifice
3	Cresent Street and Flatlands Avenue	Hydraulic	Sluice Gate (60'x36")

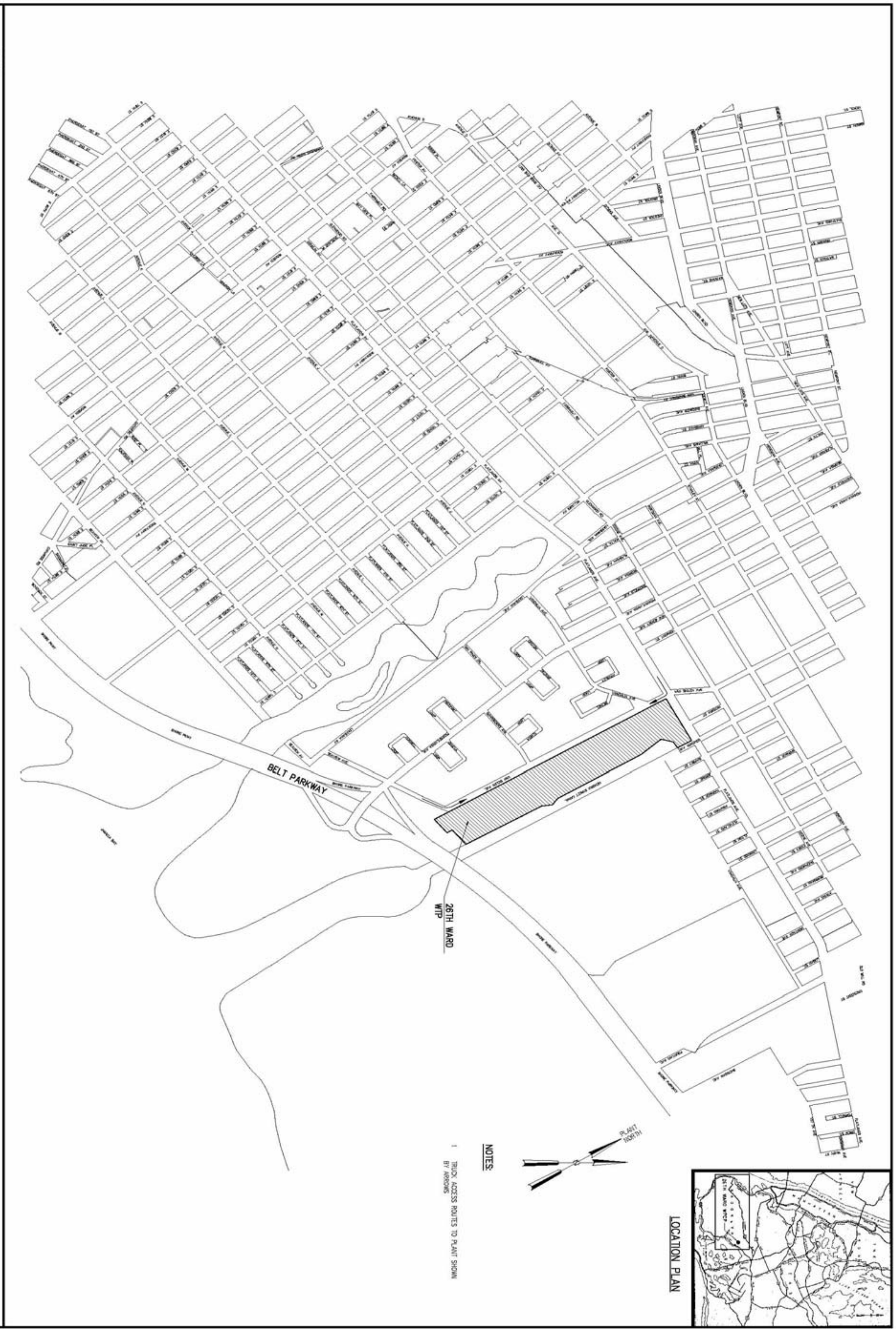


FIGURE 1-1: 26TH WARD WPCP
LOCATION MAP

HAZEN AND SAWYER
Environmental Engineers & Scientists
HAZEN AND SAWYER, P.C.
498 Seventh Avenue • New York, New York 10018

A number of sewage treatment facilities have existed at the 26th Ward site since the 1890s. The original activated sludge facility was constructed in 1949 with a design flow of 60 mgd. Expansions and modernization in the 1970s resulted in the 85 mgd facility in operation today. In 1992, regulations banning sludge dumping at sea resulted in the construction of a sludge dewatering facility. The current site layout for the plant is shown in Figure 1-2.

The 26th Ward WWTP is designed for 85 percent removal of suspended solids and Biochemical Oxygen Demand (BOD_5) utilizing the step aeration activated sludge process. The facility is designed to treat a peak design flow of 170 mgd (2 times design dry weather flow) through the plant headworks, primary treatment, and disinfection facilities and 127.5 mgd (1.5 times design dry weather flow) through the secondary treatment facilities.

At present, the 26th Ward WWTP is the only Jamaica Bay plant that has undergone the BNR retrofit. Pursuant to the Judgment, the 26th Ward WWTP is undergoing additional BNR upgrading.

Dry weather flows and regulated wet weather flows are conveyed to the 26th Ward WWTP's high level and low level wet wells. The low side receives flow from two interceptors:

- The 60-inch Flatlands Avenue interceptor, which serves the western portion of the drainage area and transports flow from Williams Avenue Regulator No. 2 just north of Fresh Creek, and
- The 60-inch diameter Vandalia Avenue interceptor serving the eastern section of the drainage area by conveying flow from the Autumn Avenue Regulator No. 3 just north of the Spring Creek Auxiliary WWTP.

The Spring Creek Auxiliary WWTP is an integral part of the 26th Ward WWTP's wet weather operations. The Spring Creek Facility is available to retain and return combined sewage in excess of 26th Ward's capacity. Wet weather flow in excess of 170 mgd is directed via the Autumn Avenue Regulator to the Spring Creek Auxiliary WWTP for capture and eventual return to the 26th Ward WWTP for treatment. If the storage capacity of the Spring Creek retention basins is exceeded, Combined Sewer Overflow ("CSO") is discharged from the Spring Creek facility to Jamaica Bay. The facility is currently being upgraded and is functional during the upgrade activities. A WWOP for the Spring Creek facility is attached to this WWOP as Appendix A.

Additional CSOs from the Flatlands Avenue Interceptor discharge into Fresh Creek where the floatables are captured and removed through a netting facility.

Following a rain event, the Autumn Avenue Interceptor also serves as a conduit for draining the stored wet weather flows from the Spring Creek Auxiliary WWTP back to the 26th Ward WWTP low level wet well.

The high level wet well receives flow only from the Hendrix Street Canal interceptor. This interceptor consists of two barrels, each 14'-0" W x 8'-4" H, and services the central portion of the 26th Ward drainage area. Regulator No. 1 located at the plant site near Hendrix

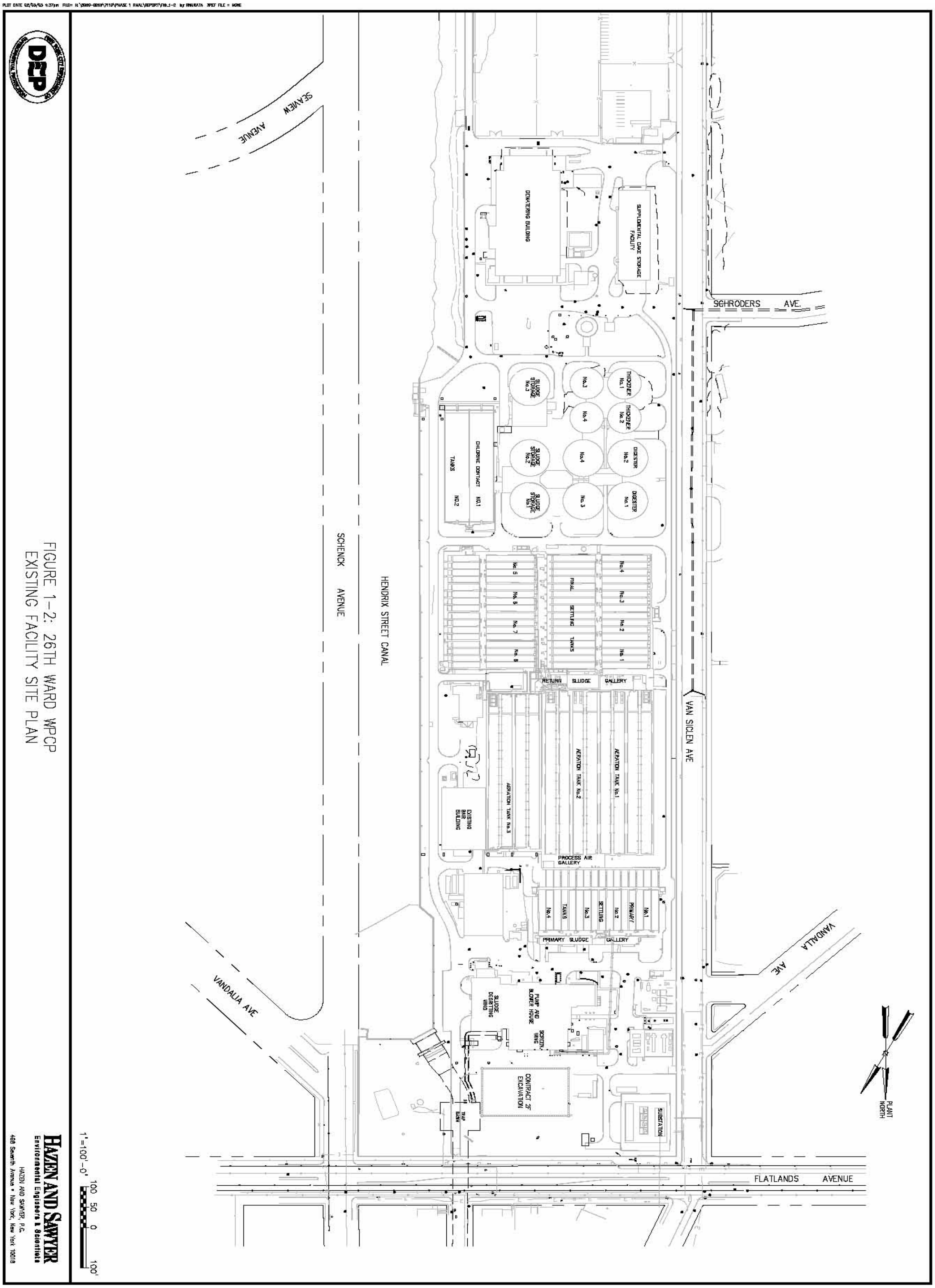


FIGURE 1-2: 26TH WARD WPCP
EXISTING FACILITY SITE PLAN

Street controls flow from the interceptor to the plant. CSOs from the Hendrix Street Regulator discharge directly into Hendrix Creek and combine with the WWTP effluent discharging to Jamaica Bay.

The plant operators are able to throttle influent flow to the 26th Ward WWTP at the three regulators. If the regulator throttling operation fails, the wet well sluice gates can be throttled to protect the wells from flooding.

The existing 26th Ward WWTP wet stream process includes preliminary screening, raw sewage pumping, preliminary settling and grit removal, step-feed activated sludge biological treatment, final settling and effluent chlorination. A process flow diagram is shown in Figure 1-3.

Flow from the high level and low level Main Sewage pumps combine in one Main Sewage Header. The combined influent flow mixes with the thickener overflow at the primary tank influent conduit. Grit and grease are removed in the primary settling tanks and flow is distributed to the aeration tanks. Return Activated Sludge is fed into the first pass of the aeration tanks and the primary tank effluent is fed to the remaining three passes. The plant has a total of three aeration tanks. Presently, two tanks (1 and 2) are in service to treat the plant influent. Aeration Tank #3 is nitrifying sludge dewatering centrate to reduce the effluent nitrogen. The aerator effluent from tanks 1 and 2 passes into eight final settling tanks, four East and four West. Effluent from Aeration Tank #3 is siphoned to the RAS channel. Final effluent from the settling tanks combines in a common channel feeding two chlorine contact tanks where the effluent is disinfected with Sodium Hypochlorite prior to discharge to Hendrix Canal. Activated sludge is wasted from the RAS discharge line and the aerator effluent channel. The Waste Activated Sludge is combined with the primary sludge in the mixed sludge well and pumped to gravity thickeners. Sludge from the thickeners is anaerobically digested and then dewatered on-site.

1.2 EFFLUENT PERMIT LIMITS

The 26th Ward WWTP is currently operating under SPDES permit No. 0026212. The plant is one of four facilities in the Jamaica Bay drainage area that are under an aggregate total nitrogen limit. The current permit requires the plant to remove 85% of CBOD and Suspended Solids and all four Jamaica Bay ("JB") WWTP's to meet a combined effluent total nitrogen limit aggregate of 45,300 lbs/day. The 26th Ward WWTP is the only one of the four Jamaica Bay WWTPs that is capable of operating in a Biological Nitrogen Removal ("BNR") mode.

As of June 1st, 2010, the BNR upgrade phase of the construction at the 26th Ward WWTP is complete and the plant is operating under full BNR mode. Pursuant to the October 7, 2009 stipulation to the Judgment ("Jamaica Bay Stipulation"), the interim nitrogen limit for Jamaica Bay stepped down to 41,600 pounds per day of TN as of November 2009.

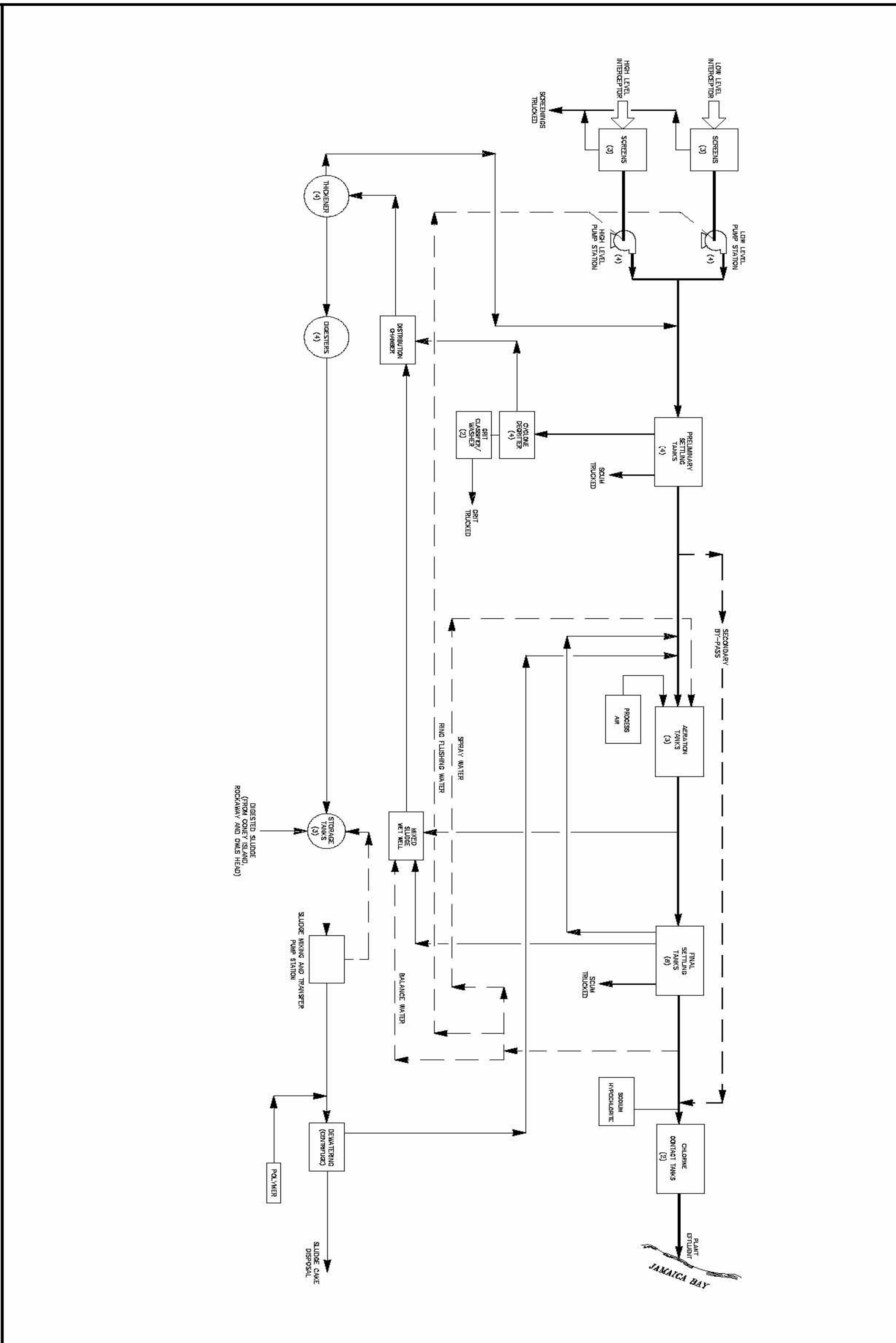


FIGURE 1-3: 26TH WARD WPCP
EXISTING FACILITY PROCESS FLOW DIAGRAM

HAZEN AND SAWYER
Environmental Engineers & Scientists
HAZEN AND SAWYER, P.C.
498 Seventh Avenue • New York, New York 10018

1.3 PERFORMANCE GOALS FOR WET WEATHER EVENTS

Procedures will be established at 26th Ward that will:

- Maximize flows to the plant as early as possible to prevent overflows at the collection system regulators,
- Maximize the amount of flow captured at the Spring Creek Auxiliary WWTP,
- Maintain stable operation and maximize removals during wet weather events,
- Reduce solids losses in the secondary system to allow for a stable recovery back to dry weather operations following a wet weather event.

1.4 PURPOSE OF THIS MANUAL

The purpose of this manual is to provide a set of operating guidelines to assist the 26th Ward operating staff in making operational decisions that will best meet the performance goals stated in Section 1.3 and the requirements of the NPDES discharge permit.

1.5 USING THIS MANUAL

Section 2 of this manual is designed to be used a quick reference tool for wet weather events during the 26th Ward upgrade construction. This manual is divided into sections that cover major unit processes at 26th Ward. Each section includes the following information:

- A list of unit processes and equipment covered in the section
- Steps to take before a wet weather event and who is responsible for these steps
- Steps to take during a wet weather event and who is responsible for these steps
- Steps to take after a wet weather event and who is responsible for these steps
- Discussion of reasons for performing the recommended steps
- Identification of the specific conditions or circumstances that trigger the recommended steps
- Identification of potential problems

Section 3, Planned Plant Upgrades, identifies the major improvements as part of the plant upgrade. Since the final design of these facilities is not yet complete, detailed operating protocols are not presented.

1.6 REVISIONS TO THIS MANUAL

This manual is a living document. Users of the manual are encouraged to identify new steps, procedures and recommendations to add to the descriptions contained herein. Modifications that improve upon the manual's procedures are also encouraged. With continued input from all users of the manual, it will become an even more useful and effective tool.

In addition to the revisions based on plant operating experience, this manual will be revised as upgrade work is completed that affects the plants ability to treat wet weather flows. The 26th Ward WWTP is currently undergoing an upgrade pursuant to the Judgment. As required by the Judgment, a revised WWOP, including specific procedures based on actual operating experience of the upgraded WWTP will be submitted 18 months after the completion of the construction.

2.0 EXISTING FACILITY WET WEATHER OPERATION PROCEDURES AND GUIDELINES

This section presents reduced flow capacities, equipment summaries and wet weather operating procedures for each major unit operation of the plant. The procedures are divided into steps to be followed before, during and after a wet weather event. Also included are the bases for the procedures, events that trigger the procedures and a description of potential problems. Figures 2-1, 2-2 and 2-3 summarize the procedures for before, during and after wet weather events. For a detailed summary of procedures for each major unit operation refer to the following sections.

2.1 REDUCED PLANT FLOWS

During the upgrade construction at the 26th Ward WWTP, a number of unit processes will be unavailable for service. Unavailability of these unit processes will reduce the flow to the plant or the flow through the secondary treatment system. Table 2-1 below lists the unit process equipment that will be available for service during construction and the corresponding maximum hydraulic capacity associated with the equipment.

Table 2-1. Maximum Hydraulic Capacities for Equipment in Service[1,2]

Process Equipment	Number of Units in Service		Minimum Plant Influent Flow	Minimum Secondary Treatment Flow
Screens	**Hi-Level**	**Low Level**		
	1	3	170.0 mgd	
	0	3	127.5 mgd	
	0	2	85.0 mgd	
Main Sewage Pumps	**Hi-Level**	**Low Level**		
	2	3	170.0 mgd	
	1	3	145.0 mgd	
	0	3	120.0 mgd	
			160.0 mgd with contractor pumps and spare discharge line pumping directly to the Primary Settling Tank	
	0	2 (#4 I/S)	85.0	
			125.0 mgd with contractor pumps and spare discharge line	
	0	2 (#4 O/S)	70.0 mgd	
			110.0 mgd with contractor pumps and spare discharge line	
Primary Settling Tanks	3		127.5 mgd	
	2		85.0 mgd	
Aeration Tanks	2		170.0 mgd	127.5 mgd

Table 2-1. Maximum Hydraulic Capacities for Equipment in Service[1,2]

Process Equipment	Number of Units in Service	Minimum Plant Influent Flow	Minimum Secondary Treatment Flow
	1	111.8 mgd[1]	63.8 mgd
Final Settling Tanks	7	170.0 mgd	127.5 mgd
	6	157.3 mgd	109.3 mgd
	5	139.0 mgd	91.0 mgd
	4	121.0 mgd	73.0 mgd
Chlorine Contact Tanks	1	85.0 mgd	

[1]The maximum capacity of the secondary system bypass is 48mgd.
[2]The maximum Secondary Treatment flow may be less than the hydraulic maximum to prevent loss of nitrification from biomass washout.

INFLUENT SCREENING

- Wet Well Separation Sluice gate is open.
- One Bar Screen at each wet well in Service(two screens total) set to operate on time and level differential level.
- Monitor Screens Operation and flow through the Screen channels.
- Confirm additional 6-yard containers are available.

MAIN SEWAGE PUMPING

- Maintain the Low-Level wet well level between elevation -11 and -14.
- High Level Flow goes to Low Level Wet Well.
- Low Level Operates 1-2 Pumps.
- Monitor Wet Well Levels.
- Confirm Additional Pumps are available.

PRELIMINARY SETTLING TANKS

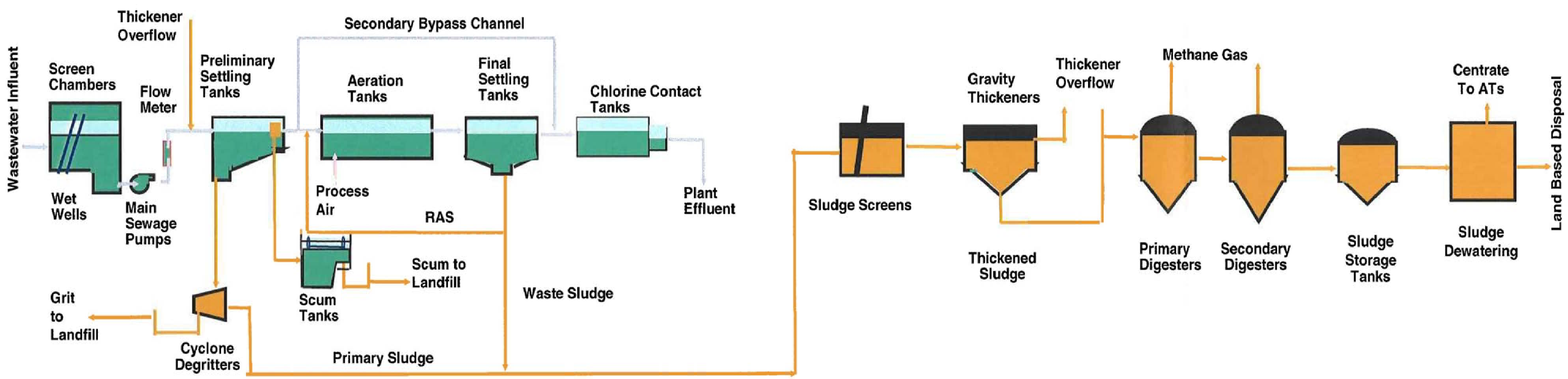
- All Preliminary Settling Tanks in service.
- Ensure that sludge pumps are working.
- Check Operation of Sludge Collectors.
- Repair any equipment out of service

GRIT REMOVAL

- Two Grit Cyclones and one Classifier in Operation
- Verify that empty grit containers are available. If not, contact the MVO to bring empties and remove full containers.
- Monitor the output from the cyclones to the classifiers. Clear any blockages in the cyclones.
- Repair any equipment failures.

SECONDARY BYPASS CHANNEL

- Verify that the magmeter has been calibrated.
- If flows greater than 127 mgd are to be bypassed, set the controller to Automatic.



AERATION TANKS

- All Aeration Tanks in service.
- Current normal operation is to feed primary effluent to Aeration Tanks 1 and 2 at 33% to passes B, C and D. Aeration tank #3 is operated to treat centrate with the effluent fed to the RAS for Aeration Tanks 1 and 2.
- With Aeration Tank #3 treating centrate when any Aeration Tank (1,2, or 3) is removed from service for construction, the remaining two tanks must be switched to treat primary effluent with centrate being fed to the plant drain.

FINAL SETTLING TANKS

- All Final Settling Tanks in Service.
- Observe effluent quality.
- Check RAS lifts for proper flow.
- Check RAS pumps in service for proper operation.
- Check tank collectors for proper operation.

EFFLUENT DISINFECTION

- Chlorine residual is checked every hour.
- Check operation of Sodium Hypochlorite feed pump.
- Check Hendrix Creek for foam. If necessary, increase the defoamant addition.

SLUDGE HANDLING

- .3 out of 4 thickeners in service.
- 3 out of 4 primary digesters, 1 secondary digester and 2 storage tanks in service.
- Normal Dewatering Operation is seven days/week. The number of centrifuges in service can vary from 4-10 depending on demand.

Figure 2-1 Operating Procedures Before Wet Weather Event at the 26th Ward WPCP

Hazen and Sawyer

INFLUENT SCREENING

- The Wet Well Separation Gate remains open and the Low Level well fills and backs into the Hi level wet well
- One Hi level bar screen and three Low Level bar screens in service(four screens total) set to operate on differential level.
- Monitor Screen Operation and flow through the Screen channels.

MAIN SEWAGE PUMPING

- Maintain the Hi Level wet well at elevation between – 8.0 and –6.0. The Low Level wet well remains flooded.
- High Level Operates 1 Pumps.
- Low Level Operates 3 Pumps.
- Monitor Wet Well Levels.
- Confirm Additional Pumps are available.

PRELIMINARY SETTLING TANKS

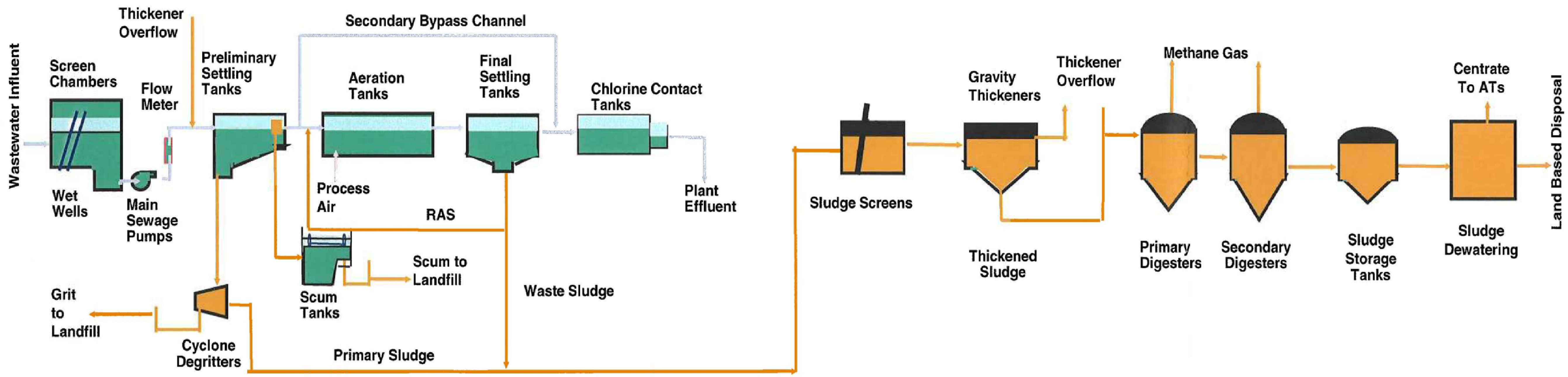
- Check the level of the Preliminary Settling Tanks influent channel.
- Ensure that sludge pumps are working. Switch pumps as necessary
- If a tank sludge collector fails remove the tank from service.

GRIT REMOVAL

- If a grit cyclone clogs, open the sludge crossover valve and place another cyclone and the second grit classifier in operation.
- Using the tow motor, shift full containers out from under the grit hopper and replace with empties.
- If all containers are full, close the grit hopper discharge gate and let the hopper fill.

SECONDARY BYPASS CHANNEL

- If the bypass controller is in automatic, verify that the valve has opened at the proper flow.
- If the bypass controller is in manual, set the valve opening and verify the proper bypass flow.



AERATION TANKS

- All Aeration Tanks in service.
- Current normal operation is to feed primary effluent to Aeration tanks 1and 2 at 33% to passes B, C and D. Aeration tank #3 is operated to treat centrate with the effluent fed to the RAS of Aeration Tanks 1 and 2.
- With Aeration Tank #3 treating centrate when any Aeration Tank (1,2, or 3) is removed from service for construction, the remaining two tanks must be switched to treat primary effluent with centrate being fed to the plant influent.

FINAL SETTLING TANKS

- Check the effluent quality. Notify the supervisor if solids are washing over the weirs.
- Check RAS lifts for proper flow.
- Check RAS pumps in service for proper operation.
- Check tank collectors for proper operation. If a collector shears a pin, a chain breaks or comes off the sprocket, close the influent gates to isolate the tanks.

EFFLUENT DISINFECTION

- Adjust the chlorine dose and flow increases. When notified by the SEE that a fourth Main Sewage Pump will be started, increase the chlorine dose in anticipation of bypassed flow.
- Chlorine residual checked every hour unless outside target range.

SLUDGE HANDLING

- No changes are made to the thickening operation during wet weather.
- No changes are made to the digestion operation during wet weather.
- No changes are made to the dewatering operation during wet weather.

Figure 2-2 Operating Procedures During
Wet Weather Event at the 26th Ward WPCP

Hazen and Sawyer

INFLUENT SCREENING

- If the chamber inlet gates are controlling flow, when the influent flow is reduced return them to the fully open position.
- Contact the MVO to remove the full containers and replace them with empties.

MAIN SEWAGE PUMPING

- If the chamber influent gates have been throttled, maintain the maximum pumping rate until the gates are fully open and the wet well levels start to fall.
- Reduce the pump operating steps as the wet well levels fall.
- As the wet-well levels fall below el. – 9.0 secure the High Level Pumps in service.

PRELIMINARY SETTLING TANKS

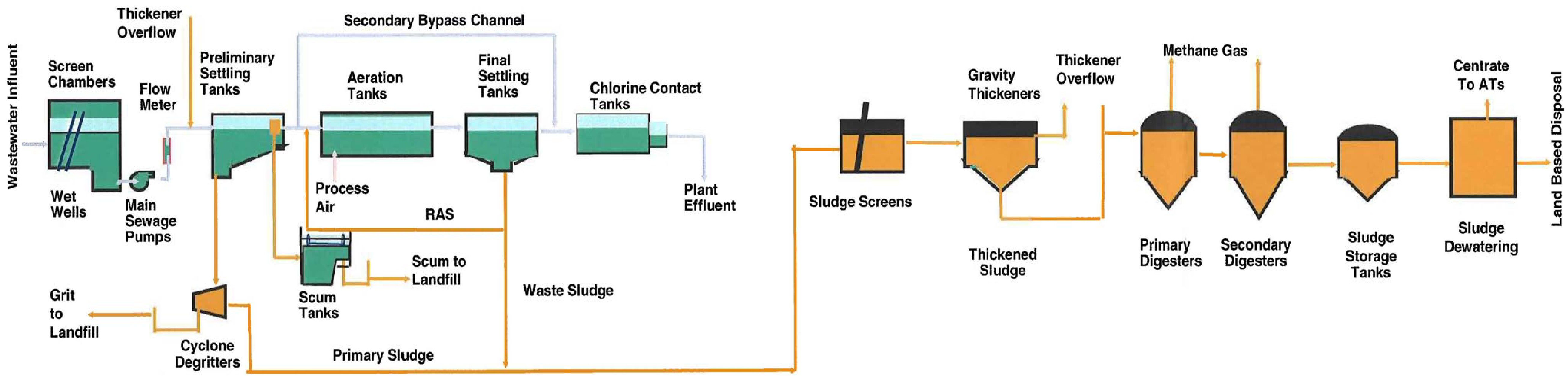
- Remove scum from the primary tanks and change full scum containers using the tow motors.
- Check tank collectors for normal operation. Notify supervisor of sheared pins or chain broken or off the sprocket.
- Contact the MVO to remove the full containers and replace with empties.
- Repair broken equipment.

GRIT REMOVAL

- Shovel grit that has overflowed onto the floor into an empty container.
- Contact the MVO to bring empties and remove full containers.
- Clear any clogged cyclones.
- Repair any equipment failures.

SECONDARY BYPASS CHANNEL

- Verify that the bypass valve closes at the proper flow. If the valve fails open, close it manually.
- Repair any broken equipment.



AERATION TANKS

- Aeration tank primary effluent feed settings remain the same.
- Adjust the sludge wasting rates based on the aeration tank inventory loss during the storm.

FINAL SETTLING TANKS

- Repair any broken equipment.
- If the grease load on the tanks is heavy, drop the scum collectors and remove the grease.
- Check tank collectors for proper operation.

EFFLUENT DISINFECTION

- As flow decreases, reduce the chlorine dose.
- **Return to normal residual check; every hour during all shifts while within target range.**
- Check operation of Sodium Hypochlorite feed pump.

SLUDGE HANDLING

- The thickened sludge pumping may require adjustment due to a reduction in wasting following the wet weather event.
- Normal digestion operation.
- Normal Dewatering Operation.

Figure 2-3 Operating Procedures After Wet Weather Event at the 26th Ward WPCP

Hazen and Sawyer

2.2 REGULATORS

2.2.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Autumn Avenue Regulator	1- 5'x3' Sluice Gate 3 - Ultrasonic Meters: 1 – Diversion Meter 1 – Regulated Meter 1 – Bench Meter
Williams Avenue Regulator	1 - 4'x3' Sluice Gate 3 - Ultrasonic Meters: 1 – Diversion Meter 1 – Regulated Meter 1 – Tide Meter
Hendrix Street Regulator	1 - 7'x4' Sluice Gate 4 - Ultrasonic Meters: 1 – Diversion Meter 1 – Regulated Meter 1 – Bench Meter 1 – Tide Meter

2.2.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE*	SSTW/STW**	• All three regulators are fully open.
During Wet Weather Event		
SEE	SSTW/STW	• The upstream and downstream flow and the overflow level of the regulators and the tide level information are gathered via a phone modem line. If the modem line is not available: • During the 7-3 shift, contact Collection Facilities Systems South via phone or radio and have them place the regulator in manual control, fully opened. Then control of the flow is operated by plant personnel via the Influent Plant Sluice Gates. During off hours, adjust the chamber influent sluice gates (See Section 2.3). • As the wet well levels in the plant increase, the regulators are manually throttled until closed in the following order: 1) Autumn Avenue 2) Williams Avenue 3) Hendrix Street
After Wet Weather Event		
SEE	SSTW/STW	• As flow to the plant falls the regulators are opened fully in the following order: 1) Hendrix Street 2) Williams Avenue 3) Autumn Avenue
Why Do We Do This?		

• To prevent flooding of the Hi-Level and Low Level wet wells. • To minimize the amount of wet weather flow that is discharged untreated. The Autumn Avenue Regulator (26th Ward Regulator 3) overflows to the Spring Creek Auxiliary WWTP where it is captured for return to 26th Ward. The Williams Avenue Regulator (26th Ward Regulator 2) overflows to Fresh Creek where floatables removal is performed. The Hendrix Street Regulator (26th Ward Regulator 1) overflows to Hendrix Creek where floatables are captured by a boom structure.
What Triggers The Change?
The flow to the plant has reached the maximum capacity and the wet wells are filling.
What Can Go Wrong?
The regulator can fail open resulting in wet well flooding. The modem line can fail resulting in loss of control of the regulators

* SEE is the abbreviation for Stationary Engineer Electric
**SSTW/STW is the abbreviation for Senior Sewage Treatment Worker / Sewage Treatment Worker

2.3 INFLUENT SCREENING

2.3.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Hi Level Screens/Wet Well	1 - Chamber Influent and Channel Influent Sluice Gate (Auto) 1 - Chamber Influent Sluice Gate (Auto) 2 - Channel Influent Sluice Gates (Manual) 3 - Channel Outlet Sluice Gates (Manual) 3 - Bar Screens 2 - Belt Conveyor 1 - Wet Well Separation Gate Sluice Gate (Auto) 3 - 6 cubic-yard containers on dollies
Low Level Screens/Wet Well	1 - Chamber Influent and Channel Influent Sluice Gate (Auto) 1 - Chamber Influent Sluice Gate (Auto) 2 - Channel Influent Sluice Gates (Manual) 3 - Channel Outlet Sluice Gates (Manual) 3 - Bar Screens 2 - Belt Conveyor 3 - 6 cubic yard containers on dollies

2.3.2 Wet Weather Operating Procedures High Level Wet Well

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• The Wet Well Separation Sluice gate is open. One High Level screen channel is open with the flow from the High Level wet well entering the Low Level wet well. • The bar screen mechanism is set for both time and level differential. • Visually inspect screen to confirm proper operation. • Visually monitor the flow through the screen channel. • Visually inspect the 6-yard container. If the container is full, use the tow motor to switch containers. • Confirm that additional empty 6-yard containers are available.

During Wet Weather Event		
SEE	SSTW/STW	• The High Level and Low Level wet well are allowed to rise. The Low Level wet well alarm at el. –10.0 will sound. The High Level wet-well will be maintained between el. –6.0 and –8.0.The High Level wet well alarm will sound at el. –6.0. One High Level screen remains in service. • If a High Level Pump must be primed, allow the wet well to rise to el. –4.0. The High Level wet well alarm will sound. After priming the pump, reduce the wet well level below el. –6.0. • If the regulator control fails or if the regulators are not closed fast enough, maintain the screen channel level by adjusting the chamber inlet sluice gate. • Visually monitor the screen channel flow. If the channel level is rising put a second screen in service. • Visually confirm that the screen channels are not approaching the overflow level. • If screen blinding occurs, place a second screen in service and close the channel influent sluice gate until the screen clears. • If the screening conveyor fails, open the screen chute to the 1.5 cubic yard containers. Use the forklift to empty the 1.5 cubic yard containers into the 6-cubic yard containers.
After Wet Weather Event		
SEE	SSTW/STW	• The Wet-Well Separation Sluice Gate remains open. If more than one High Level screen is in service secure the additional screens so that only one High Level screen remains in service. • If the chamber inlet sluice gates are controlling flow, return them to the fully open position. • Contact the MVO to remove full containers and replace with empties.
Why Do We Do This?		
• To protect the Main Sewage Pumps from damage by large objects. • To allow the plant to pump the maximum flow through the preliminary treatment tanks without flooding the High Level wet well and the High Level screen channels.		
What Triggers The Change?		
• An increase in wet well level due to an increase in flow to the WWTP. • Flooding of the bar screen channels. • Regulator control failure.		
What Can Go Wrong?		
Screen failure, screen blinding, screen channel flooding. Screenings conveyor failure. Screenings overflowing the containers. Influent gate failures. Both wet wells can flood at el-3.0 with the sewage overflowing from the High Level wet well.		

2.3.3 Wet Weather Operating Procedures Low Level Wet Well

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• One Low Level screen channels is in service. The Low Level wet well is operated in the range of el –11.0 to –14.0. • The bar screen mechanism is set for both time and level differential. • Visually inspect the screen to confirm proper operation. • Visually inspect the 6-yard container. If the container is full, use the tow motor to switch containers. • Confirm that additional empty 6-yard containers are available.
During Wet Weather Event		
SEE	SSTW/STW	• Allow the Low Level wet well to fill and back into the High Level wet well. • The High Level and Low Level wet well are allowed to rise. The Low Level wet well alarm at el. –10.0 will sound. The High Level wet well will be maintained between el. –6.0 and –8.0. The High Level wet well alarm will sound at el. –6.0. As the wet well levels rise put additional Low Level screens in service. • If the regulator control fails or the regulators are not closed fast enough, maintain the screen channel level by adjusting the chamber inlet sluice gate. • If screen blinding occurs, place a second screen in service and close the channel influent sluice gate until the screen clears. If all Low Level screens are in service, place a second High Level screen in service. • If the screening conveyor fails, open the screen chute to the 1.5 cubic yard containers. Use the forklift to empty the 1.5 cubic yard containers into the 6-cubic yard containers.
After Wet Weather Event		
SEE	SSTW/STW	• As the wet well levels return to normal, the additional screens are removed from service until only one Low Level screen is operating • If the chamber inlet sluice gates are controlling flow, return them to the fully open position. • Contact the MVO to remove full containers and replace with empties.

Why Do We Do This?
• To protect the Main Sewage Pumps from damage by large objects. • To allow the plant to pump the maximum flow through the preliminary treatment tanks without flooding the wet wells or the Low Level bar screen channels.
What Triggers The Change?
• An increase in wet well level due to an increase in flow to the WWTP. • Flooding of the bar screen channels. • Regulator control failure.
What Can Go Wrong?
Screen failure, screen blinding, screen channel flooding. Screenings conveyor failure. Screenings overflowing the containers. Influent gate failures. Both wet wells can flood with the sewage overflowing from the high level wet well.

2.4 INFLUENT WASTEWATER PUMPING

2.4.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Hi Level Main Sewage Pumps	3 - 36-inch Gate Valves (Manual) 3 - Check Valves (Auto) 3 - Main Sewage Pumps 1 - Wet Well Separation Sluice Gate (Auto)
Low Level Main Sewage Pumps	3 - 36-inch Gate Valves (Manual) 3 - Check Valves (Auto) 3 - Main Sewage Pumps 1 - 78-inch Venturi Combined Discharge Flow Meter

2.4.2 Wet Weather Operating Procedures Hi Level Main Sewage Pumps

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• The Wet Well Separation Sluice Gate is open. One screen channel is open with the flow from the High Level wet well entering the Low Level wet well. • Confirm the additional High Level Main Sewage Pumps are available for service. • Monitor both wet well elevations

During Wet Weather Event		
SEE	SSTW/STW	• The Wet Well Separation Gate is temporarily closed to prime one High Level pump. The gate is re-opened and the High Level and Low Level wet wells are allowed to rise. • The Low Level wet well alarm at el. –10.0 will sound. The High Level wet-well will be maintained between el. –6.0 and –8.0. The High Level wet well alarm will sound at el. –6.0. • One High Level Main Sewage Pump is in service. If a Low Level Main Sewage Pump will not start, place a second High Level Main Sewage Pump in service. A total of four Main Sewage Pumps are required to pump 170 mgd. If less then four pumps are available, place the temporary discharge line pumps in service (contractor pumps). These two pumps can discharge a maximum of 40 mgd. • Adjust the operating step of the Main Sewage Pumps based on wet well levels. • Whenever major equipment (i.e. screens, primary tanks, final settling tanks) is out of service pump to the maximum plant influent flow listed in Table 2-1 "Maximum Hydraulic Capacities with Equipment out of Service".
After Wet Weather Event		
SEE	SSTW/STW	• If the chamber influent gates have been throttled, maintain the maximum pumping rate until the gates are fully open and the wet well levels start to fall. • Reduce the pump operating steps as the wet well levels fall. • As the wet-well levels fall below el. –9.0 secure the High Level Pumps in service.
Why Do We Do This?		
• To allow the plant to pump the maximum flow through the preliminary treatment tanks without flooding the wet wells or the High Level bar screen channels. • To minimize the need for flow storage in the collection system and reduce the combined sewer overflows to Jamaica Bay.		
What Triggers The Change?		
An increase in wet well level due to an increase in flow to the WWTP.		
What Can Go Wrong?		
Main Sewage Pump failure on start-up or while operating. Screen blinding requiring adjustment of the pump operating step until an additional screen is put in service.		

2.4.3 Wet Weather Operating Procedures Low Level Main Sewage Pumps

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
	SSTW/STW	• The Wet Well Separation Sluice Gate is open with the flow from the High Level wet well entering the Low Level wet well. • One Low Level screen channel is open. • Depending on the time of day, one or two Low Level Main Sewage pumps will be in service. • Confirm that additional Low Level Main Sewage Pumps are available for service. • Monitor both wet well elevations. • Adjust the pump step to maintain the Low Level wet well elevation between –14 and –11.

During Wet Weather Event		
SEE	SSTW/STW	• As the wet well levels raise the Low Level wet well alarm at el. –10.0 will sound. The High Level wet well will be maintained between el. –6.0 and –8.0. The High Level wet well alarm will sound at el. –6.0. The Low Level wet well will remain flooded during the wet weather event. • Notify the chlorination station operator prior to placing a fourth main sewage pump in service. • As the wet well levels rise, adjust the operating step of the pumps in service. If the operating pump steps are maximized, place additional Low Level pumps in service. At 170 mgd, there should be three Low Level and one High Level pumps in service. • If a Low Level Main Sewage Pump will not start, place a second High Level Main Sewage Pump in service. A total of five Main Sewage Pumps are required to pump 170 mgd. If less than five pumps are available, place the temporary discharge line pumps in service (contractors pumps). These two pumps can discharge a maximum of 40 mgd. • Adjust the operating step of the Main Sewage Pumps based on wet well levels. • Whenever major equipment (i.e. screens, primary tanks, final settling tanks) is out of service pump to the maximum plant influent flow listed in Table 2-1 “Maximum Hydraulic Capacities with Equipment out of Service”.

After Wet Weather Event		
SEE	SSTW/STW	• If the chamber influent gates have been throttled, maintain the maximum pumping rate until the gates are fully open and the wet well levels start to fall. • Reduce the pump operating steps as the wet well levels fall. • As the wet-well levels fall below el. –14.0 secure the additional Low Level pumps.
Why Do We Do This?		
• To allow the plant to pump the maximum flow through the preliminary treatment tanks without flooding the wet wells or the Low Level bar screen channels. • To minimize the need for flow storage in the collection system and reduce the combined sewer overflows to Jamaica Bay.		
What Triggers The Change?		
• An increase in wet well level due to an increase in flow to the WWTP.		
What Can Go Wrong?		
Main Sewage Pump failure on start-up or while operating. Screen blinding requiring adjustment of the pump operating step until an additional screen is put in service.		

2.5 PRIMARY SETTLING TANKS

2.5.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Primary Settling Tanks	1 - 78-inch Raw Sewage Force Main 1 - 36-inch Thickener Overflow Line 4 - 167'long x 67' wide x 12' deep Primary Settling Tanks 32 - Influent 2'x2' Sluice Gates (8 per PST) 16 - Chain and Flight Collectors (4 per PST) 4 - Sludge Trough Cross-Collector (1 per PST) 16 – Scum Collectors (4 per PST) 4 - 12"x12" Drain Sluice Gates 6 - 450/250 gpm Primary Sludge Pumps 2 – Scum Pits 2 – Clamshells for scum removal from the scum pits 2 – 6 cubic yard containers on dollies

2.5.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• All primary tanks are in service during normal operation. • Skim grease from the tank and remove it from the scum pits into the containers. • Ensure that sludge pumps are working. • Check operation of the collectors. • Repair any equipment out of service.
During Wet Weather Event		
SEE	SSTW/STW	• Whenever a Primary Settling Tank is out of service the maximum plant influent and secondary treatment flows shall be according to the capacities noted in Table 2.1 "Maximum Hydraulic Capacities with Equipment out of Service". • Check the level of the Primary Tank influent channel. Notify the supervisor if the channel is near flooding so the influent flow can be reduced. • Check the effluent weirs, if flooding is occurring notify supervisor. • Check the sludge pumps for proper operation. Switch pumps in service as necessary. If the sludge pump suction line appears clogged shut the pump and back flush through the pump from the discharge of a second pump. • If the vertical sludge line to the grit cyclones clogs, switch the valves to pump through the second line. • If the tank cross collector fails, remove the tank from service.
After Wet Weather Event		
SEE	SSTW/STW	• Check tank collectors for normal operation. Notify the supervisor of sheared pins or chain broken or off the sprocket. • Repair broken equipment. • Remove scum from the Primary Tanks and change full scum containers using the tow motors. • Contact the MVO to remove full containers and replace with empties.
Why Do We Do This?		
• To maximize the amount of flow that receives primary treatment. • To protect downstream processes from abnormal wear due to grit abrasion. • Prevent grit and grease accumulation in the aeration tanks.		
What Triggers The Change?		
An increase in flow to the primary settling tanks.		
What Can Go Wrong?		
Broken shear pins, broken or slipped collector chains. Plugged sludge pump suction and discharge line. Grease carryover to the aeration tanks.		

2.6 GRIT REMOVAL

2.6.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Grit Removal	4 - 24” Cyclone Sludge Degritters 2 - 15’ long x 4 ‘ wide Grit Classifiers 2 -Grit Storage Hoppers 2 – Grit Hopper discharge gates 3 - 6 cubic yard Grit Containers on dollies.

2.6.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Two grit cyclones feeding one grit classifier is the normal operation. • Verify that empty grit containers are available. If not, contact the MVO to bring empties and remove full containers. • Monitor the output from the cyclones to the classifiers. Clear any blockages in the cyclones. • Repair any equipment failures.
During Wet Weather Event		
SEE	SSTW/STW	• Check the cyclones and classifiers for proper operation. • If a cyclone clogs, open the primary sludge crossover line to the other cyclones and put another cyclone and classifier in service. • Using the tow motor, shift full containers out from under the grit hopper and replace with empties. Contact the MVO to bring empties and remove full containers. • If all containers are full close the grit hopper discharge gate and let the hopper fill.
After Wet Weather Event		
SEE	SSTW/STW	• Shovel grit that has overflowed onto the floor back into the container. • Clear clogged cyclones. • Replace all full containers with empties. • Repair broken equipment.
Why Do We Do This?		
To protect the downstream equipment from abnormal wear and to prevent accumulation of grit in the aeration tanks.		
What Triggers The Change?		
Increased grit load in the primary settling tanks due to increased flows and first flush of the collection system.		
What Can Go Wrong?		
Grit cyclones can clog. Grit classifier failure. Grit hopper discharge gate fails in the open position. Grit container overflows onto the floor.		

2.7 SECONDARY SYSTEM BYPASS

2.7.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Secondary Bypass System	1 – 36 "Automatic Control Valve 1 – 36" Magmeter 1 - Flow controller

2.7.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	Instrumentation Technician	• Verify that the magmeter has been calibrated. • If flows above 127 mgd are to be bypassed, set the controller for Automatic. • The secondary system bypass shall be set according to the capacities noted in Table 2-1 "Maximum Hydraulic Capacities with Equipment out of Service" whenever one aeration tank and/or two or more final settling tanks are out of service.
During Wet Weather Event		
SEE	SSTW/STW	• If the bypass controller is in automatic, verify that the valve opens when the flow is greater than the bypass setting. • If the bypass controller is in manual, set the valve opening and verify the correct bypass flow. • If the magmeters fails, set the valve opening based on the amount of flow to be bypassed. For example, an 80% open valve will bypass 43 mgd.
After Wet Weather Event		
SEE	SSTW/STW	• Verify that the bypass valve closes at the proper flow. If the valve fails open, manually close. • Repair any failed equipment.
Why Do We Do This?		
• To prevent secondary system failure due to hydraulic overload. • To maximize the flow that receives primary and secondary treatment without causing hydraulic failure. • To maximize the flow that receives primary treatment and chlorination. This prevents secondary system failure due to hydraulic overload.		
What Triggers The Change?		
Influent flows are higher than the hydraulic maximum that can be treated through the secondary system.		
What Can Go Wrong?		
Bypass fails closed causing hydraulic overload of the secondary system. Bypass fails open resulting in too much flow being bypassed. Magmeter fails resulting in estimation of bypass flow. Magmeter is not calibrated causing incorrect bypass flow.		

2.8 AERATION TANKS

2.8.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Aeration Tanks	3 – 4 pass aeration tanks Influent channels 15 - Manual Step Feed Gates Diffusers 4 - Blowers 1 - Mixed Sludge wet well 2 – Waste Sludge pumps

2.8.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Current normal operation is to feed Aeration tanks #1 and #2 at 33% feed to passes B, C and D. Aeration tank #3 is operated to treat centrate with the effluent pumped to the RAS channel.
During Wet Weather Event		
SEE	SSTW/STW	• No changes are made to the aeration tank operations during a wet weather event.
After Wet Weather Event		
SEE	SSTW/STW	• Adjust sludge wasting rates based on the aeration tank inventory loss during the storm.
Why Do We Do This?		
• Manual gate operation limits the operator's ability to make rapid adjustments. • Wasting is adjusted to maintain steady aeration tank inventory.		
What Triggers The Change?		
A change in aeration tank MLSS.		
What Can Go Wrong?		
Blower failure resulting in loss of treatment performance from lack of aeration. Mixed waste sludge pump failure. Clogged or broken diffusers.		

2.9 FINAL SETTLING TANKS

2.9.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Final Settling Tanks	8 - Final Settling Tanks (4 East and 4 West) 4 - Common RAS pumps 32 - Chain and Flight Collectors (4 per FST) 8 - Sludge Trough Cross-Collectors (1 per FST) 32 - Inlet Sluice Gates (4 per FST) 32 – Rotating Scum Collectors (4 per FST) 8 – Common RAS Telescoping Valves (1 per FST)

2.9.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Normal operation is for all tanks in service. • Observe effluent quality. • Check the RAS lifts for proper flow. • Check the RAS pumps in service for proper operation. • Check the tank collectors for proper operation. • Skim grease by dropping the scum collectors.
During Wet Weather Event		
SEE	SSTW/STW	• Check sludge collectors. If a collector shears a pin, a chain breaks or comes off the sprocket, close the influent gates to isolate the tank. • Check the effluent quality. Notify the supervisor if solids are washing out over the weirs. • Check the RAS lifts for clogging. • Check the RAS pump flow rate.
After Wet Weather Event		
SEE	SSTW/STW	• Repair any broken equipment. • If the grease load on the tanks is heavy, drop the scum collectors and remove the grease.
Why Do We Do This?		
To determine the maximum flow the clarifiers can treat without a catastrophic solids loss.		
What Triggers The Change?		
Solids washout over the clarifier effluent weirs.		
What Can Go Wrong?		
Clogged RAS lifts. RAS pump failure. Solids washout at the final effluent weirs. Broken chains and flights. Chains off the sprocket. Sheared collector pins.		

2.10 PLANT EFFLUENT CHLORINATION

2.10.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Plant Effluent Chlorination	2 - Chlorine Contact Tanks 2 –Inlet Rectangular Butterfly Gates 3- Sodium Hypochlorite Pumps 4 – Sodium Hypochlorite Storage Tanks Chlorine Diffusers

2.10.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Monitor Sodium Hypochlorite Storage Tank levels. • The chlorine residual is checked every hour. If the residual is out of target range, then it is checked every half hour. • Check operation of Sodium Hypochlorite feed pump. • Check Hendrix Creek for foam. Increase defoamants addition if necessary.
During Wet Weather Event		
SEE	SSTW/STW	• Adjust the chlorine dose as flow increases. When notified by the SEE that a fourth Main Sewage Pump will be started, increase the chlorine dose in anticipation of bypassed flow. • Check the chlorine residual every hour. If the residual is out of target range, then it is checked every half hour. • Check the Sodium Hypochlorite Storage tank level. If low isolate the tank and place a different tank on-line. • Check Hendrix Creek for foam. If necessary feed additional defoamants.
After Wet Weather Event		
SEE	SSTW/STW	• As flow decreases, reduce the chlorine dose. • Check the Sodium Hypochlorite tank storage levels. Notify supervisor of need for delivery. • The chlorine residual is checked every hour. If the residual is out of target range, then it is checked every half hour.
Why Do We Do This?		
To meet the elevated chlorine residual demand from additional flow and from bypassed flow that has only received Preliminary Treatment.		
What Triggers The Change?		
Increased chlorine demand caused by increase in flow and secondary bypassing of flow.		
What Can Go Wrong?		
The chlorine dose is not high enough to anticipate the increased demand resulting in a low residual. Secondary bypassing can occur without the chlorination operator being forewarned. Failure of a hypochlorite feed pump.		

2.11 SOLIDS HANDLING: THICKENING

2.11.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Gravity Thickeners	1 – Inlet Distribution Box 4 – Gravity Thickeners 4 - Inlet Slide Gates 8 - Thickened Sludge Pumps

	3– Thickener Collector Mechanisms

2.11.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Normal operation is with all four thickeners in service. • Thickeners receive flow from the mixed sludge well. The Primary sludge passes through the secondary screens before reaching the mixed sludge well. RAS, aerator effluent and effluent balance water are gravity fed directly to the well.
During Wet Weather Event		
SEE	SSTW/STW	• The thickened sludge pumping rate may need to be increased to handle the "first flush" solids captured in the Primary Settling Tanks.
After Wet Weather Event		
SEE	SSTW/STW	• The thickened sludge pumping rate may require adjustment due to a reduction in wasting following a wet weather event.
Why Do We Do This?		
To prevent overloading of the gravity thickeners from the increased solids.		
What Triggers The Change?		
Increases in solids load from the "first-flush" of material that is scoured from the collection system during the early part of the wet weather event.		
What Can Go Wrong?		
Collector mechanism failure. Thickened Sludge Pump failure. Waste sludge pump failure. Secondary Screen failure. Loss of solids into the thickener overflow.		

2.12 SOLIDS HANDLING: DIGESTION

2.12.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Sludge Digestion	4 - Sludge Digestion Tanks 3 - Sludge Storage Tanks 4 - Sludge Heaters 6 – Sludge Recirculation Pumps 2– Sludge Transfer Pumps 6 - Gas Recirculators (0 Operational)

2.12.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• All equipment is in service. All four digesters are operated as primary digesters with heating and recirculation. • The sludge storage tanks receive flow from Coney Island and Jamaica via force main and from Rockaway and Owls Head via sludge boat and barge.
During Wet Weather Event		
SEE	SSTW/STW	• No changes are currently made to the Sludge Digestion Operation during wet weather.
After Wet Weather Event		
SEE	SSTW/STW	• No changes are currently made to the Sludge Digestion Operation during wet weather.
Why Do We Do This?		
N/A		
What Triggers The Change?		
N/A		
What Can Go Wrong?		
Hot loop pump failure. Sludge recirculation pump failure. Plugged sludge heaters. Gas recirculator failure. Over pressurization of the digesters resulting in gas venting.		

2.13 SOLIDS HANDLING: DEWATERING

2.13.1 Unit Processes and Equipment List

UNIT PROCESS	EQUIPMENT
Sludge Dewatering	13 - Centrifuges 13 - Sludge Feed Pumps 4 - Cake Conveyors 2 - Polymer Storage Tanks 13 - Polymer Feed Pumps 8 – Cake Storage Silos

2.13.2 Wet Weather Operating Procedures

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• The number of centrifuges in service will vary from 4-10 depending on the sludge demand.
During Wet Weather Event		
SEE	SSTW/STW	• No changes are currently made to the Sludge Digestion Operation during wet weather.
After Wet Weather Event		

SEE	SSTW/STW	• No changes are currently made to the Sludge Digestion Operation during wet weather.
Why Do We Do This?		
N/A		
What Triggers The Change?		
N/A		
What Can Go Wrong?		
Struvite blocking the centrate return line. Polymer pump failure. Sludge feed pump failure. Centrifuge failure.		

3.0 Planned Plant Upgrades

The 26th Ward WWTP is undergoing plant stabilization and a BNR upgrade. During construction, the secondary system continues to have the capacity to treat 127.5 mgd. Sufficient pumping capacity should be available to pump 170 mgd during wet weather event. In the event that additional main sewage pumps are out of service, the temporary discharge pumps (contractor's pumps) can be utilized. These pumps have a maximum capacity of 40 mgd. A site plan and a process flow diagram for the upgraded facilities are presented in Figures 3-1 and 3-2, respectively.

The plant upgrade will result in no increase to the current 170 mgd maximum capacity. This section summarizes the major improvements to be implemented as part of the overall plant upgrade. Please note that the sections below describe the current upgrades being performed under Contracts 11 and 12. Contracts 13 and 20 are currently under design and are not described in the sections following.

3.1 INFLUENT SCREENING AND MAIN SEWAGE PUMPING

The existing High Level and Low Level pumps will have new valves and suction piping installed. Main Sewage Pumps Nos. 4, 5, and 6 will be upgraded with new shafts, bearings, impellers, and motors to have a capacity to pump 42.5 mgd. The existing raw sewage discharge force main to the primary tanks will be replaced with a new flow meter installed. The four existing main influent gates will have electric/hydraulic gate operators installed, while the bar screen isolation gates and the tie-gate between the high and low level wet wells will receive electrical/mechanical operators.

3.2 PRIMARY SETTLING TANKS

The four existing primary tanks will be rehabilitated with minor repairs to the expansion joints. New tank collector mechanisms, rails, selected piping and new grit removal equipment will be installed.

3.3 AERATION TANKS

The number of Aeration Tanks at 26th Ward remains at three. The tanks have anoxic/oxic switch zones constructed with new mixers to allow the flexibility of changing the aerobic volume for nitrification. The tanks have also undergone an aeration system upgrade with new air piping, and new diffusers. Two of the four existing process air blowers have been rehabilitated including a new electrical system. The remaining two process air blowers are being refurbished. In the interim, three (3) temporary blowers are still available. A mechanical actuator has been added to each Pass D gate for the purpose of sending excess storm flow to the D-passes on Aeration Tanks 1 & 2 however permanent pedestals for accessing these controls have not been completed as of the issuing of this manual. As such the operators are not able to safely access the controller to open the D-pass gates during wet weather.

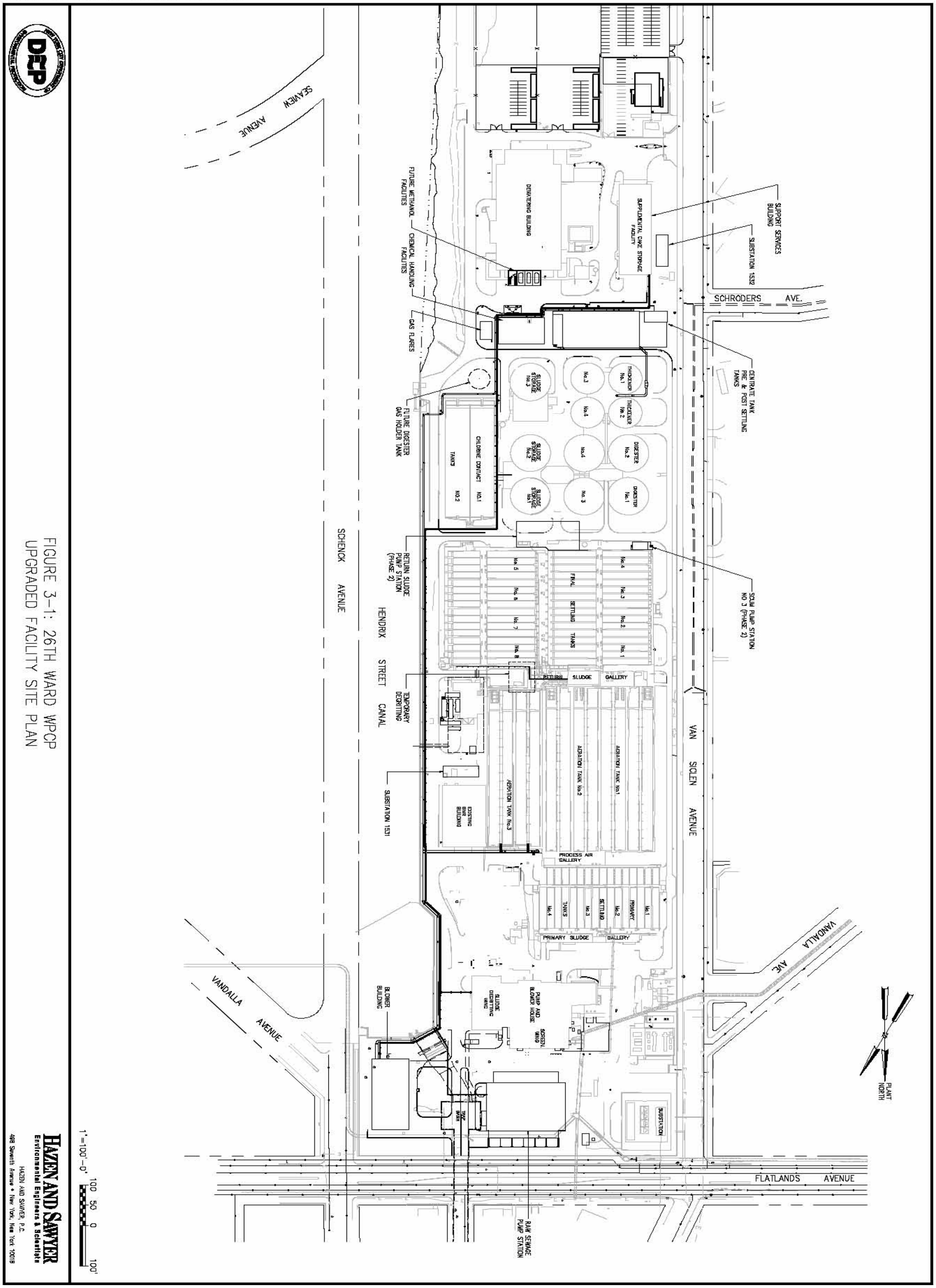


FIGURE 3-1: 26TH WARD WPCP UPGRADED FACILITY SITE PLAN

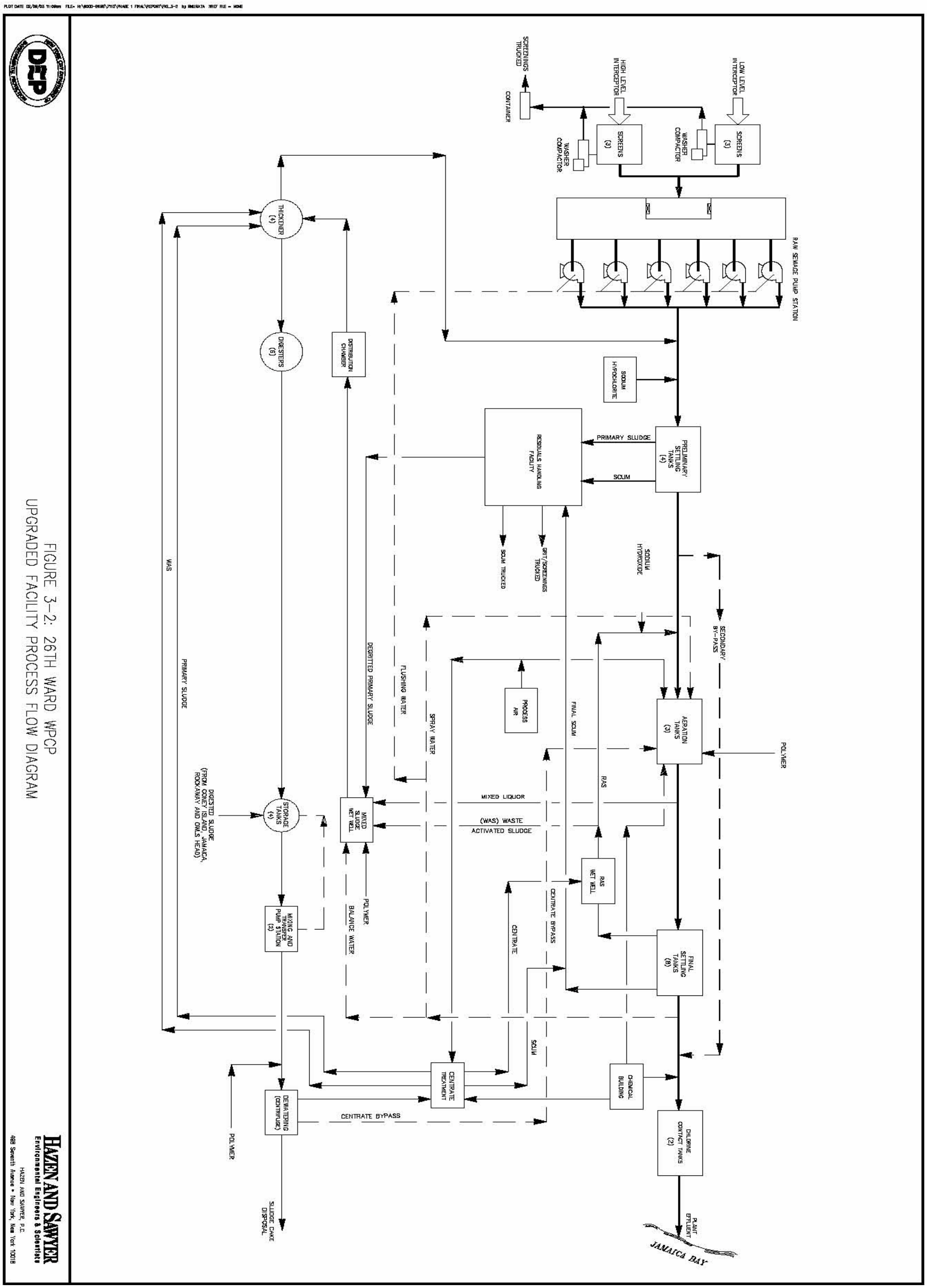


FIGURE 3-2: 26TH WARD WPCP
UPGRADED FACILITY PROCESS FLOW DIAGRAM

3.4 FINAL SETTLING TANKS

The existing eight final settling tanks will undergo an upgrade consisting of new chains, flights, collector drives, and scum removal cranes. The RAS bell weirs will be rehabilitated.

3.5 PLANT EFFLUENT CHLORINATION

The existing chlorine contact tanks will be upgraded and improved to reduce short-circuiting and to increase mixing efficiency in the tanks. The Sodium Hypochlorite storage and feed system will be constructed in a new building and sized to include hypochlorite feed to the aeration tank froth control hoods and RAS chlorination.

3.6 SEPARATE CENTRATE TREATMENT SYSTEM

Aeration Tank #3 has been designed with the flexibility for separate centrate treatment with internal recycle and RAS from the main aeration tanks. Effluent from Aeration tank #3 can be directed to the main plant RAS channel and the nitrified centrate can be denitrified in the main aeration tanks. The existing alkalinity feed system has been refurbished and is usable.

3.7 RAS AND WAS SYSTEMS

The existing RAS pumps, rated 12 mgd each (42% design dry weather flow) have been replaced in kind with new units.

New WAS pumps have been installed with local flow meters to maintain a constant SRT in the aeration tanks. New piping will follow.

3.8 GRAVITY THICKENERS

The gravity thickeners will undergo a complete rehabilitation with new collector mechanisms and influent piping.

3.9 SLUDGE DIGESTION AND STORAGE

Under separate contracts the four existing anaerobic sludge digesters are undergoing gas system rehabilitation with new gas mixing compressors, flame arresters and drip traps. The sludge heating system will be connected to the dewatering heating system with provisions to connect a portable boiler to the system.

3.10 SPRING CREEK CSO RETENTION FACILITY

In addition to these planned 26th Ward WWTP upgrades, the DEP has also upgraded the Spring Creek Auxiliary Water Pollution Control Plant (AWWTP). This upgrade was initiated in March 2003. The upgrade includes: automation of the effluent gates to maximize storage, installation of a new odor control system, replacement of the basin cleaning system, replacement of the basin dewatering pumps, elimination of the effluent tide gates, new backup power emergency generator, a new PLC based SCADA system, and new personnel facilities.

APPENDIX A

SPRING CREEK WET WEATHER OPERATING PLAN

Wet Weather Operating Plan:
Spring Creek CSO Retention Facility

July 2010

SPRING CREEK CSO RETENTION FACILITY
WET WEATHER OPERATING PLAN
TABLE OF CONTENTS

List of Figures

SECTION 1

INTRODUCTION

This section presents a description of the Spring Creek Combined Sewer Overflow (CSO) Retention Facility, its drainage area, collection system, capacity and how the plant should be used and maintained.

1.1 BACKGROUND

The Spring Creek facililty is located on Spring Creek along the Brooklyn-Queens border and is approximately one mile east of the 26th Ward Wastewater Treatment Plant (WWTP). The function of the Spring Creek facility is to capture the combined sewer overflow (CSO) from tributary drainage areas in Brooklyn and Queens. Figure 1-1 shows the location of the Spring Creek facility.

Spring Creek facility was placed into service in the early 1970’s and has a minimum storage capacity of approximately 19.3 million gallons (mg); approximately 9.9 mg in basin storage and approximately 9.4 mg in influent barrel storage.

Flow is conveyed to the plant by four overflow barrels from the Autumn Avenue regulator (26W-R3) located in the Borough of Brooklyn, and by two overflow barrels from the 157th Avenue regulator (JA-R2) located in the Borough of Queens as shown in the Process Flow Schematic Figure 1-2. The facility does not provide treatment of combined sewage via controlled processes as in a typical wastewater pollution control facility. The facility provides floatables control, high rate settling and storage of CSO flows. Disinfection of the CSO flows at the facility will not be provided.

1.1.1 Drainage Area

The Spring Creek facility operates as a flow-through retention facility for tributary drainage areas in Brooklyn and Queens within the 26th Ward and Jamaica Wastewater Treatment Plant (WWTP) drainage areas. The retention facility is designed to fully contain certain storms and act as a flow-through facility to maximize the reduction of CSO overflows to Spring Creek during larger storms. The Spring Creek system is comprised of Old Mill Creek, which is tributary to Jamaica Bay, and Old Mill Creek’s tributaries, Spring Creek and Ralph Creek. The total tributary area is composed of 3,256 acres, of which 1,874 acres are in Brooklyn and 1,382 acres are in Queens. The combined sewers in the drainage area are circular, ranging from 10 inches to 216 inches in diameter, and downstream from the regulators they are either rectangular or curve bottom conduits, ranging in size from 8.5 feet by 15 feet to 15 feet by 10 feet. The total length of the collection piping in both tributary areas is approximately 310,000 feet. The CSO is conveyed to Spring Creek basins by four overflow barrels from the Autumn Avenue regulator (26W-R3) and two overflow barrels from the 157th Avenue regulator. The length of each of the four barrels from the Autumn Avenue regulator (JA-R2) to the basins is approximately 767 feet and the length of each of the two barrels from the 157th Avenue regulator is approximately 7,900 feet.

1.1.2 Wet Weather Flow Control

The control of influent flow to Spring Creek facility is accomplished through automated control of the Autumn Avenue Regulator (26W-R3) and from overflow from the 157th Avenue Regulator (JA-R2), which has its regulator gate permanently set in the full open position, as shown in Figure 1-2. The 26th Ward operators only have control of the Autumn Avenue regulator. Wet weather flow overflows the weirs in the regulators when flow exceeds two times the design dry weather flow (2xDDWF) for the 26th Ward and Jamaica WWTPs. An Operating Stationary Engineer Electric (SEE) at the 26th Ward WWTP has the option of setting the 26th Ward regulators' gates to direct more flow to Spring Creek facility and has the ability to either locally or remotely control the gate operation during wet weather events. The SEE controls the regulators in accordance with the requirements listed in the 26th Ward WWTP WWOP.

The facility has six basins with a minimum retention volume, including inline storage, of 19.3 mg. Drain-back from the facility is by gravity to elevation -7.50 (Brooklyn Highway Datum) and by pumping below this level. Approximately 7.0 mg of CSO is stored in the basins above elevation –7.50 and approximately 8.9 mg are stored above elevation -7.5 in the influent barrels. The stored volume flows by gravity back to the collection system through influent barrels numbered 3, 4, 5 and 6 as shown in the Process Flow Schematic Figure 1-2 and Flow Diagram Figure 1-3. Flow back rates fluctuate depending upon the storm event and the total volume of flow retained in the facility. Current operations require pumping the remaining 3.4 mg of CSO. This volume, retained within the basins below elevation –7.50, is removed during the dewatering operations and may be followed by basin cleaning. Both the Pump back rate to the 26th Ward WWTP and the amount of spray water used to clean the basins is determined by the operators at the Spring Creek facility and the 26th Ward WWTP as well as the flow conditions within the collection system and the 26th Ward WWTP.

1.1.3 Spring Creek CSO Retention Facility General Description

The Spring Creek facility has six influent barrels that feed six CSO basins whose volume provides for stormwater retention, floatables control and solids settling. The basins can overflow to Spring Creek when the water surface elevation in the basins is at elevation 1.0 foot, depending upon tide levels. The overflow weir is set at elevation -1.5 feet but the sluice gates will not open until the basin water surface elevation is at 1.0 foot and there is a preset elevation difference between the level in the basins and the tide level outside the basins to maximize storage capacity and to prevent inflow of the tide into the basins. The overflow flows through up to 24 sluice gates at the effluent end of the basins into Spring Creek. As flow recedes, the CSO retained within the basins and influent barrels above elevation –7.50 feet drains by gravity back into the sewer system for treatment at the 26th Ward WWTP through barrels numbered 3, 4, 5 and 6. Below elevation -7.50 feet, the retained volume is screened and pumped via the Dewatering Pump System located within the Pump Building through a 24"/30" force main and discharges into the Autumn Creek Regulator. The CSO retained within the basins and influent barrels above elevation -7.50 is not screened as it flows back by gravity back to the collection system and 26th Ward WWTP for treatment. A more detailed description of the Spring Creek facility is included in Section 2.1 of this WWOP.

Each retention basin is approximately 55.58 feet wide and approximately 471.75 feet long, measured from inlet to overflow end wall. The passage of floatables to the receiving waters is controlled by floating booms.

1.1.4 Spray Water /Dewatering Systems

The Spray Water System is comprised of a series of motorized valves, piping, and pumping equipment that conveys brackish bay water to the basins for cleaning purposes. The spray water system bay water is distributed through 12 sets of PVC spray water pipes with holes to clean solids from the basin floor and walls. One or two spray water pumps will operate at any time to provide bay water to the basins and cross collector channel. Figure 1-4 depicts the Spray Water System schematic.

The basin dewatering system is shown on Figure 1-5. During the basin dewatering or cleaning operation the system retained flow is first screened prior to being pumped to the Autumn Avenue Regulator for treatment at the 26th Ward WWTP.

1.1.5 Plant Computer System

A new plant computer system has been provided to monitor and control equipment within the facility. The system monitors plant instrumentation, basin cleaning system, basin dewatering and screening system, HVAC systems and emergency generator. It records and maintains plant records and produces reports of the plant monitoring data.

During a wet weather event, the computer system records basin level and storage as well as overflow to Spring Creek. The system is designed to ensure that maximum storage capacity is achieved in the basins by automatically opening the effluent sluice gates in a sequential fashion when the water surface elevation within the basins is at elevation +1.0 and there is a 1.0 foot differential between this water surface elevation in the basins and the tide elevation outside the basins in Spring Creek. Once the basins have emptied to the overflow weir elevation or the tide elevation is within four inches of the height of the water level when the basin level is above the overflow weir, the computer system automatically closes the effluent sluice gates.

1.1.6 Flow Measurement

Flow into the Spring Creek facility basins is measured using level sensors located in the influent to basins 2, 4 and 6. The sensors measure the rate of change in the elevation within the basins. The readings for the three sensors are averaged and convert it to flow rate. Overflow from the basins is measured using two sets of level sensors locate in each basin. The first sensor is located upstream of the overflow weir to obtain the height of the basin elevation over the weir while the second is located just downstream of the overflow weir which is used to determine the effluent channel elevation. Depending on the tidal elevation and its relation to the basin elevation, the appropriate equation (i.e. submerged weir, rectangular weir, etc) is used to calculate the overflow volume. Retained flow below el. -7.5 and wash water is measured by a magnetic flow meter located on the discharge of the dewatering pumps. The locations of the level sensors are shown on Figure 1-2.

1.2 PURPOSE OF THIS MANUAL

The purpose of this manual is to provide a set of operating guidelines to assist Spring Creek facility staff in making operational decisions. During a wet weather event, numerous operational decisions must be made to effectively manage and optimize capture of wet weather flows. Each storm event produces a unique combination of flow patterns and plant conditions. No manual can describe the decision making process for every possible wet weather scenario encountered at the Spring Creek facility. This manual can, however, serve as a useful reference guide for new and experienced operators alike. This manual provides useful operational guidelines in preparing for an expected wet weather event, provides a source of ideas for controlling specific unit processes during a wet weather event, and provides operational protocols for monitoring and controlling unit processes during wet weather events.

1.3 USING THIS MANUAL

This manual is designed to be used as a reference guide during wet weather events and is broken down into sections that cover major unit processes at the Spring Creek facility. Each protocol for the unit processes includes the following information:

- list of unit processes and equipment covered in the section;
- steps to be taken before a wet weather event and identification of responsible party(ies);
- steps to be taken during a wet weather event and identification of responsible party(ies);
- steps to take after a wet weather event and identification of responsible party(ies); and
- discussion of reasons for performing the recommended control steps.

This manual should be periodically updated to reflect and document the most current operational protocols practiced at the Spring Creek facility. Users of this manual are encouraged to identify new protocols, procedures, and recommendations to further the objectives of the manual. Modifications that improve upon the manual’s procedures to maximize treatment of wet weather flows are encouraged.

1.4 REVISIONS TO THIS MANUAL

In addition to revisions based upon operational experience, this manual will also be revised as modifications and stabilizations are made to the facility. Such modifications are as follows:

As a result of the Spring Creek facility upgrade, the following summarizes the improvements to the CSO facility operations.

- New basin cleaning system;
- New effluent sluice gates and tide control system;
- New basin dewatering pumps;
- New computer-based process instrumentation and control system;

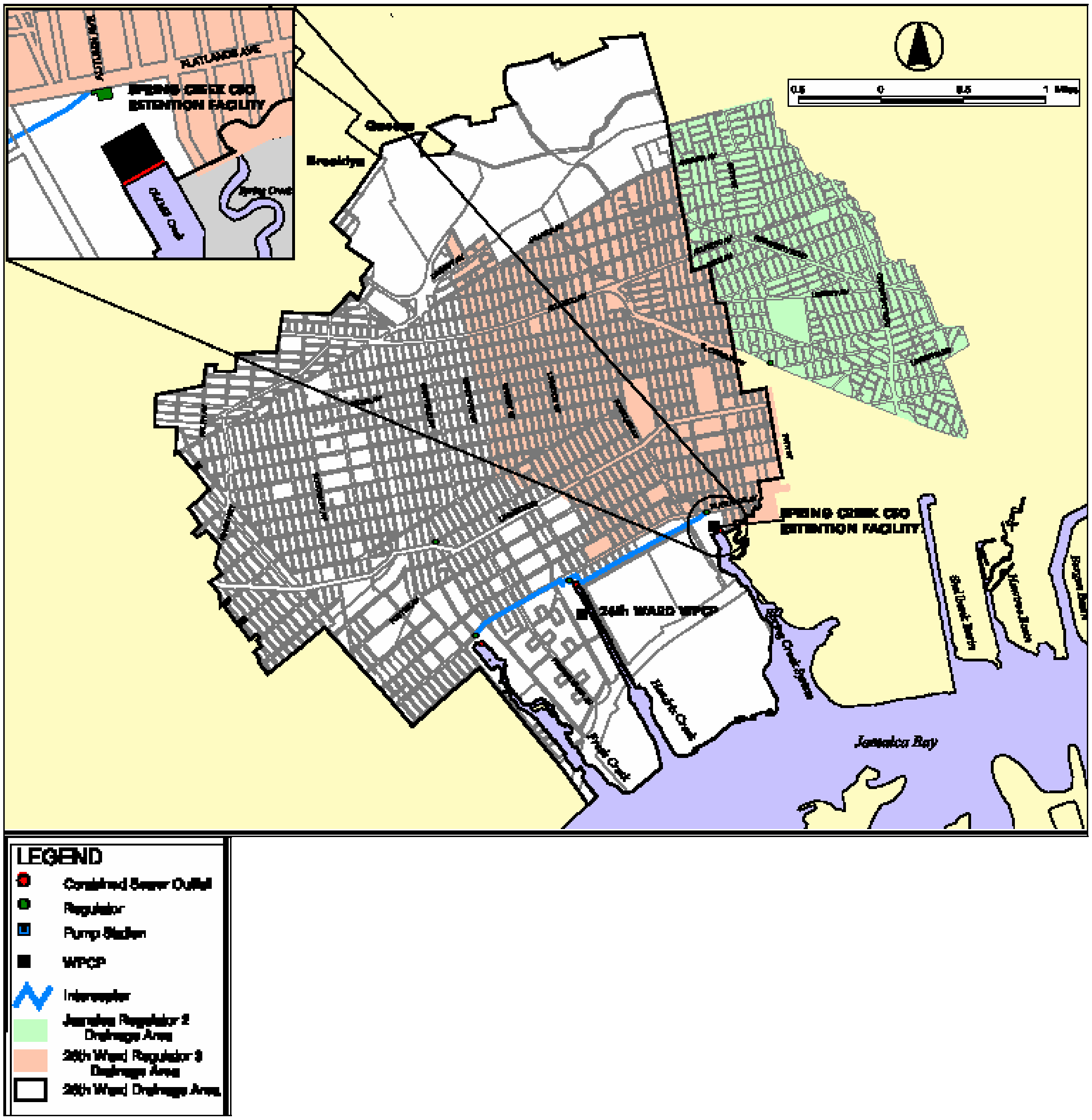


Figure 1-1

Spring Creek AWPCP
Facility Drainage Areas & Outfall Locations

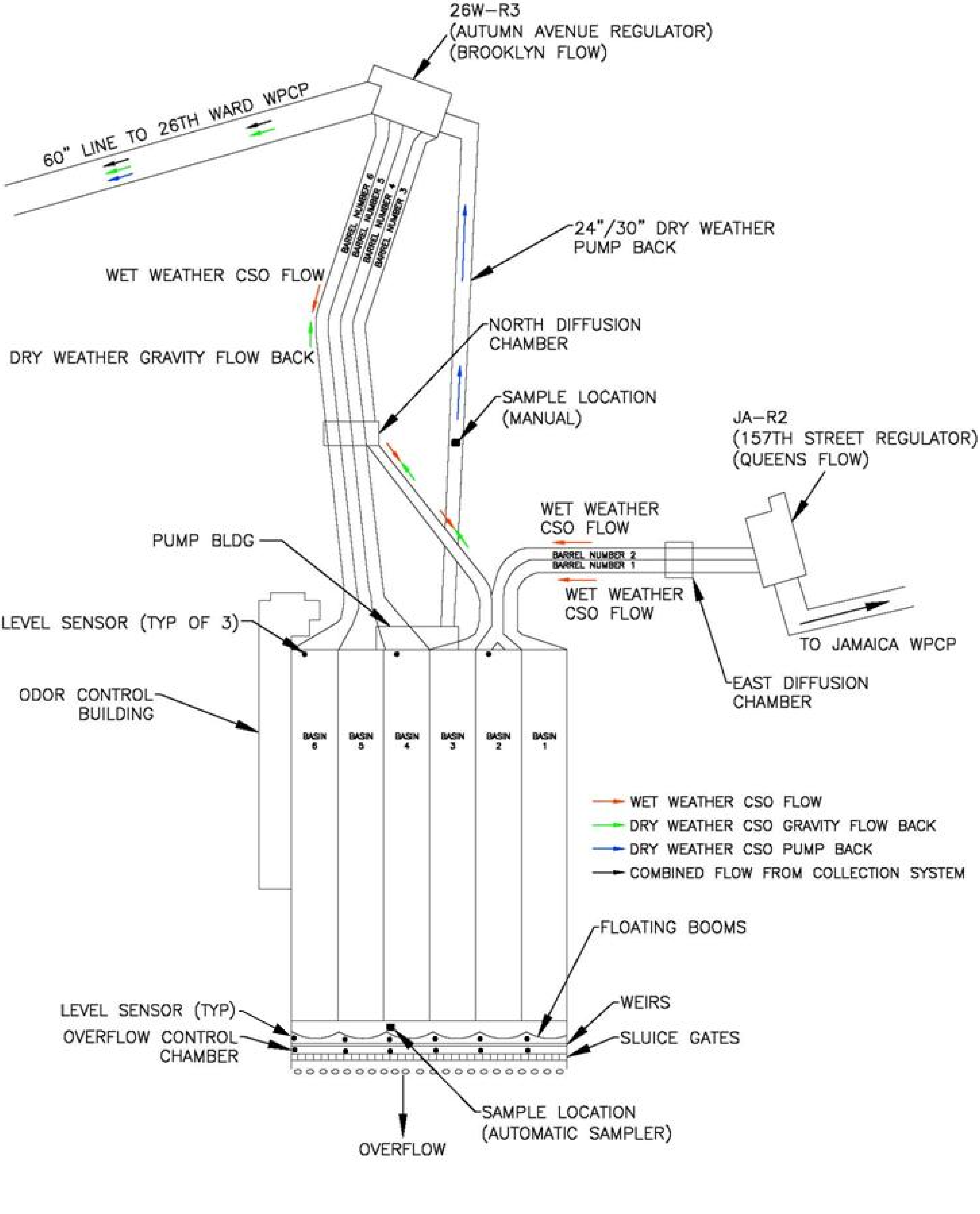
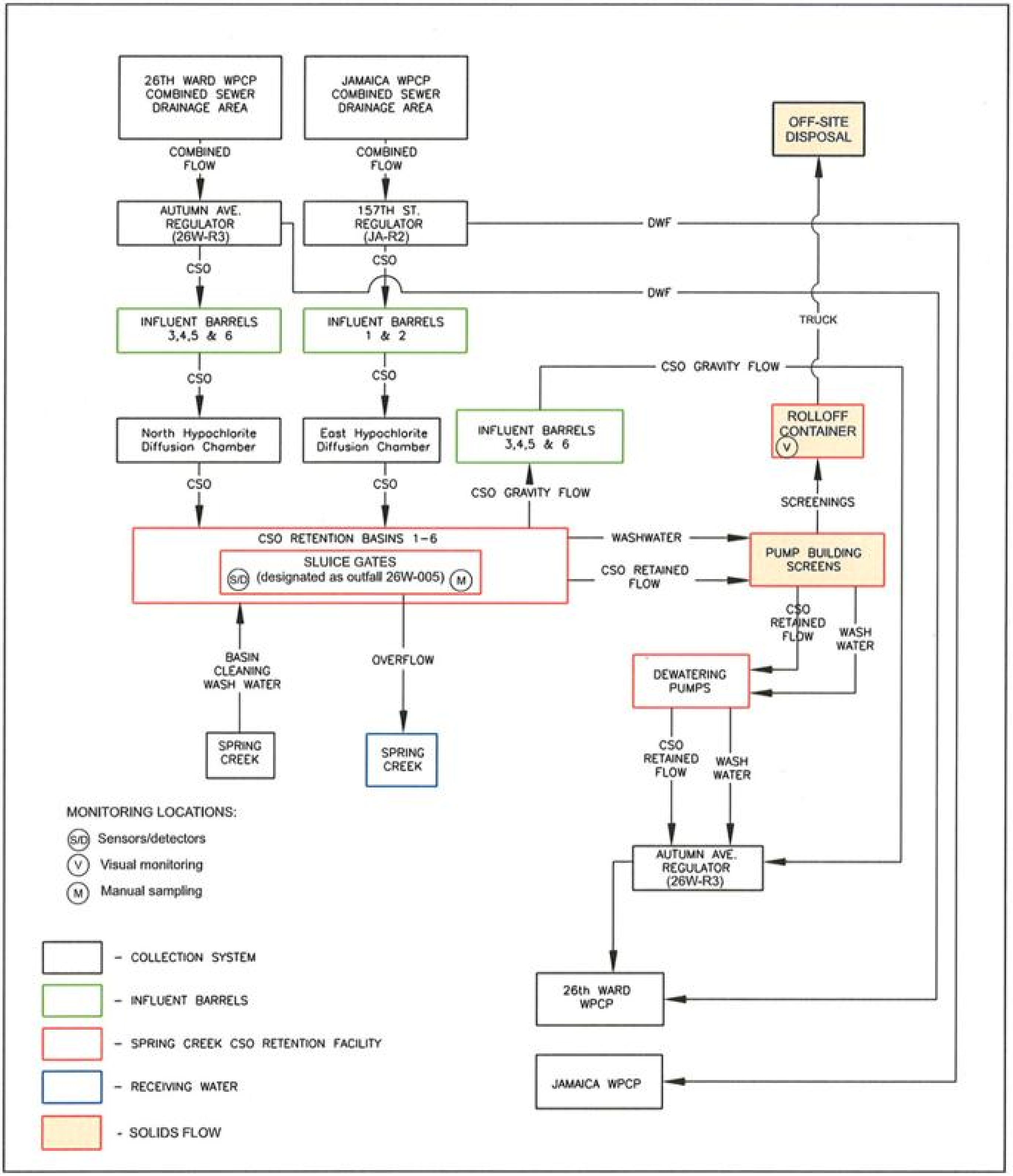


Figure 1-2

Spring Creek AWPCP Process Flow Schematic



HydroQual
1200 MacArthur Boulevard
Mahwah, New Jersey 07430
(201) 529-5151 f: (201) 529-5728

Figure 1-3
Spring Creek AWPCP Flow Diagram

26th Ward WPCP
Spring Creek CSO Retention Facility

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DEP

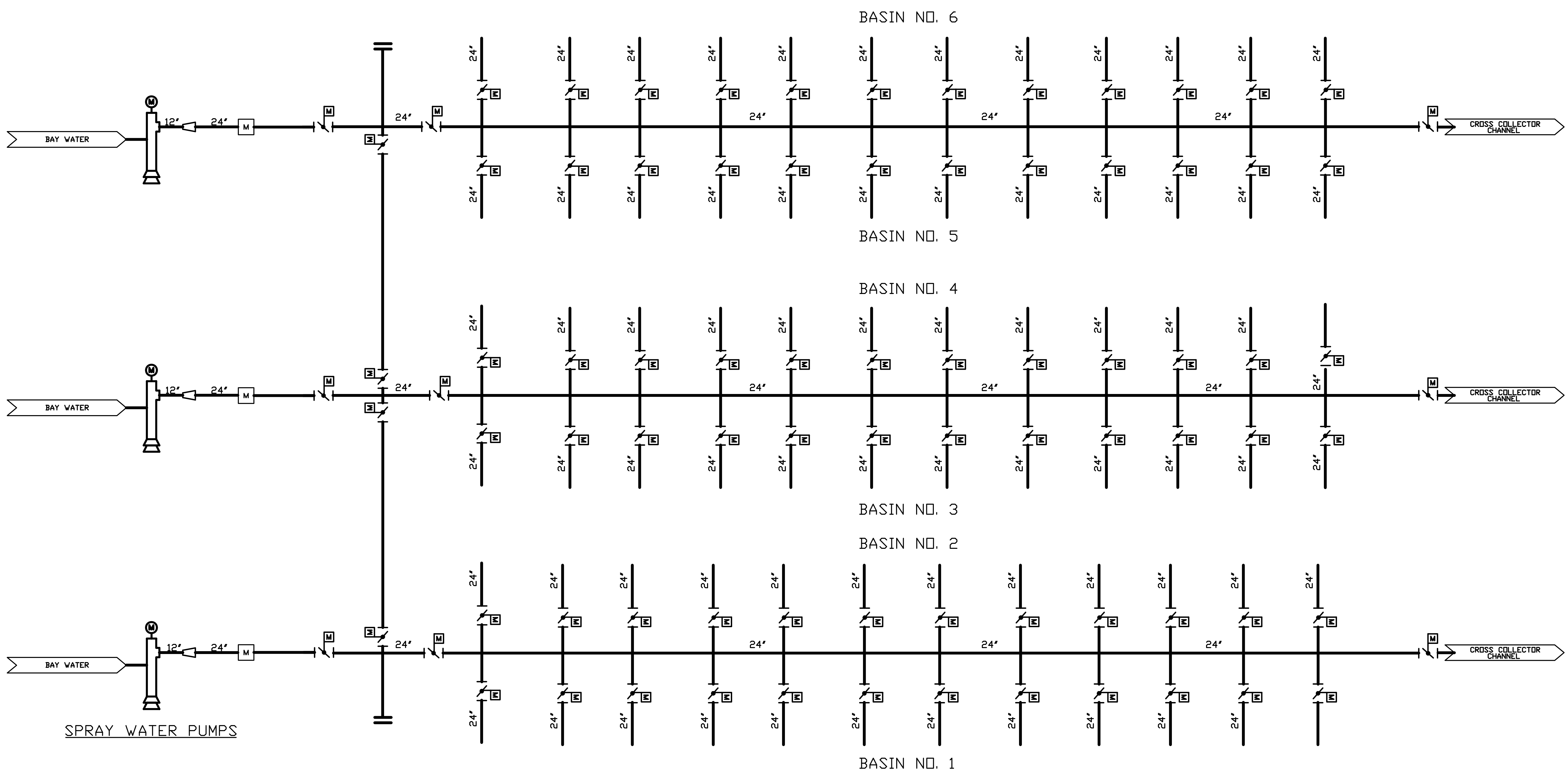


Figure 1-4
Spray Water System Schematic

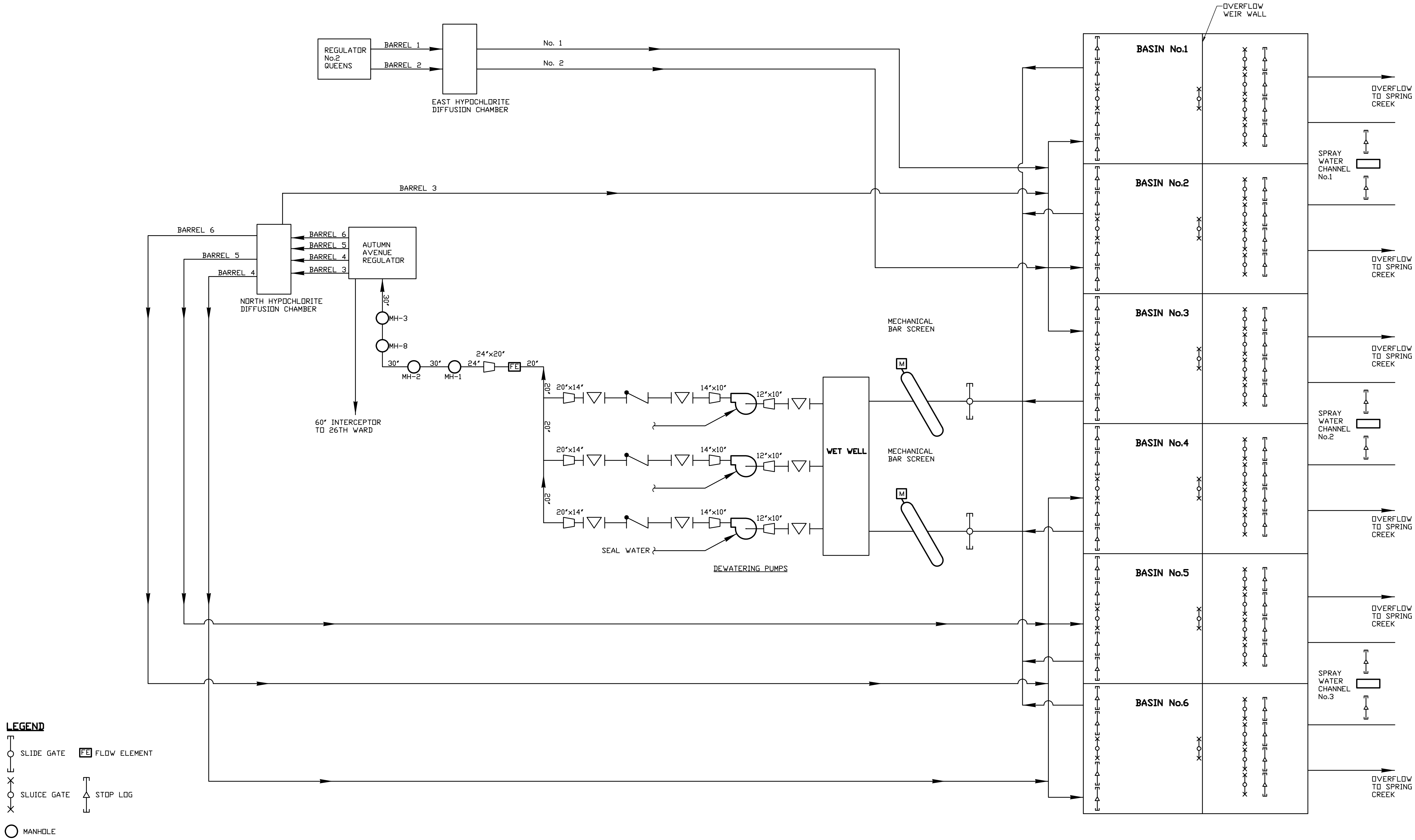


Figure 1-5
Basin and Basin Dewatering System
Flow Schematic

SECTION 2

UNIT PROCESS OPERATIONS

This section presents equipment summaries and wet weather operating protocols for each major unit process within the plant. The protocols are divided into steps to be followed before, during and after a wet weather event.

2.1 BASIN AREA

The following information and protocols apply to the existing basin area. Flow schematic for the basins is shown in Figure 1-5.

Unit Processes	Equipment
Retention Basins	Six (6) Basins each at 55.58 ft wide x 471.75 ft long

Before Wet Weather Event

1. During normal dry weather operations, all six basins are continuously in service unless maintenance is being performed within the basins. The plant is manned during the day shift from 7:00 am to 3:00 pm, seven days a week. The plant operations are monitored by Spring Creek personnel during manned plant hours and by 26th Ward plant personnel during off hours.
2. Plant operators monitor the weather on a daily basis to determine if a rain event may occur. If wet weather is predicted they will pump out the basins to provide the maximum storage capacity.
3. Seepage into the basins is also monitored on a daily basis by plant operating personnel using the basins' ultrasonic level sensors. During dry periods, basin elevation is monitored and is pumped down as necessary to remove any accumulated inflow and infiltration (I/I) regardless of weather a wet weather event is predicted or not.

During Wet Weather Event

1. Effluent grab samples are collected and analyzed in accordance with the requirements of SPDES Permit Number NY0026212. Sampling information is included at the end of this section. The basins and Spring Creek levels are monitored continuously utilizing ultrasonic level elements. When the water surface elevation of any one basin reaches elevation +1.0 foot and there is a differential of at least 1 foot between the basin water elevation and the Spring Creek tidal elevation, the effluent sluice gates will open and the basins will discharge to Spring Creek until either the water surface elevation within the basins reaches the overflow weir level elevation of -1.5 feet or there is a 4 inch differential between Spring Creek water elevation and the Basin water elevation. The effluent sluice gates will then close.

After Wet Weather Event

1. Upon the end of a wet weather event, the basins drain by gravity to elevation -7.50 as the flow within the collection system returns to normal flow conditions. Once plant staff has arrived on site and flows within the basins have receded to elevation-7.50 feet, the Spring Creek operators check with the 26^{th} Ward WWTP to determine when the WWTP can handle the dewatering/cleaning flows from the Spring Creek facility. When they receive approval to pump down the basins from 26^{th} Ward WWTP, the basin dewatering and/or cleaning operating occurs. The basin dewatering operation requires the basin electrically operated drain valves to be opened by the operator and the dewatering pumps and screens to be put into operation by the operator. The operator can either start the equipment remotely using the SCADA system or manually from the local control panel. The retained CSO flow within the basins is then screened and pumped back to the Autumn Avenue Regulator and into the interceptor that flows to the 26^{th} Ward WWTP.
2. The basins can be cleaned after the dewatering operation is completed by utilizing the Spray Water System. Three spray water pumps, interconnected by a common header with isolation valves, supply brackish water to the three spray water systems. Each system is comprised of motorized valves and piping laterals and is capable of cleaning two basins. Cleaning of the basins is accomplished by discharging the brackish bay water through a series of twelve sets of drop pipes per basin. Each set of drop pipes is equipped with automated butterfly valves that open in a sequential manner to clean a section of the basins. The drop pipes are located on each side of the basin and are connected to spray water piping with nozzles located near the basin floors and at elevation 4.0. The piping at elevation 4.0 cleans the walls and the piping along the floor cleans the floor of the basins.
3. Any remaining debris in the basins is flushed into the collection channel that runs down the center of the basins and is directed to the Pump Building where it is screened. Screened flow is pumped back to the Autumn Avenue Regulator (collection system) for treatment at the 26^{th} Ward WWTP.
4. Screenings removed during the basin dewatering and cleaning operation are collected and discharged into a container for ultimate disposal offsite.
5. Pump-back and basin cleaning is only performed while the facility is manned. The operations may be extended into off hours by holding personnel on overtime on an as needed basis. Dry weather pump-back of I/I flows typically occurs during normal working hours.

Why Do We Do This?

Basin dewatering and cleaning is performed to maximize the storage volume within the basins for the next wet weather event, to remove for disposal any floatables retained and to pump all solids back to the collection system for further treatment at the 26^{th} Ward WWTP. The removal of solids also reduces negative impacts on the receiving waters resulting from the next wet weather event should it cause an overflow into Spring Creek.

2.2 CSO SCREENING

The following information and protocol apply to the existing climber screens located within the Pump Building at the influent to the Dewatering System wet well. The climber screens are shown in the flow schematic on Figure 1-5.

Unit Processes	Equipment
Climber Screens	Two (2) Infilco Degremont screens (2 Hp) Two (2) 1-1/2 Cubic Yard Disposal Containers Flow Capacity >15,000 gpm per Screen

Before Wet Weather Event

1. During normal dry weather operations the screens are not in service.

During Wet Weather Event

1. The climber screens are not operated.

After Wet Weather Event

1. During the basin pump down and cleaning operation, the climber screens are operated continuously. The screen operation is initiated from either the SCADA system or from the local control panel. The screens can operate off of differential water level in the screen channels or manually.
2. Debris collected on the screens is discharged from the screens into disposal containers that are normally wheeled to a hoist and emptied into a ten-cubic-yard container.

Why Do We Do This?

Climber screens are used to remove floatables and large solids from the flow that will be conveyed to 26th Ward. This reduces the load at the 26th Ward WWTP and reduces maintenance on the dewatering pumps.

2.3 BASIN DEWATERING SYSTEM

Unit Processes	Equipment
Dewatering Pumping	3 - dewatering pumps each rated at 4,050 GPM at a TDH of 34 feet 3 Pump Operation: 12,000 GPM 2 Pump Operation: 8,000 GPM 1 Pump Operation: 4,050 GPM 3 - variable speed controllers 1 - wetwell (operating depth range 10-20 ft)

The Basin Dewatering System is shown in the flow schematic in Figure 1-5.

Before Wet Weather Event

1. The dewatering pumps are operated in either automatic or manual mode at low speed during non-wet weather events to pump accumulated seepage from the basins to the collection system for treatment at the 26th Ward WWTP. In the automatic mode, the speed of the operating pump varies based upon the level in the wet well. The wet well operating band is between elevations -7 and -17 and all pumps will shut down at elevation -27. This equates to an operating band of ten to twenty feet as referenced in the above table. Typically two pumps are utilized to pump the basins down.

The depth of the wet well is approximately 33'-0" with the bottom of the wet well at elevation -27.0 and the top of the wet well at elevation +6.0 feet. The operating range of the wet well is as follows:

Elevation	Action
+5.5 feet	Level Alarm High High
+5.0 feet	Level Alarm high
-7.0 feet	Start Dewatering Pump
-17.0 feet	Stop All Dewatering Pump
-27.0 feet	Alarm Low Low level

During Wet Weather Event

1. During wet weather events the pumps are off.

After Wet Weather Event

1. Upon the end of a wet weather event, the basins are drained by gravity to elevation
   -7.5. This operation occurs automatically without intervention by operations personnel.
2. The remaining storage volume is screened and conveyed back to the Autumn Avenue Regulator when the collection system flows have receded and the 26th Ward WWTP can accept the dewatering and wash water flows from the Spring Creek facility. Typically two screens and one pump are in operation and a second pump may come on depending upon wetwell level, cleaning flows, or the rate at which plant personnel deems most advantageous to dewater the basins in coordination with flows to the 26th Ward WWTP.

Why Do We Do This?

The three variable speed pumps are used to provide pumping capability during basin dewatering and cleaning operations. The removal of the retained flow and the cleaning of the basins maximizes the storage volume within the basins for the next wet weather event, removes for disposal any floatables retained and pumps all solids back to the collection system for further treatment at the 26th Ward WWTP. The removal of solids also reduces water quality impacts on the receiving waters from the next wet weather event should it cause an overflow into Spring Creek.

2.4 SAMPLING AND ANALYSIS

2.4.1 Monitoring Requirements

The following effluent overflow parameters, listed in Table 2.5.1, shall be monitored and the sampling results shall be reported on the monthly operating report. Sample locations are indicated on Figure 2-1, Sampling Locations.

Table 2.4.1- SPDES Monitoring Requirements for CSO Regional Facilities as of April 2007

OVERFLOW PARAMETER	REPORT	UNITS	SAMPLE FREQUENCY	SAMPLE TYPE	FN
Overflow Volume	total, per event[7]	MG	See Footnote 5	Calculated	(1) (4)
Retained Volume	total, per month	MG	See Footnote 5	Recorded, Totalized	(8)
BOD, 5-Day	average, per event	mg/l	1/Each day of event	Composite	(2)
Total Suspended Solids	average, per event	mg/l	1/Each day of event	Composite	(2)
Settleable Solids	average, per event	ml/l	1/Each day of event	Grab	(3)
Oil and Grease	average, per event	mg/l	1/Each day of event	Grab	(6)
Screenings	total, per month	cu.yds.	----------	Calculated	
Fecal Coliform	geometric mean, per event	No./100 ml	1/Each day of event	Grab	(3)
Precipitation	total, per event	inches	Hourly/Each day of event	Auto, Recording gauge within drainage area	

FOOTNOTES:

(1) Flows refer to effluent overflows associated with the design storm for the CSO retention facility.

(2) Composite sample shall be a composite of grab samples, one taken every four hours during each overflow event. Typically, samples shall be taken from an access pipe located at basin 4 effluent channel. If this basin is out of service, samples can be taken from any other basin.

(3) When the facility is manned, grab samples are to be taken every four hours during each flow event.

(4) Effluent overflow shall be calculated using a hydraulic model of the sewer system that is approved by the DEC. The permittee shall submit a report, with the first annual CSO BMP report, explaining the hydraulic model calibration of the combined sewer drainage system tributary to the facility for DEC approval.

(5) In addition to the data supplied on the monthly operating report, the permittee shall provide a summary of the required monitoring to be submitted annually as part of the CSO BMP report required in CSO BMP #14 of this permit. The report shall tabulate sampling results, summarize the number of overflow events, the volume of overflow during each event, volume retained and pumped to the WWTP, and the peak flow rate (a calculated number) during each event, and provide an evaluation of the performance of the facility.

(6) Only when CSO retention facility is manned.

(7) An event starts once overflow out of the CSO retention facility begins, and ends once the overflow stops and the pump back to the associated wastewater treatment plant has finished.

(8) The permittee shall measure and record the total volume of flow retained and returned to the WWTP each month.

2.4.2 Monitoring Performed

All samples must be taken in conformance with the current permit, and are to be taken and preserved according to all regulatory guidelines.

1. Overflow Volume

Effluent overflow is defined as the CSO volume discharged to the basins' effluent channel over the overflow weir wall for basins numbered 1 through 6 during a storm event when the sluice gates are open. The total effluent overflow volume (MG) per event shall be monitored and reported. The current SPDES permit states that the overflow volume shall be calculated using a hydraulic model of the sewer system that is approved by the DEC. However, as per discussions between NYCDEP and NYSDEC, overflow volume is being calculated based on actual measurements rather than a model.

In the Spring Creek facility, the overflow volume is measured at the overflow weir wall through ultrasonic level sensors labeled 242-01, 02, 03, 04, 05, and 06 located in each of the six basins, respectively, and these six individual level readings, in combination with tidal elevations, are converted into a flow quantity via an algorithm and totalized to provide for a total overflow quantity for each overflow event.

2. Retained Volume

Stored CSO is conveyed to the 26th Ward WWTP after a storm event is over and there is adequate capacity at the 26th Ward WWTP to accept the stored volume of CSO. The Retained Volume is defined as the total CSO volume that is stored in the basins and influent barrels during a storm event and is equal to the total volume within the basins and influent barrels that can drain back from the facility by gravity plus the total volume that is pumped to the Autumn Avenue Regulator during the pump-back dewatering operation. The current SPDES permit states that the total Retained Volume shall be measured, recorded and totalized each month. Additionally, NYSDEC has requested that the reporting of the total Retained Volume for each event be included in the monthly operating report. Overflow Volume and Retained Volume shall also be submitted annually as part of the CSO BMP Report.

The pump-back flow is measured, recorded and totalized by utilizing the magnetic flow meter labeled as FE 115 located on the dewatering pump system's discharge header. The gravity flow volume is being calculated based on basin elevations.

3. BOD, 5-Day, Total Suspended Solids

BOD, 5-day and Total Suspended Solids (TSS) composite samples shall be taken from the basins' effluent channel and shall be reported as average per event. The composite samples shall be a composite of samples taken by an automatic sampler from the effluent channel taken every four hours during each overflow event.

4. Settleable Solids

Settleable Solids grab samples shall be taken from the basins' effluent channel and shall be reported as average per event. When the facility is manned, grab samples shall be taken manually every four hours during each overflow event.

5. Oil and Grease

When the facility is manned, Oil and Grease grab samples shall be taken from the basins' effluent channel and shall be reported as an average per event.

6. Screenings

Screenings shall be calculated and reported as a total per month, after being collected in the screenings containers located at the discharge end of each climber screen.

7. Fecal Coliform

Fecal Coliform grab samples shall be taken from the basins' effluent channel and shall be reported as the geometric mean per event. When the facility is manned, grab samples shall be taken manually every four hours during each overflow event.

8. Precipitation

The current SPDES permit states that precipitation data (inches of rain) shall be acquired hourly for each rain day of event and shall be reported as total per event.

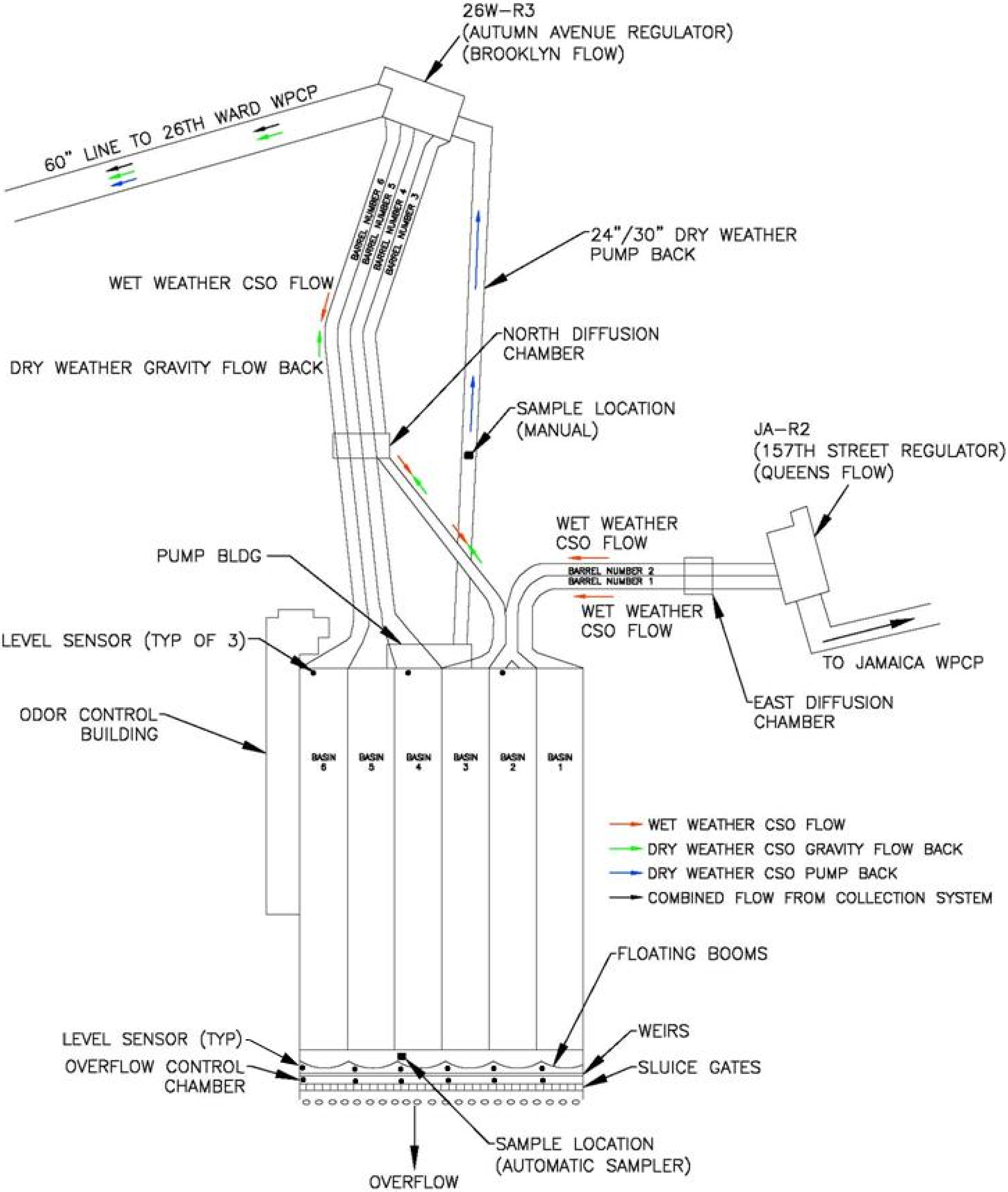


Figure 2-1
Spring Creek AWPCP Sample Locations

City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

Jamaica Water Pollution Control Plant
Wet Weather Operating Plant

Prepared by:
The New York City Department of Environmental Protection
Bureau of Wastewater Treatment

June 2007

Table of Contents

List of Tables

1.0 INTRODUCTION

New York State requires the development of a Wet Weather Operating Plan (WWOP) for collection systems that include combined sewers. This requirement is one of 13 Best Management Practices (BMPs) that New York includes in the SPDES permit requirements of plants with combined sewer systems. This particular provision has been included in consideration of the Federal Combined Sewer Overflow (CSO) policy that mandates maximization of flow to Publicly Owned Treatment Works (POTWs). This document provides an evaluation and specific guidance for the wet weather operation of the Jamaica WPCP during the planned stabilization upgrade of the WPCP that has been proceeding in multiple phases. Phase II of the stabilization upgrade is currently ongoing.

1.1 BACKGROUND OF EXISTING SYSTEM

The Jamaica WPCP is located in the Jamaica Bay area of Queens, New York**.** The Jamaica WPCP serves an area of 25,528 acres, with a design population of 740,000.

The first treatment facility at the site of the Jamaica plant was constructed in 1903. It was chemical precipitation process with lime addition, flocculation, settling and disinfection with chlorine. The plant was designed for flow of 1 MGD. On 1926, the old plant was demolished and the new facility with new fine screenings chamber, pumping station and chlorination was constructed. The facility was designed for average flow of 50 MGD.

In the late 1930's the plant was upgraded to a 65 mgd modified aeration plant. The design took advantage of the existing grit building, screening and pumping facilities, and added a blower and power building, a new chlorination building, a screenings dewatering building, four aeration tanks, eight final tanks, two sludge thickeners, and twelve digesters. Chlorination contact time was achieved through a 84-inch outfall pipe to Jamaica Bay.

The plant soon reached it design capacity and the plant upgrade to 100 mgd was achieved in 1960-1964. Expansion and upgrade included addition of two aerated grit chambers, four preliminary tanks, two aeration tanks, four final tanks, three sludge thickeners, and a chlorine contact tank. The plant was designed for step feed activated sludge process capable of 85% removal of BOD and suspended solids.

In 1971 the plant was further upgraded to the present design capacity. The upgraded plant was designed to provide primary treatment and chlorination to wet weather peak flow of twice design average dry weather flow (200 mgd), and secondary treatment to one an a half times average dry weather flow. In the 1990's, a sludge Dewatering Building was constructed at the plant under the City–Wide Sludge Management Program.

1.2 DRAINAGE AREA

The Jamaica WPCP drainage area is served by separate and combined sewers. A 96-inch diameter intercepting sewer serves the drainage area east of the Van Wyck Expressway. Most of the sewers serving this eastern area are separate sanitary sewers. The strictly sanitary sewers in the collection system, discharge to the interceptors without regulation. The drainage area west of the Van Wyck Expressway is served by a 72-inch diameter, intercepting sewer. The western area are combined sewers designed to carry both combined and storm water flows. Both intercepting sewers are connected to the treatment plant through a junction chamber located at 134th Street.

The Jamaica WPCP regulation system is comprised of 14 regulating structures, which include hydraulic sluice gates, fixed orifice outlets, diversion chambers and tide gate structures. During dry weather the sluice gate is wide open to admit all sanitary flow. A list of these regulators and outfall locations can be found in Table 1-2. Three regulators (Nos. 2, 3, and 14) will be automated under the Citywide SCADA Program which is part of the CSO Consent Order. The overflow from regulator No. 2 is routed to the Spring Creek CSO retention facility. Also note that five regulators in the Jamaica system (Nos. 1, 2, 3, 9, 14) are monitored through the telemetry system.

There are three pumping stations located in the Jamaica WPCP Drainage Area: St. Albans (Storm), Rosedale (Sanitary), and Howard Beach (Combined). It should be noted that Howard Beach is one of the largest pump stations (57.6 MGD capacity) in the New York City system.

1.3 WASTEWATER TREATMENT PLANT DESCRIPTION

Wastewater treatment at the plant consists of screening, primary settling, step aeration activated sludge, final settling and chlorination with sodium hypochlorite. Sludge treatment consists of cyclone degritting of primary sludge, gravity thickening of combined waste activated and primary sludge, anaerobic digestion and centrifuge dewatering. Some sludge from the plant is pumped to 26th Ward plant by a force-main. Centrate from the sludge dewatering facility is recycled through the plant, which adds a significant nitrogen load on the plant. Sludge cake, grit, scum and screenings are removed from the plant by truck for disposal to an off-site facility.

Plant Upgrading

Construction of the plant stabilization upgrading has been divided into multiple phases. Plant upgrading for the Jamaica WPCP will include installation of facilities to improve the plant's overall wastewater treatment process reliability and operation. Currently, Phase II construction is ongoing. Phase II improvements include the following:

Phase II:

- Process air system improvements including new refurbished blowers, silencers, air filters, air filters and diffusers.
- New Channel air system including blowers, filters, silencers, piping, and diffusers.
- Aeration tank improvements, including new motor operated influent gates, new diffusers and including replacement of the foam spray system.
- All thickener pumps replacement and installation of new grinders. Installation of one new mechanical sludge thickening filter press.
- Administrative/personnel building, new boilers.
- Degritting system and degritting equipment replacement, new secondary screens, primary sludge pumps and degritted primary sludge pumps replacement. Digester complex improvements including conversion of two storage tanks into two secondary digesters.
- Effluent water pumping station.
- Flushing Water System Upgrade
- Vehicle Maintenanceoff site building
- Associated instrumentation and control systems, including automatic DO control, flow monitoring and control systems, and pH analyzers. DCS tie-in.
- Screen chamber gate and inlet gate operation PST.
- Final tank improvements including new influent gates, new mechanical equipment, and modifications with EDI.
- Chlorination upgrades.
- Final grading, paving, and landscaping of land surrounding the new construction.
- Associated electrical, HVAC, and plumbing work

1.4 EFFLUENT PERMIT LIMITS

The Jamaica WPCP is currently operating under SPDES Permit No. 0026115. Under this SPDES Permit, the plant is rated at 100 mgd dry weather flow and 200 mgd wet weather flow. The current effluent flow, CBOD, TSS, and fecal coliform limits and monitoring requirements from the permit are summarized in Table 1-1 below.

Table 1-1: Jamaica WPCP
Conventional Effluent Limitations and Monitoring Requirements

PARAMETER	Limit	Monitoring Requirement
DRY WEATHER FLOW	100 mgd	(12-Month Rolling Avg.)

CBOD [1]	25 mg/l [2]	(30 day mean)
	40 mg/l	(7 day mean)
	50 mg/l [3]	6 consecutive hour avg.
TSS [1]	30 mg/l [2]	(30 day mean)
	45 mg/l	(7 day mean)
	50 mg/l	Daily maximum
	50 mg/l [3]	6 consecutive hour avg.
FECAL COLIFORM	200	(30 day geom. mean)
	400	(7 day geom. mean)
	800 [5]	6 hour geom. Mean
	2400 [5]	Instantaneous Maximum
TOTAL CHLORINE RESIDUAL	2 mg/l [4]	Daily maximum
pH	6.0 – 9.0 SU	Range

(1) Frequency: 1/day; Sample Type: 24-hour composite
(2) Effluent values shall not exceed 15% of influent values.
(3) During periods of wet weather influence, it is recognized that permittee may not be able to meet CBOD5 and suspended solids limits for effluent concentrations and mass loadings. Relief from these requirements shall be granted, if permittee can demonstrate that treatment is being maximized while up to maximum treatable flow is being accepted.
(4) During periods of wet weather influence, in order to achieve proper fecal coliform kill it may be necessary to exceed the effluent chlorine residual limit. Relief shall be granted, if permittee can demonstrate that such exceedances are necessary in order to provide optimum disinfection.
(5) This in an Interstate Environmental Commission (IEC) requirement. The permittee is not required to perform this sampling but shall be required to meet the permit limit at all times. EPA, DEC, or IEC may perform the sampling.

1.5 WET WEATHER FLOW CONTROL

Flow control of the plant is currently achieved by throttling of a plant influent gate when flows exceed 200 mgd. The plant has two influent gates installed in series (Gates “A” and “B”). For the past few years the plant has only utilized Gate A for throtttling. DEP had planned to install new actuators for both Gates A and B, but a recent inspection of the gates found Gate B to be in poor condition. DEP intends to remove Gate B to prevent a failure that could impact operation of the plant. Under the Phase II upgrade, DEP intends to install a new actuator only on Gate A for throttling control. Until Gate B is repaired, wet weather flow to the plant will be throttled by the current practice of closing Gate A which can result in high approach velocities to the screening area.

1.6 PERFORMANCE GOALS FOR WET WEATHER EVENTS

The goal of this Wet Weather Operating Plan is to maximize treatment of wet weather flows at the Jamaica WPCP and, in doing so, reduce the volume of untreated CSO being discharged to the Jamaica Bay and its tributaries. The Jamaica WPCP will be maintained in continuous operation by the NYC DEP during the entire construction period of the stabilization contracts. The major operating requirements include:

- The minimum acceptable level of treatment at the plant throughout the duration of the construction period shall be secondary treatment and disinfection.
- Dewatering and trucking of sludge, screenings, scum and grit, and the delivery of chemicals and fuel oil shall proceed throughout the duration of the Contract.

There are two primary objectives in maximizing treatment for wet weather flows:

1. Consistently achieve primary treatment and disinfection for wet weather flows up to 200 MGD. In doing so this, the plant will satisfy the SPDES requirement of providing this level of treatment for 2xDDWF.

2. Consistently provide secondary treatment for wet weather flows up to 150 MGD before bypassing the secondary treatment system. In doing so this plant will provide a secondary level of treatment for 1.5xDDWF in accordance with the SPDES requirement.

1.7 PURPOSE OF THIS MANUAL

The purpose of this manual is to provide a set of operating guidelines to assist the Jamaica WPCP staff in making operational decisions which will best meet their performance goals and the requirements of the NPDES discharge permit. During a wet weather event, numerous operational decisions must be made to effectively manage and optimize treatment of wet weather flows. Plant flow is controlled through influent pump operations and adjustment of regulators. Flow rates at which the secondary bypass is used are dependant upon a complex set of factors, including conditions within specific treatment processes (such as sludge settling characteristics) and anticipated storm intensity and duration. Each storm event produces a unique combination of flow patterns and plant conditions. No manual can describe the decision making process for every possible wet weather scenario which will be encountered at the Jamaica WPCP. This manual can, however, serve as a useful reference, which both new and experienced operators can utilize during wet weather events. The manual can be useful in preparing for a coming wet weather event, a source of ideas for controlling specific processes during the storm, and a checklist to avoid missing critical steps in monitoring and controlling processes during wet weather.

1.8 USING THIS MANUAL

This manual is designed as a reference during wet weather events. It is broken down into sections that cover major unit processes at the Jamaica WPCP. Each protocol for the unit processes includes the following information:

- List of unit processes and equipment covered in the section
- Steps to take before a wet weather event and who is responsible for these steps
- Steps to take during a wet weather event and who is responsible for these steps
- Steps to take after a wet weather event and who is responsible for these steps
- Discussion of why the recommended control steps are performed
- Identification of specific circumstances that trigger the recommended changes
- Identification of things that can go wrong with the process

This manual is a living document. Users of the manual are encouraged to identify new steps, procedures, and recommendations to further the objectives of the manual. Modifications, which improve upon the manual's procedures to maximize treatment of wet weather, are encouraged. With continued input from the plant's experienced operations staff this manual will become a useful and effective tool. Thus this WWOP will be updated periodically.

1.9 REVISIONS TO THIS MANUAL

In additions to revisions based on plant operating experience, this manual will also be revised as modifications and stabilizations are made to the collection system and the Jamaica WPCP that affect the plant's ability to receive and treat wet weather flows. Applicable changes are listed as follows:

- **Regulator Automation-** DEP intends to provide Regulator automation for Regulator Nos. 2, 3, and 14 to plant operators under the SCADA system project. Control strategies for these regulators will be incorporated into this manual after automation is complete.
- **Throttling Gate Automation-** Throttling Gate A will be actuated by a Trident type of operator under the Phase II upgrade. The objective of the throttling gate system is to automatically throttle flow into the plant to no more than 200 MGD during wet weather conditions, and to prevent the level in the afterbay channel from exceeding its normal elevation. The revisions to the operating procedure for the gate will be incorporated into this manual after automation is complete.
- **Future Construction Phases-** Future construction phases may impact the operation of the plant and may require revisions to this manual. Thus this manual will be updated periodically.

TABLE 1-2 Outfalls/ Regulators Jamaica WPCP			
Outfall	**Location**	**Size**	**Waterbody**
002	130th Place (Reg. #2, 4, 5)	84" DIA	Bergen Basin
003	123rd St (Reg. # 3)	DBL 8' x 9'	Bergen Basin
003a	123rd St (Reg. # 14)	DBL 13'6" x 9'	Bergen Basin
005	225th St (Reg. # 6, 7. 8, 9)	4BL 16' x 8'	Thurston Basin
006	JFK Airport (Reg. # 1)	3BL 19' x 9'	Head of Bergen Basin
007	225th St (Reg. # 6, 7, 8, 9)	4BL 17' x 6'	Thurston Basin

Reg. No.	Regulator Location	Type
1	JFK Airport	DC./TG.
2	79th St. & N.Conduit Ave.	HYD./Man.
3	123rd. St. & 150th Ave.	HYD.
4	Liberty Ave. & Van Wyck Exp.	DC.
5	134th St. & 150th Ave. (WPCP)	HYD.
6	225th St. & 138th Ave.	MECH.
7	135th Ave. & Springfield Blvd.	DC.
8	133rd. Ave. & Springfield Blvd.	DC.
9	Linden Blvd. & Springfield Blvd.	DC.
10	Linden Blvd. & Farmers Blvd.	DC.
11	Cross Bay Blvd. e/o 157th Ave.	TG.
11A	Cross Bay Blvd. & 157th Ave.	DC.
12	Cross Bay Blvd. & 159th Ave.	TG.
13	146th Ave. w/o 153rd. St.	TG.
14	124th St. & N.Conduit Ave.	HYD.

❖❖❖end of section❖❖❖

2.0 EXISTING FACILITY – WET WEATHER OPERATING PROCEDURES AND GUIDELINES

This section presents equipment summaries and wet weather operating protocols for each major unit operation of the plant The protocols are divided into steps to be followed before, during, and after a wet weather event and that address the rational trigger mechanisms and potential problem areas for wet weather operations. Table 2-1 located at the end of this Section outlines a summary of unit operation capacities.

2.1 THROTTLING GATES

The objective of throttling the gates during a storm event is to prevent the bar screen area from flooding and limiting the plant flow into the plant to twice design flow or 200 mgd.

2.1.1 Equipment for Throttling Gate System

Forebay Chamber (Proposed)	
Number of Gates	2
Service	Throttling
Type Operator	Hydraulic Actuator / Future - Trident

The objective of throttling the gate system is to automatically throttle flow into the plant to no more than 200 mgd during maximum wet weather conditions, and to prevent the level in the channel from flooding. To achieve both objectives the gate shall be controlled inversely proportional to the level in the wet well. The gate shall be fully open when the level in the wet well is below 14.9. The closure of the gate is physically limited such that the gate cannot be lowered below a fixed elevation corresponding to the maximum wet weather flow of 200 mgd entering the plant. The plant has two influent gates installed in series (Gates “A” and “B”). Gate A is in close proximity to the bar screens and Gate B is further upstream. DEP intends to remove Gate B and until Gate B is repaired, wet weather flow to the plant will be throttled by the current practice of closing Gate A which results in high approach velocities to the screening area.

2.1.2 Throttling Gates

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Senior Sewage Treatment Worker (SSTW)	Sewage Treatment Worker (STW)	• Gate should be in full open position during dry weather and prior to wet weather. • Check gate operation.
During Wet Weather Event		
SSTW	STW	• Leave gate in full open position until: 1. plant flow approaches capacity of pumps in service with wet well not to exceed above 14.9 elevation or 2. screen channel level exceeds acceptable level with maximum pumping, or 3. bar screens become overloaded with screenings or 4. grit removal exceeds the plants grit handling capacity • Set the gate to maintain acceptable wet well water level, 14.5 Hi and 10 Low. • Record all throttling gate adjustments on the Throttling Gate Log • As wet weather event subsides open the gate to maintain the wet well water level until the gate is completely open.
After Wet Weather Event		
SSTW	STW	• Make sure the throttling gate is in the full open position. • Conduct maintenance or repair of the throttling gate as necessary.
Why do we do this?		
To regulate flow to the WWTP and prevent excessive flows from destabilizing plant performance.		
What triggers the change?		
High water levels in the wet well or other unacceptable plant conditions related to high flows.		
What can go wrong?		
If the throttling gate is not operated when necessary, or fails to operate, high water levels in the wet well may result. Flooding of the screen chamber may occur.		

❖❖❖end of section❖❖❖

2.2 WASTEWATER SCREENING

The Jamaica WPCP has primary bar screens upstream of the main sewage pumps. The following information and protocol apply to the existing screens.

2.2.1 Equipment

Primary Screens	
Number of Units	4
Bar Openings	1”
Screen Channel Width (nominal)	8’-4”
Screen Channel Invert Elevation at Screens	(-)19’
Operating Higher Floor Elevation	13.75’

2.2.2. Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• During normal dry weather operations, operating experience will dictate the number of screens required based on parameters such as grit settling problems, and quantity of screenable material. Maintain the wet-well level at an elevation that will just “drown out” the wastewater streams as they leave the effluent gates of the screen channels in service to enter the wet well. The exact wet-well operating level to be selected for use depends on the wastewater flow rate per channel. Also, it depends on the requirements of keeping channel velocities high to prevent grit deposits and bar screen velocities low enough to prevent damage to the bar screen. • General guide for number of primary screens in service for various flow ranges: **Up to 50 MGD — 1 Primary Screen** **50 to 100 MGD — 2 Primary Screens** **100 to 150 MGD — 3 Primary Screens** **150 to 200 MGD — 4 Primary Screens** • Rotate screen operation to ensure that all available screens are in working order. Make sure empty screening containers are available.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
During Wet Weather Event		
SSTW	STW	• Put third and fourth primary screen into operation. • Set all screen rakes to continuous operation • Regulate the plant flow with the throttling gate and • pump speed • Remove and replace screening containers as necessary.
After Wet Weather Event		
SSTW	STW	• Take extra screen out of operation. Return to two screens online. • Remove screenings for disposal.
Why do we do this?		
Two primary screens can accommodate the plant design flow of 100 mgd. Three primary screens are required to handle up to 150 mgd and 200 mgd for four screens.		
What triggers the change?		
Whenever a rain event is anticipated all four screens are put online automatically.		
What can go wrong?		
If an insufficient number of screens are online the screen channel may surcharge above acceptable levels.		

❖❖❖end of section❖❖❖

2.3 WASTEWATER PUMPING

Five pumps are provided, although only three are needed to handle the anticipated peak flow when the largest pump is out of service. The remaining pumps are standby.

2.3.1 Equipment

EQUIPMENT	
Number of Pumps	5
Number of Standby Pumps	2
Type of Pump	Vertical, Mixed Flow Pumps
Suction and Discharge Size, In.	48; 42
Motor Horsepower/Type of Drive	800 Hp/WRM
Maximum RPM	450
Minimum Speed RPM	315
Flow, MGD	67
Head, Ft.	55

2.3.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• Monitor wet well elevation. • Number and speed of pumps in service are selected and manually adjusted by operator in the pump control room • Adjustments made based on maintaining the level in the wet well at a nominally constant level. • Check that wet well level monitors are functional. • If possible, prior to an anticipated wet weather event, draw down the interceptor by 1 to 3 feet • Check operation of screens

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
During Wet Weather Event		
SSTW	STW	• Monitor wet well elevation. • As wet well level rises put off-line pumps in service and increase speed of variable speed pumps as necessary • Pump to maximum capacity during wet weather events. • All adjustments are made manually by operators in the pump control room based on maintaining wet well level within desired operating range • Restrict flow through influent gates if pumping rate is maximized and wet well level continues to rise (See influent gate operations)
After Wet Weather Event		
SSTW	STW	• Maintain pumping rate as required to keep wet well level in operating range. • If the influent gates have been throttled, maintain maximum pumping rate until all previously constricted influent gates are returned to fully open position and flow begins to decrease lowering wet well level. • Reduce pump speeds and number in service to maintain wet well level and return to dry weather operation.
Why do we do this?		
Maximize flow to treatment plant, and minimize need for flow storage in collection system and associated overflow from collection system into receiving water body.		
What triggers the change?		
High flows, and the subsequent increase in the level of the wet well.		
What can go wrong?		
Pump fails to start. Pump fails while running. Screens blind, necessitating pump speed reduction or slowdown. Subsequent flooding of wet well and bar screen equipment.		

❖❖❖end of section❖❖❖

2.4 PRIMARY TANKS

The primary settling tanks are designed to effectively treat approximately 40 MGD each. If taking tanks out of service increases the flow to each tank above this amount, the primary settling effluent quality should be checked to avoid overloading and degradation of the secondary treatment process.

2.4.1 Equipment

Primary Settling Tanks	
5	200
4	160
3	120
2	80
1	40

Primary Settling Tanks		
Number of Tanks	5	2 Units - Eastside
Unit Dimensions (Ft.)		
Length	160	
Width	175	
Sidewater Depth	12	
Total Weir Length (Ft.)	280 / Tank = 1400	
	Design Average	**Design Peak**
Overflow Rate (gpd/sf)	1,670	3,330
Weir Loading (gpd/lf)	71400	142,900
Detention Time (Hr)	1.3	0.65

2.4.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SSTW	STW	• Under normal operations all available primary tanks should be in service. • Check the sludge collector operation and inspect tanks for broken flights. • Check for floating sludge or bubbles on the tank surface as an indication of sludge collector problems. • Check sludge pump operation. • Repair any malfunctions or equipment out of service.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
During Wet Weather Event		
SSTW	STW	• Make sure all <u>five</u> primary sludge pumps are on-line. • Check the collector and drive operation. • Make sure grit flushers are operating. • If the flight or major equipment in the tank fails, may take that particular tank out of service.
After Wet Weather Event		
SSTW	STW	• Take tanks out of service for repair or maintenance if necessary. • Remove floating debris and scum on the tanks. • Repair equipment failure as needed. • Clean the effluent weirs if needed.
Why do we do this?		
To provide settling for the increased flows.		
What triggers the change?		
Elevated flow rates and rising influent wet well levels.		
What can go wrong?		
Elevated water levels in the PSTs; sludge removal conduit clogging; collector shear-pin failure; primary sludge pump malfunction etc.		

❖❖❖end of section❖❖❖

2.5 BYPASS CHANNEL

That portion of the primary settling tank flow, which is in excess of the secondary treatment process capacity, must be bypassed around secondary treatment. This bypass automatically occurs by an adjustable overflow weir to limit the flow to a secondary treatment of 150 MGD (one and a half times greater then the design dry weather flow). All associated instrumentation will be replaced under a capital project. This includes a meter with a totalizer. At present, all instrumentation is out of service, and the secondary flow cannot be confirmed.

2.5.1 Equipment

EQUIPMENT	
Bypass Overflow Weir	Overflow Weir to a 54" pipe
Location of Weir	South of Pre-Tank No. 4 Outfall Channel

2.5.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• Conduct routine bypass checks, to see if not operational, set at exactly 150 mgd the weir overflows. • When operational, check the bypass flow meter.
During Wet Weather Event		
SSTW	STW	• Repair failures as necessary.
After Wet Weather Event		
SSTW	STW	• As the plant flow drops and stays at or below 150mgd, check to see that there is no overflow occurring from the weir.
Why do we do this?		
• To relieve flow to the aeration system and avoid excessive loss of biological solids. • To relieve primary clarifier flooding.		
What triggers the change?		
A flow of 150 MGD.		
What can go wrong?		
If the bypass gate is not used properly, the primary clarifiers may flood and the aeration tanks can discharge large amounts of biological solids.		

❖❖❖end of section❖❖❖

2.6 AERATION TANKS

2.6.1 Equipment

Equipment	NUMBER
Aeration Tanks	4
	Unit Dimensions (ft)
Length	31.5
Width	30
Number of Passes	4
Sidewater Depth	15

2.6.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• During normal dry weather operations, at least 3 aeration tanks should be in operation. • The plant operates in a step feed mode with inlets at the head of passes B, C, and D. Return Activated Sludge (RAS) is fed at inlet of A- pass. • Maintain the dissolved oxygen levels at or greater than 3 mg/L . • Monitor and check to see all required RAS pumps are working.
During Wet Weather Event		
SSTW	STW	• Monitor the dissolved oxygen and adjust the airflow to maintain greater than 3 mg/L. • During wet weather operations, at least four aeration tanks should be in operation
After Wet Weather Event		
SSTW	STW	• Monitor the dissolved oxygen, and maintain greater than 3 mg/L dissolved oxygen.
Why do we do this?		
The Jamaica WPCP is hydraulically designed to convey peak flows up to one and a half times the design dry weather flow under typical operating conditions. The flow to the aeration tanks is automatically controlled at the primary settling tanks storm overflow chamber so that storm flows in excess of 150 mgd or up to an additional flow of 50 mgd (total 200 mgd) are routed around the aeration and final settling tanks into the chlorine contact tanks.		

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
What triggers the change?		
Increasing speed and/or starting raw wastewater pumps to accommodate high wet weather flows.		
What can go wrong?		
Potential impacts of wet weather events on the activated sludge process include: • Loss of biomass from the aeration tanks and secondary clarifiers • Overloading of the aeration system resulting from high $CBOD_5$ loadings caused by solids washout from the sewer system and solids washout from the primary clarifiers • Decreased $CBOD_5$ and nitrogen removal efficiency due to shortened hydraulic retention time in the aeration tanks. The operator must be careful not to let the dissolved oxygen levels drop much below 3.0 mg/l because this can adversely affect secondary treatment efficiency.		

❖❖❖end of section❖❖❖

2.7 FINAL CLARIFIERS AND DISTRIBUTION

2.7.1 Equipment

Final Settling Tanks	**NUMBER**
Number of Units	12
Sidewater Depth (ft.)	12
Unit Dimensions Diameter (ft)	120

2.7.2 Wet Weather Operating Protocol

WHO DOES IT?		**WHAT DO WE DO?**
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SSTW	STW	• During normal dry weather operation all available final clarifiers should be in service. • Check the collars for plugging. Free any plugged collars. • Skim tanks as necessary.
During Wet Weather Event		
SSTW	STW	• Observe the clarity of the effluent and watch for solids loss. • If necessary, increase the RAS rate to maintain low blanket levels. • The secondary bypass gate is an adjustable weir that is set. • When secondary treatment flow exceeds 150 mgd, the flow would normally overflow.
After Wet Weather Event		
SSTW	STW	• Make sure the secondary bypass is not overflowing below 150 mgd. • Observe the effluent clarity. • Monitor the secondary clarifier blanket levels. • Skim the clarifiers if necessary.
Why do we do this?		
High flows will substantially increase solids loadings to the clarifiers, which may result in high clarifier sludge blankets or high effluent total suspended solids (TSS). These conditions can lead to loss of biological solids, which can destabilize treatment efficiency when the plant returns to dry weather flow conditions.		

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
What triggers the change?		
Flows in excess of 150 mgd.		
What can go wrong?		
Excessive loss of TSS will reduce the biomass inventory of the plant, which will adversely affect secondary treatment efficiency when the plant returns to dry weather flow conditions.		

❖❖❖end of section❖❖❖

2.8 CHLORINATION

2.8.1 Equipment

Equipment	**NUMBER**	
Number of Tanks	2	
Number of Bays per Tanks	3	
Hydrochlorite Storage Tanks	4	
Total Capacity Hydrochlorite Storage Tanks (gals.)	20,000	
Detention Time - Minutes	**2 Tanks in Service**	**1 Tank in Service**
Design Average Flow, 100 MGD	44	22
Peak Dry Weather Maximum, 110 MGD	30	15
Peak Weather Maximum 200MGD	22	11

2.8.2 Wet Weather Operating Protocol

WHO DOES IT?		**WHAT DO WE DO?**
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SSTW	STW	• Normal operation is to maintain full hypochlorite tanks. • Make sure there are sufficient chlorine residual test kit supplies. • Report problems immediately • Perform preventative maintenance on equipment if necessary
During Wet Weather Event		
SSTW	STW	• Check, adjust and raise the Hypochlorite feed rates to maintain storm chlorine residual between 0.65 to 0.85 mg/L. • Check and maintain the Hypochlorite tank levels.
After Wet Weather Event		
SSTW	STW	• Drop the Hypochlorite feed rates as needed to maintain the normal 0.50 to 0.65 mg/L chlorine residual. • Maintain the Hypochlorite tank levels. • Repair equipment as necessary.
Why do we do this?		
Hypochlorite demand will increase as flow rises and secondary bypasses occur. Increase the Hypochlorite feed rates to maintain the target chlorine residual.		

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
What triggers the change?		
High flows and secondary bypasses will increase Hypochlorite demand and usage.		
What can go wrong?		
Manual chlorination control with rapid flow changes and effluent quality changes can cause the chlorine residual to increase or decrease dramatically. Effluent chlorine residual must be monitored closely to maintain the target residual.		

❖❖❖end of section❖❖❖

2.9 SLUDGE THICKENING, DIGESTION, AND STORAGE

Sludge dewatering and the tracking of sludge, screenings, scum and grit shall proceed unimpeded throughout the duration of the plant upgrade

2.9.1 Equipment

Equipment	Design Condition	Present Condition
Sludge Thickeners		
Installed	3/2 + Mechanical	3/2
Operating	3/2 + Mechanical	3/2
Anaerobic Sludge Digesters		
Number of Units	6	6 (4 Primary and 2 Secondary)
Number of Units Operating	6	6
Sludge Storage		
Number of Storage Tanks	6	6
Storage Capacity (days)	13	11
Sludge Dewatering		
Number of Centrifuges	4	4
Unit Capacity	300	300

2.9.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
During Wet Weather Event		
SSTW	STW	• Sludge handling activities should proceed, as they normally would during dry weather flow. A major component of the plant return stream is centrate, which is related to dewatering operations.

Table 2-1. Rated Capacity for Equipment in Service at Jamaica WPCP				
Process Equipment	**Number of Units Installed**	**Number of Units in Service**	**Minimum Plant Influent Flow**	**Minimum Secondary Treatment Flow**
Screens	4	4 3 2 1	200 150 100 50	
Main Sewage Pump	5	4 3 2 1	200 150 100 50	
Primary Settling Tanks	5	5 4 3 2	200 160 120 80	
Aeration Tanks *	4	4 3 2	200 163 125	150 113 75
Final Settling Tanks *	12	12 11 10 9 8	200 188 175 163 150	150 138 125 113 100
Chlorine Contact Tanks	2	2 1	200 150	

Note: * - Minimum plant flow based on limited capacity of secondary bypass channel.

❖❖❖end of section❖❖❖

City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

Rockaway
Water Pollution Control Plant
Wet Weather Operating Plant

Prepared by:
The New York City Department of Environmental Protection
Bureau of Wastewater Treatment

December 2007

TABLE OF CONTENTS

Section 1 – Introduction **Page**

1.0 INTRODUCTION

One effective strategy to abate pollution resulting from CSOs is to maximize the delivery of flows during wet weather to a wastewater treatment plant for processing. Delivering these flows would maximize the use of available wastewater treatment plant capacity for wet weather flows and would ensure that combined sewer overflow would receive at least primary treatment prior to discharge. To implement this goal, New York State requires the development of a Wet Weather Operating Plan (WWOP) for collection systems that include combined sewers. This requirement is one of 13 Best Management Practices (BMPs) that New York includes in the SPDES permit requirements of plants with Combined Sewer Overflows (CSOs). This particular provision has been included in consideration of the Federal CSO policy that mandates maximization of flow to Publicly Owned Treatment Works (POTWs). The implementation of these plans will help The City to improve treatment of sewage during wet weather events, and will allow them to demonstrate compliance with the State and Federal BMP requirements.

1.1 BACKGROUND

The Rockaway Water Pollution Control Plant (WPCP) is located in the Rockaway section of Queens, New York, on the shore of Jamaica Bay**.** The Rockaway WPCP treats wastewater from a combined sewage collection system, which serves a population of approximately 98,000 and which drains storm water flow from an area of approximately 3,500 acres.

The Rockaway plant was constructed in two stages. The first stage was constructed in 1951 with a capacity to treat an average flow of 15 MGD. The second stage, constructed in 1962, provided modifications to the original facilities and increased the capacity to 30 MGD with a hydraulic capacity to pass a maximum flow of 60 MGD. The plant was upgraded again in the 1970’s to its current design average dry weather flow capacity of 45 MGD. The upgraded plant was designed to provide primary treatment and chlorination to wet weather peak flow of twice design average dry weather flow (90 MGD), and secondary treatment to 1.5 times average dry weather flow.

The Rockaway WPCP design average dry weather flow capacity is 45 MGD. In fiscal year 2003, flow to the plant averaged 19 MGD. (The trend of actual influent flow to the plant has been downward over the past several years, from approximately 30 MGD in the early 1990’s to 19 MGD in 2003.)

In 1997, DEP’s Office of Environmental Planning and Assessment (OEPA) developed water demand and wastewater flow projections for each of the City WPCPs. The high-end projected flow to the Rockaway WPCP to the year 2045 is 20.5 MGD, and the low-end flow projection is 17.4 MGD.

1.2 DRAINAGE AREA

Wastewater is conveyed to the Rockaway WPCP through two intercepting sewers on Beach Channel Drive. The areas to the west of the plant are served by a 48" interceptor, and those to the east are served by a 66" interceptor. The combined sewer system (east side) is designed to bypass peak storm flows to Jamaica Bay via a series of regulator structures. A typical regulator consists of one or more float controlled sluice gates, which regulate the flow to the interceptors.

There are four pumping stations located in the Rockaway WPCP Drainage Area. Of these, only one pumps combined sewage; the remaining three pump sanitary flow only. Table 1-2 lists the regulators and outfalls for the Rockaway WWTP drainage area.

1.3 WASTEWATER TREATMENT PLANT DESCRIPTION

Wastewater treatment at the plant consists of screening, primary settling, step aeration activated sludge, final settling and chlorination with sodium hypochlorite. Sludge treatment consists of cyclone degritting of primary sludge, gravity thickening of combined waste activated and primary sludge, and anaerobic digestion. Digested Sludge is transported via vessel to another DEP plant for centrifuge dewatering treatment. Grit, scum and screenings are removed from the plant by truck for disposal to an off-site facility

1.4 EFFLUENT PERMIT LIMITS

The Rockaway WPCP is currently operating under SPDES Permit No. 0026221. Under this SPDES Permit, the plant is rated at 45 MGD dry weather flow and 90 MGD wet weather flow. The current effluent flow, CBOD, TSS, and fecal coliform limits and monitoring requirements from the permit are summarized in Table 1-1 below.

Table 1-1: Rockaway WPCP
Conventional Effluent Limitations and Monitoring Requirements

Parameter	Limit	**Monitoring Requirement**
TOTAL FLOW	45 MGD	(30 day mean)
$CBOD_5$ (1)	25 mg/l (2)	(30 day mean)
	40 mg/l	(7 day mean)
	50 mg/l (3)	6 consecutive hour avg.
TSS (1)	30 mg/l (2)	(30 day mean)
	45 mg/l	(7 day mean)
	50 mg/l	Daily maximum
	50 mg/l (3)	6 consecutive hour avg.
FECAL COLIFORM	Not exceed 200/100 ml	(30 day geom. mean)
	Not exceed 400/100 ml	(7 day geom. mean)
	Not exceed 800/100 ml	6 hour geom. mean
TOTAL CHLORINE RESIDUAL	2 mg/l (4)	Daily maximum
pH	6.0 – 9.0 SU	Range

(1) Frequency: 1/day; Sample Type: 24-hour composite
(2) Effluent values shall not exceed 15% of influent values.
(3) During periods of wet weather influence, it is recognized that permittee may not be able to meet BOD5 and suspended solids limits for effluent concentrations and mass loadings. Relief from these requirements shall be granted if permittee can demonstrate that treatment is being maximized while up to maximum treatable flow is being accepted.
(4) During periods of wet weather influence, in order to achieve proper fecal coliform kill it may be necessary to exceed the effluent chlorine residual limit. Relief shall be granted, if permittee can demonstrate that such exceedances are necessary in order to provide optimum disinfection

1.5 WET WEATHER FLOW CONTROL

Original design of the collection system assumed that when it was necessary to limit flow to the plant, the regulators should be used in preference to throttling the plant inlet gates. Throttling at the inlet gates surcharges the interceptors, which in turn may cause deposition behind the gates or produce damaging velocities through the inlet gates and into the screen units located just downstream.

1.6 PERFORMANCE GOALS FOR WET WEATHER EVENTS

The goal of this Wet Weather Operating Plan is to maximize treatment of wet weather flows at the Rockaway WPCP and, in doing so, reduce the volume of untreated CSO being discharged to the Jamaica Bay and its tributaries.

There are three primary objectives in maximizing treatment for wet weather flows:

- Consistently achieve primary treatment and disinfection for wet weather flows up to 90 MGD before CSOs occur. In doing so the plant will satisfy the SPDES requirement of providing this level of treatment for 2xDDWF.

- Consistently provide secondary treatment for wet weather flows up to 67.5 MGD before bypassing the secondary treatment system. In doing so this plant will provide a secondary level of treatment for 1.5xDDWF.

- Note: The plant had been prematurely bypassing secondary treatment. This was probably due to two out of four aerators in service. Currently, the plant is operating with three aerators with the intent of delaying secondary bypassing until 1.5 x DDWF. In addition, the overflow weirs for the secondary bypass channel were raised four inches. Since Rockaway seldom receives 1.5xDDWFs, it has not been confirmed that the secondary system will not prematurely bypass.

- Do not appreciably diminish the effluent quality or destabilize treatment upon return to dry weather operations.

1.7 PURPOSE OF THIS MANUAL

The purpose of this manual is to provide a set of operating guidelines to assist the Rockaway WPCP staff in making operational decisions which will best meet their performance goals and the requirements of the NPDES discharge permit. During a wet weather event, numerous operational decisions must be made to effectively manage and optimize treatment of wet weather flows. Plant flow is controlled through influent pump operations and adjustment of regulators. Flow rates at which the secondary bypass is used are dependant upon a complex set of factors, including conditions within specific treatment processes (such as sludge settling characteristics) and anticipated storm intensity and duration. Each storm event produces a unique combination of flow patterns and plant conditions. No manual can describe the decision making process for every possible wet weather scenario which will be encountered at the Rockaway WPCP. This manual can, however, serve as a useful reference, which both new and experienced operators can utilize during wet weather events. The manual can be useful in preparing for a coming wet weather event, a source of ideas for controlling specific processes during the storm, and a checklist to avoid missing critical steps in monitoring and controlling processes during wet weather.

1.8 USING THE MANUAL

This manual is designed to allow use as a reference during wet weather events. It is broken down into sections that cover major unit processes at the Rockaway WPCP. Each protocol for the unit processes includes the following information:

- List of unit processes and equipment covered in the section
- Steps to take before a wet weather event and who is responsible for these steps
- Steps to take during a wet weather event and who is responsible for these steps
- Steps to take after a wet weather event and who is responsible for these steps
- Discussion of why the recommended control steps are performed
- Identification of specific circumstances that trigger the recommended changes
- Identification of things that can go wrong with the process

This manual is a living document. Users of the manual are encouraged to identify new steps, procedures, and recommendations to further the objectives of the manual. Modifications that improve upon the manual's procedures to maximize treatment of wet weather are encouraged. With continued input from the plant's experienced operations staff this manual will become a useful and effective tool.

1.9 REVISIONS TO THIS MANUAL

In additions to revisions based on plant operating experience, this manual will also be revised as modifications and stabilizations are made to the collection system and the Rockaway WPCP that affect the plants ability to receive and treat wet weather flows. Applicable changes are listed as follows:

- **Regulator Automation-** Under DEP's SCADA system project, automatic control of the regulators will be provided to plant operators. Control strategies for these regulators should be incorporated into this manual after automation is complete.

- **Throttling Gate Automation-** The automation system for the influent gates is not operable. The influent gate actuators will be replaced under a future upgrade project. This work has not been scheduled yet.
- **Future Construction Phases-** The upgrade of the Rockaway WPCP will be performed under multiple phases. The first phase is currently under design and 30% design drawings have been developed. The construction work related to Phase 1 has not been scheduled due to a lack of capital funding for the project.

TABLE 1-2 COMBINED SEWER OUTFALLS LOCATIONS

ROCKAWAY CSO SPDES OUTFALLS			
OUTFALL ID	**OUTFALL LOCATION**	**OUTFALL SIZE**	**RECEIVING WATER**
ROC-003	JAMAICA BAY & PLANT BYPASS	72" DIA	JAMAICA BAY
ROC-004	JAMAICA BAY & SEASIDE AVENUE	12" DIA	JAMAICA BAY
ROC-005	JAMAICA BAY & BEACH 102nd STREET	12" DIA	JAMAICA BAY
ROC-006	JAMAICA BAY & BEACH 101st STREET	8" DIA	JAMAICA BAY
ROC-007	JAMAICA BAY & BEACH 100th STREET	10" DIA	JAMAICA BAY
ROC-008	JAMAICA BAY & BEACH 99th STREET	12" DIA	JAMAICA BAY
ROC-009	JAMAICA BAY & BEACH 98th STREET	12" DIA	JAMAICA BAY
ROC-010	JAMAICA BAY & BEACH 97th STREET	12" DIA	JAMAICA BAY
ROC-011	JAMAICA BAY & BEACH 96th STREET	12" DIA	JAMAICA BAY
ROC-012	JAMAICA BAY & BEACH 94th STREET	10" DIA	JAMAICA BAY
ROC-013	JAMAICA BAY & BEACH 93rd STREET	12" DIA	JAMAICA BAY
ROC-014	JAMAICA BAY & BEACH 91st STREET	12" DIA	JAMAICA BAY
ROC-015	JAMAICA BAY & BEACH 88th STREET	DBL 36" DIA	JAMAICA BAY
ROC-016	NORTON BASIN & BAYSWATER AVENUE	60" DIA	NORTON BASIN
ROC-017	BANNISTER CREEK & BEACH 9th STREET	24" DIA	BANNISTER CREEK
ROC-029	JAMAICA BAY & BEACH 106 STREET	72" DIA	JAMAICA BAY
ROC-030	JAMAICA BAY & BEACH 104th STREET	12" DIA	JAMAICA BAY
ROC-031	MOTT BASIN & REDFERN AVENUE	11' X 4'6"	MOTT BASIN

❖❖❖end of section❖❖❖

2.0 EXISTING FACILITY – WET WEATHER OPERATING PROCEDURES

This section presents equipment summaries and wet weather operating protocols for each major unit operation of the plant. The protocols are divided into steps to be followed before, during and after a wet weather event that address the rational trigger mechanisms and potential problem areas for wet weather operations. Table 2-1 found at the end of this section summarizes plant systems and minimum capacities.

2.1 THROTTLING GATES

Wastewater is conveyed to the Rockaway Plant via two intercepting sewers along Beach Channel Drive. The area east of the plant is served by a 66-inch interceptor, while the area to the west is served by a 48-inch interceptor. The flow from each interceptor passes through a regulator chamber. The chambers are designed such that an increase in the water level in the regulator chamber causes floats located in the stilling basin to rise. At high flows, the floats mechanically activate regulating gates, which throttle the flow into the plant. Prior to entering the plant, the flow branches into four conduits, each having a hydraulically operated sluice gate at the plant entrance.

An analysis of Rockaway wet weather flow performance has shown favorable results with respect to effluent quality at the high end of observed flows. The peak flow to the plant never reaches NYSDEC's objective of 2XDDWF. However, in the event that peak flows do exceed 2XDDWF the following procedures are to be followed.

2.1.1 Equipment

Plant Influent Gates	
Number of Gates	4
Service	Throttling
Type Operator	Trident Hydraulic Operator

2.1.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SEE	SSTW/STW	• Gates are operated in a position slightly above the water level in order to contain gas fumes that enter the plant. Fully open is 62" typical level is 47." • Check gate operation.
During Wet Weather Event		
SEE	SSTW/STW	• Leave gate in full open position until: 1. Plant flow approaches capacity of pumps in service or 2. Screen channel level exceeds acceptable level with maximum pumping, or 3. Bar screens become overloaded with screenings or 4. Grit removal exceeds the plants grit handling capacity • Set the influent gates to maintain acceptable wet well water level • Record all influent gate adjustments on the Throttling Gate Log • As wet weather event subsides open the influent gates to maintain the wet well water level until the gate is completely open.
After Wet Weather Event		
SEE	SSTW/STW	• Make sure the influent gates are in the full open position. • Conduct maintenance or repair of the influent gates as necessary.
Why Do We Do This?		
To regulate flow to the WWTP and prevent excessive flows from destabilizing plant performance.		
What Triggers The Change?		
High water levels in the wet well or other unacceptable plant conditions related to high flows.		
What Can Go Wrong?		
• If the influent gates are not operated when necessary, or fails to operate, high water levels in the wet well may result. Flooding of the screen chamber may occur.		

❖❖❖end of section❖❖❖

2.2 WASTEWATER SCREENING

The Rockaway WPCP has primary bar screens upstream of the main sewage pumps. The following information and protocol apply to the existing screens.

2.2.1 Equipment

PRIMARY SCREENS	
Number of Units	4 units
Bar Openings	1"
Screen Channel Width (nominal)	4' - 0"

2.2.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operations, operating experience will dictate the number of screens required based on parameters such as grit settling problems, and quantity of screenable material. General guide for number of primary screens in service for various flow ranges: **Up to 30 MGD 1 Primary Screen** **30 to 60 MGD 2 Primary Screens** **60 to 90 MGD 3 Primary Screens** • Rotate screen operation to ensure that all available screens are in working order. Make sure empty screenings containers are available.
During Wet Weather Event		
SEE	SSTW/STW	• Normal operation typically involves two primary screens in service, which is enough capacity to handle a typical wet weather event. If required a third screen is put into service with a fourth pump. • Set all screen rakes to continuous operation if needed in order to prevent blinding.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
		• Regulate the plant flow with the influent gates if the screens become overwhelmed or the water elevation in the screen channel exceeds -15.0. • Remove and replace screenings containers as necessary.
After Wet Weather Event		
SEE	SSTW/STW	• Take extra screen out of operation. Return to one screen online. • Remove screenings for disposal.
Why Do We Do This?		
One primary screen can accommodate the plant average flow of 20 mgd. Two primary screens are required to handle normal wet weather flows up to 60 mgd. A third screen can be put into operation if excessive flows are seen. This leaves the fourth screen on standby in case of a screen failure or excessive loadings.		
What Triggers The Change?		
Flows in excess of 30 mgd will require a second primary screen to be put online. During a wet weather event, once a third pump goes into operation a second screen is put into service. The screen rakes will operate in automatic mode with shorter time cycles or will be operated in manual mode depending on the severity of the wet weather event.		
What Can Go Wrong?		
If an insufficient number of screens are online the screen channel may surcharge above acceptable levels (-15.0)		

❖❖❖end of section❖❖❖

2.3 MAIN SEWAGE PUMPS

2.3.1 Equipment

Main Sewage Pumps	
Number of Pumps	5
Number of Standby Pumps	2
Type of Pump	Mixed flow Centrifugal pumps
Suction and Discharge Size, In.	24 / 20
Motor Horsepower/Type of Drive	200 Hp/Vertical Mount – Direct Drive
Maximum Speed , RPM	600
Minimum Speed, RPM	425
Flow, MGD	17
Head, Ft.	50

2.3.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Monitor wet well elevation. • Number and speed of pumps in service are selected and manually adjusted by operator in the pump control room • Adjustments made based on maintaining the level in the screen chamber after bay at a nominally constant level • Check that wet well level monitors are functional.
During Wet Weather Event		
SEE	SSTW/STW	• Monitor wet well elevation. Set all screen rakes to continuous operation. • As wet well level rises put off-line pumps in service and increase speed of variable speed pumps as necessary • Pump to maximum capacity during wet weather events always leaving one pump out of service as standby • All adjustments are made manually by operators in the pump control room based on maintaining wet well level within desired operating range • Restrict flow through influent gates if pumping rate is maximized and wet well level continues to rise (See influent gate operations)

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
After Wet Weather Event		
SEE	SSTW/STW	• Maintain pumping rate as required to keep wet well level in operating range. • If the influent gates have been throttled, maintain maximum pumping rate until all previously constricted influent gates are returned to fully open position and flow begins to decrease lowering wet well level. • Reduce pump speeds and number in service to maintain wet well level and return to dry weather operation.
Why Do We Do This?		
Maximize flow to treatment plant, and minimize need for flow storage in collection system and associated overflow from collection system into receiving water body.		
What Triggers The Change?		
High flows, and the subsequent increase in the level of the screen chamber after bay.		
What Can Go Wrong?		
Pump fails to start. Pump fails while running. Screens blind, necessitating pump speed reduction or slowdown. Subsequent flooding of wet well and bar screen equipment.		

❖❖❖end of section❖❖❖

2.4 PRIMARY TANKS

The primary settling tanks are designed to effectively treat approximately 22.5 MGD each. If taking tanks out of service increases the flow to each tank above this amount, the primary settling effluent quality should be checked to avoid overloading and degradation of the secondary treatment process.

2.4.1 Equipment

Number of Primary Settling Tanks in Service	Maximum Sustainable Flow Rate (Approx.)	
4	90 MGD	
3	67.5 MGD	
2	45 MGD	
1	22.5 MGD	
	Design Average	**Design Peak**
Overflow Rate (gpd/sf)	2,000	4,000
Weir Loading (gpd/lf)	17,000	34,000
Detention Time (Hr)	1.08	0.54
Longitudinal Collectors	8	
Cross Collector	4	
Grease Pit	1	
Skimmings Dipping Weir w/ Trough	2 per tank	
Clam Shell	1	
6 Cubic Yard (cy) Container	4-6 (Dependent on availability)	
Primary Sludge Pump Stations (PSPS)	1	
Primary Sludge Pumps (PSPs)	6 (2 Standby)	
Cyclone Degritters	Total 4 4 In service	
Grit Washers	Total 2 2 In Service	

2.4.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SEE	SSTW/STW	• Under normal operations all available primary tanks should be in service. • Check the flow balance to all tanks in service by looking at the effluent weirs. • Check the sludge collector operation and inspect tanks for broken flights. • Check for floating sludge or bubbles on the tank surface as an indication of sludge collector problems. • Check sludge pump operation. • Repair any malfunctions or equipment out of service.
During Wet Weather Event		
SEE	SSTW/STW	• Make sure four primary sludge pumps are on-line. • Watch water surface elevations at the weirs for flooding and flow imbalances. • Check the collector and drive operation. • Make sure grit flushers are operating. • Assign additional operators to grit handling if necessary. • Repair equipment failures as needed. • Reduce flow (sewage pumps and throttling gate) if: 1. Sludge cannot be withdrawn quickly enough from the primaries, 2. Grit accumulation exceeds the plants ability to handle it, 3. A primary tank must be taken out of service.
After Wet Weather Event		
SEE	SSTW/STW	• Take tanks out of service for repair or maintenance if necessary. • Remove floating debris and scum on the tanks. • Repair any failures. • Clean the effluent weirs if needed.

❖❖❖end of section❖❖❖

2.5 BYPASS CHANNEL

That portion of the primary settling tank flow, which is in excess of the secondary treatment process capacity, must be bypassed around secondary treatment.

2.5.1 Equipment

BYPASS CHANNEL	
Bypass Overflow Weir	3 Overflow weir boxes
Location of Weirs	West end of primary effluent channel

2.5.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Check the bypass flow meter operation.
During Wet Weather Event		
SEE	SSTW/STW	• During bypasses record the bypass flow rate on the Bypass Log. • Repair failures as necessary.
After Wet Weather Event		
SEE	SSTW/STW	• As the plant flow drops and stays below 67.5mgd, check to see there is no overflow occurring from the weirs.
Why Do We Do This?		
• To relieve flow to the aeration system and avoid excessive loss of biological solids. • To relieve primary clarifier flooding.		
What Triggers The Change?		
High blankets in final clarifiers, as well as primary and/or secondary treatment system flooding.		
What Can Go Wrong?		
If the bypass gate is not used properly the primary clarifiers may flood and secondary clarifier sludge blankets could rise and discharge large amounts of biological solids.		

❖❖❖end of section❖❖❖

2.6 AERATION TANKS

2.6.1 Equipment

Aeration Tanks	
Number of Tanks	4 units
Length	143.33 ft
Width of Pass	22.75 ft
Number of Passes Per Tanks	4
Sidewater Depth	18 ft
Diffuser System	Ceramic Tube

2.6.2 Wet Weather Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operations, 2 aeration tanks should be in operation. • The plant operates step feed activated sludge with B, C, and D addition. • Check the dissolved oxygen levels and control the airflow to maintain greater than 3 mg/L in the aeration tanks. • Monitor Filamentous Growth
During Wet Weather Event		
SEE	SSTW/STW	• Monitor the dissolved oxygen and adjust the air flow to maintain greater than 3 mg/L in the aeration tanks.
After Wet Weather Event		
SEE	SSTW/STW	• Monitor the dissolved oxygen, and maintain greater than 3 mg/L dissolved oxygen in aeration tanks.
Why Do We Do This?		
The Rockaway WPCP is hydraulically designed to convey peak flows up to 1.5 times the Design Dry Weather Flow (DDWF) under typical operating conditions.		
What Triggers The Change?		
Increasing speed and/or starting raw wastewater pumps to accommodate high wet weather flows.		

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	

What Can Go Wrong?

Potential impacts of wet weather events on the activated sludge process include:

- Loss of biomass from the aeration tanks and secondary clarifiers
- Overloading of the aeration system resulting from high CBOD loadings caused by solids washout from the sewer system and solids washout from the primary clarifiers
- Decreased CBOD and Nitrogen removal efficiency due to shortened hydraulic retention time in the aeration tanks.
- The operator must be careful not to let the dissolved oxygen levels drop much below 3.0 mg/l in the aerators because this can adversely affect secondary treatment efficiency.

❖❖❖end of section❖❖❖

2.7 FINAL CLARIFIERS AND DISTRIBUTION

2.7.1 Equipment

FINAL SETTLING TANKS		
Number of Tanks	4	
Length	250.0 ft	
Width	56.5 ft	
Sidewater Depth	12.0 ft	
Flight & Chain Sludge Collection System	16 longitudinal collectors; 2 Cross Collectors	
Manually Rotary Dipping Weir	2 per tank	
Skimmings Concentration Pit	1	
Skimmings Trough	2 per tank	
Clam Shell	None	
6 Cubic Yard (cy) Container	N/A (Collection goes to plant headworks)	
	Design Average	**Design Peak**
Surface Settling Rate (gpd/sf)	800	1,200
Weir Overflow Rate (gpd/lf)	27,000	40,500
Detention Time (Hr)	2.7	1.8

2.7.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operation all available final clarifiers should be in service. • Check the telescoping weirs for plugging. Clean dirt weirs. • Observe blanket levels, tank surface. • Skim tanks as necessary. • Check the flow balance to all tanks in service by looking at effluent weirs. • Normal operation is to set the RAS rates to maintain a minimal sludge blanket
During Wet Weather Event		
SEE	SSTW/STW	• Balance flows to the tanks to keep the blanket levels even. • Observe the clarity of the effluent and watch for solids loss. • Monitor the sludge blanket levels. • If necessary, increase the RAS rate to maintain low blanket levels.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
After Wet Weather Event		
SEE	SSTW/STW	• Modify the sludge wasting based on MLSS levels. • Observe the effluent clarity. • Monitor the secondary clarifier blanket levels. • Skim the clarifiers if necessary.
Why Do We Do This?		
High flows will substantially increase solids loadings to the clarifiers which may result in high clarifier sludge blankets or high effluent TSS. These conditions can lead to loss of biological solids, which can destabilize treatment efficiency when the plant returns to dry weather flow conditions.		
What Triggers The Change?		
Rising sludge blankets that cannot be controlled.		
What Can Go Wrong?		
Excessive loss of TSS will reduce the biomass inventory of the plant which will adversely affect secondary treatment efficiency when the plant returns to dry weather flow conditions.		

❖❖❖end of section❖❖❖

2.8 CHLORINATION

2.8.1 Equipment

Chlorination System		
Number of Tanks	2	
Number of Passes Per Tank	2	
Hypochlorite Storage Tanks	4	
Total Capacity Hypochlorite Tanks	36000	
Sodium Hypochlorite Metering Pump	3	
Dilution Water Pumps - Automatic Strainer - Manual Strainers	2 2 None	
Skimmings Trough w/ Weir	None	
Sump Pit	None	
Chopper Pumps	None	
Hydraulic Actuated Slide Gate	None	
Detention Time - Minutes	**3 Tanks in Service**	**2 Tank in Service**
Design Average Flow, 45 MGD	38.2	23.8
Dry Weather Maximum, 25 MGD	69.3	42.8
Peak Weather Maximum, 90 MGD	19.2	11.9

Proper chlorine disinfection relies on required exposure time to adequately disinfect secondary effluent. During periods of extreme wet weather, there may be insufficient exposure time in the chlorine contact tank to adequately disinfect the effluent. In addition, excessive solids in secondary effluent resulting from high flows can hinder disinfection as well. In spite of the potential for reduced effectiveness, it is preferable to send as much flow through the disinfection units as possible to achieve some level of disinfection. Recommendations for maximizing chlorine disinfection efficiency during high flows include:

- Experiment with chlorine dosage at high flows. Adequate kills may be achievable at detention times of less than 15 minutes with the proper chlorine dosage.
- Optimize chlorine mixing. Poor mixing will greatly reduce chlorination effectiveness.

2.8.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	**IMPLEMENTATION**	
Before Wet Weather Event		
SEE	SSTW/STW	• At least two chlorination tanks should be in service. • Normal operation is to maintain full hypochlorite tanks. • Check, adjust and maintain the Hypochlorite feed rates to provide a chlorine effluent residual target. • When the chlorination system is on automatic, the hypo feed rate is controlled by a feed forward controller based on a Hach CL-17 chlorine residual meter. When the chlorination system is on manual, the operator will control the hypo feed rate based on titrations for chlorine residual, the change from the last reading, and the change in flow conditions. When the chlorine residual is on target, the operator checks the residual every hour. When the chlorine residual is out of the target range, the operator checks the residual every half hour. • Report problems immediately • Perform preventative maintenance on equipment if necessary.
During Wet Weather Event		
SEE	SSTW/STW	• Check, adjust and maintain the Hypochlorite feed rates to provide a chlorine effluent residual target. • When the chlorination system is on automatic, the hypo feed rate is controlled by a feed forward controller based on a Hach CL-17 chlorine residual meter. When the chlorination system is on manual, the operator will control the hypo feed rate based on titrations for chlorine residual, the change from the last reading, and the change in flow conditions. When the chlorine residual is on target, the operator checks the residual every hour. When the chlorine residual is out of the target range, the operator checks the residual every half hour. • Check and maintain the Hypochlorite tank levels.
After Wet Weather Event		

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td>SEE</td><td>SSTW/STW</td><td>• Drop the Hypochlorite feed rates as needed to maintain the chlorine residual.
• When the chlorination system is on automatic, the hypo feed rate is controlled by a feed forward controller based on a Hach CL-17 chlorine residual meter. When the chlorination system is on manual, the operator will control the hypo feed rate based on titrations for chlorine residual, the change from the last reading, and the change in flow conditions. When the chlorine residual is on target, the operator checks the residual every hour. When the chlorine residual is out of the target range, the operator checks the residual every half hour.
• Maintain the Hypochlorite tank levels.
• Repair equipment as necessary.</td></tr>
<tr><td colspan="3">Why Do We Do This?</td></tr>
<tr><td colspan="3">Hypochlorite demand will increase as flow rises and secondary bypasses occur. Increase the Hypochlorite feed rates to maintain the target chlorine residual.</td></tr>
<tr><td colspan="3">What Triggers The Change?</td></tr>
<tr><td colspan="3">High flows and secondary bypasses will increase Hypochlorite demand and usage.</td></tr>
<tr><td colspan="3">What Can Go Wrong?</td></tr>
<tr><td colspan="3">Manual chlorination control with rapid flow changes and effluent quality changes can cause the chlorine residual to increase or decrease dramatically. Effluent chlorine residual must be monitored closely to maintain the target residual.</td></tr>
</table>

❖❖❖end of section❖❖❖

2.9 SLUDGE THICKENING, DIGESTION AND STORAGE

2.9.1 Equipment

Sludge Thickening Digestion and Storage	
Present Condition	
Waste Activated Sludge Handling	
Waste Activated Sludge (WAS) Wet Well	1
WAS Pumps	4
Polymer Pumps	None
SLUDGE THICKENERS	
Installed	6
Operating	2
Anaerobic Primary Sludge Digesters	
No. of Units	3
No. of Units Operating	2 (1 is meso, 1 is thermo, 1 is o/o/s)
Anaerobic Secondary Sludge Digesters	
No. of Units	4
No. of Units Operating	0 (not heated, used as decant)
Sludge Storage	
No. of Storage Tanks	2 (plus 4 secondary digesters for decant)
Storage Capacity (Days)	approx. 12 days

2.9.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
During Wet Weather Event		
SEE	SSTW/STW	• Sludge handling activities should proceed as they normally would during dry weather flow. • Balance-Water flow to the thickeners can also be reduced before any changes in sludge wasting are made.

Table 2-1. Rated Capacity for Equipment in Service				
Process Equipment	**Number of Units Installed**	**Number of Units in Service**	**Minimum Plant Influent Flow**	**Minimum Secondary Treatment Flow**
Screens	4	3 2 1	90 60 30	
Main Sewage Pump	7*	7 6 5 4 3 2 1	90 90 85 68 51 34 17	
Primary Settling Tanks	4	4 3 2 1	90 67.5 45 22.5	
Aeration Tanks	4	4 3 2 1		67.5** 51** 34 17
Final Settling Tanks	4	4 3 2 1		67.5 51 34 17
Chlorine Contract Tanks	2	2 1***	90 45	

*Two of the seven main sewage pumps are located at a higher elevation and can only be put in service under extreme wet weather conditions.
**Current plant operation uses two aeration tanks in order to maintain a more stable dry weather operation. Fortunately the Rockaway WPCP only rarely sees wet weather flows severe enough to impact a 2-tank system.
*** The third Chlorine Contact Tank is used only as a flow through channel.

Jamaica Bay Stakeholder Team
Meeting No. 1
June 22, 2006

The first Jamaica Bay Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on June 22nd at the Ryan Visitor's Center in Floyd Bennett Field. The purpose of the meeting was to introduce the Long Term Control Plan for Combined Sewer Overflow (CSO) and discuss the implications for Jamaica Bay and its tributaries.

Stephen Whitehouse of Starr Whitehouse, consultants coordinating public participation for the project, opened the meeting by introducing John Gebrian, project engineer from O'Brien and Gere, and DEP officials. He said the meeting would be introductory and that later meetings will focus on developing abatement alternatives. Stephen added that a city-wide stakeholder group is looking at CSO issues in the harbor and asked for a nominee for that committee.

Stephen described the Long Term Control Plan, a city wide project to improve the quality of water through the reduction of the number and volume of CSO events. Roughly 60% of the Jamaica Bay drainage area is served by combined sewers. CSO incidents occur when the flow from a storm event exceeds the capacity of the treatment plant or conveyance system, in which case combined sewage—a mixture of sanitary and storm sewage—is discharged into adjacent waterbodies. Of the 450 CSO locations in New York City, only a small number are in Jamaica Bay, but they tend to serve comparatively larger upland drainage areas that yield proportionately greater volumes during storms.

Stephen described the regulatory process that has led to the current LTCP project. 1994 EPA CSO policy delineated the LTCP process, which was clarified and expanded in the 2000 Wet Weather Quality Act. In 2004 Consent Order between NYS Department of Environmental Conservation and the NYCDEP committed the City to a schedule of CSO abatement projects and set out the specific process and schedule for the LTCP. The LTCP differs from concurrent Jamaica Bay Watershed Protection Plan (WPP) insofar as LTCP looks at CSO issues across the entire City while the Jamaica Bay WPP is examining a broader range of issues within a smaller geography.

John Gebrian indicated the location of the CSO areas in Jamaica Bay. He spoke about the city's efforts over the years for improving water quality in Jamaica Bay. John described the water quality issues, which include dissolved oxygen, odors, and pathogens. He said Jamaica Bay attains the Dissolved Oxygen Water Quality Standards (WQS) 96% of the time, while Grassy Bay attains the WQS 81% of the time. In the summer months, Jamaica Bay attains Dissolved Oxygen WQS 87% of the time and Grassy Bay attains WQS 35% of the time. John said that CSOs are not an important contributing factor in the low dissolved oxygen (DO) counts in the Bay but are a larger problem in the tributaries, where there is poor circulation. John then detailed the specific provisions in the consent order.

Several stakeholders suggested that the DO figures should be compared to John Taracredi's at NPS. They expressed concern that the testing points are not representative of the Bay.

John then described the LTCP process. He said that next step is creating a model simulation to help the team to evaluate alternatives. He stated that he wants the stakeholder group to identify the kind of water quality improvements that they want and help to evaluate them against community concerns as well as cost and performance.

The floor was opened to questions.

- Several stakeholders asked for precision about the location of combined and separate sewers. Stephen said that they would bring a map of this for the next time but that generally Jamaica Bay is served with combined sewers.

- Another stakeholder stated the need for public education about stormwater drains. She spoke about a locally-initiated project to stencil the storm drains and difficulties in implementing it. John Gebrian suggested bringing the issue up in the WPP.

- Another stakeholder asked about the bulkheads being built by DDC in Shellbank Creek. She said that they are being built without fallout. Stephen said that the team would look into it.

- One stakeholder took exception to the statement that the quality of the New York Harbor is the best it's ever been. He felt it was important to address nitrogen issues at every opportunity. John and Stephen reiterated that CSOs are not the cause of the nitrogen problems and suggested pressing the issue in the WPP.

- On stakeholder asked whether it was possible to put forward updates after the plan's submission, given that the current level of development could impact the feasibility of the plan. John responded that the LTCP will likely include 15-50 specific improvements in Jamaica Bay which would become obligations. Stephen added that the LTCP is working with population projections to 2045 to avoid that problem. Several more questions were asked about how growth was being taken into account in the model. Stephen and John explained how the projections were developed based on extrapolations. John added that they have developed baseline figures for water use per person.

- One stakeholder stated his preference for building tanks.

Stephen suggested that we go around the room and that stakeholders specify the way that they use the Bay. The group, composed of activists, advocates, and life-long residents, partake in a number of uses, the most prevalent being boating and fishing, followed by scuba diving, bathing, waterskiing, and birding.

Each of the stakeholders spoke to their own experience of Jamaica Bay. Some common concerns emerged including:

> High Nitrogen Levels

> Increased Residential Development and the Capacity of the Sewers

> Degradation of Wetlands and Marshlands, important to natural systems and habitat.

> Lack of Public Access to the Bay for Boating and Swimming

> Need for Public Education Concerning Separate Sewers

Other issues include:

> Recurring plans (by others) to dispose of Dredge Materials in Barrow Pits.

> Fishing, both the decreasing yields and quality of the fish

> Odors

> Clarity of the Water

The next meeting will be on September 14th. Meeting notes will be made available through the study area web site. Hard copies are available on request. Additional background materials are also available on the password protected web site.

Jamaica Bay Stakeholder Team
Meeting No. 2
September 14, 2006

The second Jamaica Bay and Tributary Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on September 14th at the Ryan Visitor's Center in Floyd Bennett Field. The objectives of the meeting were: to describe investigations or analyses performed as part of the project; to provide background on water quality planning requested at the last meeting; and to finalize lists of existing uses and goals for the waterbody.

Mark Klein, DEP, started the meeting and introduced Stephen Whitehouse, Starr Whitehouse, a consultant for public participation. Stephen asked for changes in the meeting notes from the first Stakeholder team meeting of 6/22/06; there were none. A stakeholder asked about the new schedule for the Jamaica Bay Watershed Protection Plan (WPP). John McLaughlin, DEP, said that submission has moved to October 1st and will be followed by a public meeting on October 4th at the Ryan Visitor Center. The stakeholder asked for a clarification of the differences between the WPP and the LTCP. Stephen replied that the LTCP focuses on the city-wide CSO problem while the WPP takes a comprehensive look at Jamaica Bay. Stephen then asked if stakeholders were willing to share their names and affiliations within the group. They agreed. A stakeholder noted that there will be a meeting to review the Paerdegat Basin Long Term Control Plan on September 26th at the Henry Hudson Yacht Club. The draft is on view at Community Board 18 and the Paerdegat Branch of the Brooklyn Public Library. There was a request to post the Paerdegat LTCP to the project website.

John Gebrian, O'Brien and Gere, gave an overview of Jamaica Bay. He described previous water quality work, including the Use and Standards Attainment Project, the predecessor of the current plan. John said that initial work on CSO in Jamaica Bay examined each tributary separately. In contrast, the LTCP treats the bay as an integral system. He shared maps of the combined and separate sewer sheds and reviewed the water quality standards for the tributaries and the bay. John stated that issues include low dissolved oxygen, from the WPCP's in the bay and from CSO in the tributaries. Additionally, elevated nitrogen levels cause the eutrophic conditions familiar to the stakeholders. There are high levels of pathogens in the tributaries, resulting from CSO, and odor problems. John spoke about DEP activities to reduce stormwater and improve capture. He then reviewed the LTCP process. A stakeholder asked him to clarify the difference between a Waterbody/Watershed Plan (WB/WS) and the LTCP. John said that the goal in creating the WB/WS plan, essentially a draft LTCP, is to set out the goals for a waterbody as determined by a scientific process. The LTCP, which will need to be approved by the NYS Department of Environmental Conservation (DEC), is a design and engineering phase. John added that, given that a good deal of work has been completed in other waterbodies prior to the WB/WS process, the difference between the WB/WS and LTCP is not always clear. Stephen Whitehouse added that the WB/WS plan, developed by stakeholder groups and technical teams, may see alterations by DEC before it becomes a LTCP. The stakeholder asked what role DEP has in the LTCP phase, particularly in terms of public participation. Stephen will look for that information for the next meeting.

Beau Ranheim, the section chief of the DEP Harbor Survey Program, spoke about water sampling, used as baseline data for the LTCP. The Harbor Survey has been ongoing for 97 years and currently gauges dissolved oxygen (DO), temperature, salinity, TSS, pH, nutrients, and bacteria. The monitoring results demonstrate a harbor-wide decrease in bacteria over the last three decades. In Jamaica Bay, sampling occurs during the summer, typically beginning on May 15th or before DO levels begin to fall. Beau showed graphs of bay-wide averages on graphs, including: DO; suspended solids; ammonia, which is decreasing; nitrate and nitrite; phosphorus, which is increasing; and chlorophyll, which is generally high. He showed maps that break down the different conditions across the bay. The maps show particularly low DO and a high concentration of chlorophyll in Grassy Bay. Ammonia levels are high near to the JFK airport. As of yet, the team cannot ascertain why. A stakeholder mentioned that these issues were not taken into account in the issuance of a new permit for the airport but encouraged his fellow stakeholders to participate in the ongoing public comment period. One stakeholder urged Beau to consider the effect of the wind on the water quality. Beau said that he would speak with water quality modelers at Hydroqual. Lastly, Beau spoke about the remote monitoring program, which allows for continuous data capture. He gave the public a web address so that they can look up current conditions at specific sites. Several stakeholders expressed interest in this technology. A stakeholder asked about the water quality sampling concurrent with the LTCP. Beau confirmed that there will be additional sampling. He added that compliance monitoring will continue for ten years after the plan is approved. A stakeholder asked how the sampling schedule took into account the different tidal conditions. Beau said his team visits each of the Harbor Survey sampling locations on a regular weekly schedule, which indirectly allows for variations in tidal conditions but is not specifically designed to seek out different tidal conditions.

Next, Rich Isleib, from Hydroqual, described the process of modeling in Jamaica Bay. The LTCP will rely on modeling to evaluate and quantify the effects of different alternatives. A model, Rich explained, creates an equation that looks at the entire system, taking into account of a variety of components. Rich went over the model components, including the bathymetry, the 3-dimensional shape of the waterbody, including depths, channels, and shorelines; transport, or the motion of the water; loading sources, such as the volume of rainwater a waterbody receives after a storm, or the outflow from the WPCPs; and reactions, or the fate of pollutants. The modeling team will calibrate the model by verifying that the model reproduces observed data points. Once the model is calibrated, the model can measure an alternative's impact on the water quality. Rich presented three different models that will be used for the LTCP. The Jamaica Bay Eutrophication Model looks at the whole waterbody at a larger grid, of 1000ft. x 1000ft. The North Channel Model and Bergen and Thurston Basin are fine grained models of the tributaries. Rich said that, for this project, they would focus on the impacts of CSO. The model will be used to evaluate related alternatives such as the impacts of sewer reconfigurations; upgrades and modifications at WPCPs; CSO storage; and aeration. One stakeholder was concerned that Best Management Practices (BMP) were not included on the list and maintained that BMP should be a central part of the LTCP. Rich affirmed their impacts would be analyzed in the landside model. Stephen stated that, while the team is supportive of BMP, the LTCP is time sensitive and, since the effects of BMP have not been quantified, it was difficult to include them as a solution in an enforceable plan. The stakeholder said that in another stakeholder group, they are moving forward to endorse BMP as an integral part of the plan. He suggested that the stakeholders may benefit from seeing a presentation on the impacts of BMP made to the Open Waters CAC. John McLaughlin said that in the WPP, BMP are included as a partial solution to CSO issues in the tributaries. Another stakeholder, also involved in the WPP, stated that BMP have incremental value and do not preclude the inclusion of other alternatives. While he supports BMP, his experience with the WPP has made him aware of difficulties in implementing them across an urban watershed and in different soil conditions. John added that most BMP are not under the jurisdiction of DEP and suggested that effective policy would come through interagency effort. A stakeholder suggested that water bill reductions could be an incentive. Another stakeholder asked for a clarification of the term BMP. The team described both behavioral and technical BMP.

Rich reviewed the sources of pollutants in the bay. He pointed out that CSO make up a small percent of the contributing sources in the bay but that CSO contribute greatly to total coliform, particularly in the tributaries. One stakeholder asked if the team had considered building a large underwater pipe that would flow into the ocean, adding that he had heard of other areas where this has greatly ameliorated water quality. It was affirmed that this alternative was explored in the WPP and the Comprehensive Nitrogen plan. Rich added that it was complicated to site such a pipe to prevent the flow from returning to the shore. A stakeholder expressed concern that the meeting schedule provided scant time to properly discuss different alternatives.

Stephen moderated a discussion about the stakeholder uses and goals for the bay and tributaries. Stated uses are boating, fishing, and swimming. One stakeholder was interested in shellfishing, currently prohibited by the National Parks Service. Overall, they noted a decrease in boating activity over the last fifty years. They speculated on the causes. Primarily, there is a lack of access and boat servicing areas. There are very few marinas and many of them are private. Additionally, the creeks can no longer be used for boating because they are too shallow. Lastly, the New York City Economic Development Corporation’s current policy of encouraging building is working towards privatizing the shoreline, while destroying wetlands. Stakeholders confirmed that swimming typically takes place at private beaches, such as at the Garrison Inlet, and off of private boats. It does not occur on the tributaries.

Stakeholders expressed frustration with the lack of active recreational opportunities in the National Park. They noted poor park infrastructure, such as a lack of trash cans; limited access; uses incompatible with recreation, such as the National Park Service’s bird sanctuary. The last General Management Plan was developed in 1979. It is not currently enforced, which residents view as a problem. Stakeholders noticed a number of discrepancies between the plan and existing uses, such as jetskiing.

The team set a tentative next meeting date of January 11th. Meeting notes will be distributed and posted on the project website. The results of the landside model will be presented at the next meeting.

Jamaica Bay Stakeholder Team
Meeting No. 3
January 11, 2007

The third Jamaica Bay and Tributary Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on January 11th at the Ryan Visitor's Center in Floyd Bennett Field.
Mark Klein, DEP, started the meeting and introduced Stephen Whitehouse, Starr Whitehouse, a consultant for public participation. Stephen asked for changes in the meeting notes from the second Stakeholder team meeting of 9/04/2006. A change had been made to the meeting minutes, based on an email correspondence, to reflect the fact that the Harbor Survey is not specifically designed to capture all tidal conditions. A stakeholder specified that active recreation and not other, passive forms of recreation, was lacking in the National Park and added that the bird sanctuary belongs to the National Park and not to the Audubon Society. The notes have been updated accordingly.

One stakeholder expressed her frustration that stakeholders are invited to DEP meetings but not included in real decision-making. She spoke specifically about the recently released Nitrogen Plan. A number of stakeholders shared comments about the Nitrogen Plan. A stakeholder said that there would be a public forum to address community concerns and said that he would inform the group when that meeting was to take place.

Stephen reviewed activities of other stakeholder teams for the Waterbody/Watershed (WB/WS) Facility Plans. Four stakeholder teams have completed their tasks of advising DEP on the draft WB/WS Plans. All of these teams had plans partially in place at the onset of the LTCP project. Changes have been made to the preexisting plans during the LTCP process, including a change based on stakeholder recommendations in Alley Creek. These draft WB/WS plans will now be submitted to the New York State Department of Environmental Conservation (NYSDEC) for review by June, 2007. After the NYSDEC review of the documents, additional public participation will be held in the form of public information meetings to present the draft WB/WS plans. Other public participation activities, which go beyond State requirements, are currently under consideration by DEP.

Next, John McLaughlin, DEP, presented a proposed pilot study on Best Management Practices (BMPs) developed as part of the Jamaica Bay Watershed Protection Plan. He stressed that the study has been proposed but has not been accepted by NYSDEC. The project will examine possibilities for street-side storm water infiltration; the construction of urban wetlands on vacant properties; improvements to street tree planting including soil enhancements; and green roofs. He said that the impact of green roofs differs greatly across use districts. Pitched roofs, typical in residential districts, are more difficult to convert, which supports an assumption that residential areas may retain less stormwater with green roofs than other use districts, such as industrial. John added that a green roof requires greater capital expenditure than a standard roof but tends to last longer. In response to a stakeholder's question, Stephen added that green roofs do not leak if built correctly. Several stakeholders stressed the need for the expedient coordination with zoning and code changes, as privately-owned, impermeable green space in their neighborhoods is disappearing in favor of paved lots and housing. John said that code revision is being considered. A member of the Jamaica Bay Task Force lauded John's efforts and said that the Task Force had encouraged this type of analysis. A stakeholder asked whether constructed wetlands would breed mosquitoes. John said that mosquitoes breed in stagnant water and not in wetlands. Another stakeholder asked how and when data from this study would be folded into the LTCP. John said that the program would require a three year monitoring period once accepted, after which it could be used in the LTCP as it applies. Another stakeholder asked about the availability of land for these endeavors. The stakeholder urged the project team to act quickly as past projects have been stopped by DEP's difficulty in expediently gaining control of strategic land. One stakeholder felt that the green methods presented have marginal benefit. He advocated for a plan favoring hard engineering solutions. Stephen said that the thrust of LTCP is an examination of the collection system and conveyance system. Green solutions will provide additional incremental benefit.

John Gebrian, O'Brien and Gere, spoke about the Waterbody/Watershed Facility Plan (WB/WS) for Jamaica Bay, which is the document that precedes the final LTCP. He said that Rockaways are not included in the study area because it is undergoing a sewer separation and has few, if any, CSOs. Stakeholders asked whether the Port Authority was taken into account in the analysis. They asked whether the airport sewage is treated on site or in DEP facilities and whether the Port Authority pays for this service. This concern was reiterated several times during the meeting. One stakeholder conveyed that the community in South Queens believes that Port Authority releases their overflow stormwater into the Rosedale and Springfield Gardens communities. The project team agreed to find information about sewer system of Port Authority at JFK and will notify stakeholders when this is posted on the project website.

John listed previous projects in Jamaica Bay, including the Use and Standards Attainment Project, and planned and ongoing projects. John reviewed the water quality issues, including low dissolved oxygen, pathogens –mainly in the tributaries– and elevated nitrogen levels. He said that the tributaries in particular suffer from odor issues. A stakeholder noted significant odor problems in Pumpkin Patch Channel. A stakeholder had observed the National Park Service opening a fire hydrant with a hose to the West Pond on Broad Channel, then opening a gate, draining the West Pond. The pond is frequented by a large geese population, reducing the polluted water into the Bay. The project team promised to follow up on this.

Next, John went over the sources of carbon, nitrogen, and phosphorus in Jamaica Bay. The treated effluent from the Water Pollution Control Plants (WPCP) is the largest source of all of these water quality indicators. John stressed that CSOs have a minor effect on the Bay although the ongoing data collection and modeling effects suggest that CSOs appear to have an effect on the tributaries. Then, John described the role of drainage areas regulators. He explained that the flow in storm conditions passes through the regulators and is redirected to outflow when there is not enough capacity in the sewer system.

John went over some of the alternatives that are currently being considered for the Jamaica Bay and Tributaries WB/WS Plan: cleaning sediment from sewers, which increases holding capacity; high level sewer separation; and adding storage including in-line storage. The Federal Environmental Protection Agency (EPA) requires that the project team examine storage that will hold up to 100% CSO capture as part of the LTCP process. As no site was suitable for a tank, the project team looked at storage tunnels. John shared figures, derived from modeling, on how different scenarios reduce annual CSO in Fresh Creek, Hendrix Creek, and overall in the 26th Ward WPCP area. As flooding may be a problem at Hendrix Creek, the project team will consider interventions, such as raising weirs, during the LTCP. A stakeholder asked whether the project team considered putting a tide gate on one of the basins. John said that the EPA would not allow it as federal rules prohibit the use of waterbodies for treatment, and the water quality on the basin may be further degraded. A stakeholder asked whether the WPCP would treat only floatables. John stated the flow would leave the plant as treated effluent. A stakeholder asked how an influx of large quantities of freshwater would affect the Bay. John stated that the fresh water inflow would be on par with current levels of salinity. John also spoke about plans at Spring Creek, none of which show significant water quality improvement.

John shared knee-of-the-curve analysis, which shows costs versus benefit. The project team will use the analysis to select the plan that best balances reduction in CSO against costs. A stakeholder was concerned that the project team was looking to second best solutions, such as cleaning the sewers, instead of best solutions, such as storage tanks.

Kevin Ward, Hazen and Sawyer, reviewed the alternatives for the WB/WS plan in the Jamaica WPCP area including high level storm sewer separation; and additional conveyance and storage. In general, plans focus on conveyance rather than increasing the capacity of the WPCPs. Kevin spoke about planned storm sewer separation in Laurelton and continued storm sewer build out in South Queens, where there have been numerous flooding complaints. Kevin said that the team is also looking at automating regulators, which will improve their effectiveness, and increasing the flow capacity of regulators. He spoke about conveyance improvements to the inverted siphon at 150th Ave and Belt Parkway. Kevin shared the schematic plan of the tunnel option that captures 100% of the CSO volume for Bergen Basin. The EPA requires that the 100% CSO volume capture scenario be evaluated. The tunnel would cost $950M. A stakeholder asked how the tunnel would be cleaned to prevent sediment build-up. Kevin said that the cleaning is designed into the facilities. Kevin shared modeling data indicating the level of water quality improvement in Bergen and Thurston Basin revealed little change between baseline and 100% capture scenarios. Kevin showed a knee-of-the-curve graph plotting the cost of the different scenarios against percent reduction in CSOs.

Jamaica Bay Stakeholder Team
Meeting No. 3
January 11, 2006

John showed a number of maps comparing existing condition and the modeled effect of 100% capture of CSOs on water quality in Jamaica Bay. In general, the 100% CSO capture scenario has little effect on water quality, as CSOs are not the main source of the water quality issues in the Bay.

A stakeholder asked how annual attainment is calculated, stating that annual attainment appears to average out the effect of specific instances of CSOs. Rich Islieb, Hydroqual, stated that yearly attainment is measured by the percent of time that the water quality attains standard levels and does not average out the impact of CSOs. A stakeholder asked whether this aggregated indicator forces the City to close swimming beaches more frequently. Stephen said that beach closure is more likely due to more stringent New York City Department of Health (NYCDOH) standards. Closed beaches may be in compliance with the State but not the City. A stakeholder observed that garbage left on the beach, when the trash cans have been removed in the winter, may be another source of floatables. A stakeholder raised the issue of health risks related to the goose excrement found in large quantities many parts of the Bay. Another stakeholder requested that a National Parks Service representative be invited to the meetings.

A tunnel alternative, which would convey outflow from a WPCP into the ocean, was discussed at length in the meeting. One stakeholder felt strongly that this alternative should be considered in the plan. He cited existing tunnels that benefit other coastal cities. John Gebrian explained that such an alternative would chiefly affect the flow from the WPCP and the LTCP looks solely to improve water quality problems associated with CSOs and not WPCPs. The stakeholder asked why the tunnel was not included in the analysis of the Jamaica Bay Watershed Protection Plan. Keith Mahoney said that such a tunnel would require a number of interstate agreements to deal with issues of current and flow across interstate borders that may adversely affect water quality in New Jersey.

John reviewed the preferred WB/WS Plan for the 26th Ward WPCP area, including the removal of sediment in major sewers; expansion of the WPCP; and floatables capture. A stakeholder asked how much the project will cost. John said that current estimates cost the project at roughly $120M. Kevin Ward reviewed the preferred WB/WS Plan for the Jamaica Water Pollution Control Plan area. The project included work currently in design in the South East Queens area which will be completed in 20-30 years. A stakeholder asked for other known timetables. John responded that improvements to the 26th Ward WPCP are currently underway and may take around six years to complete.

A stakeholder said that he would like to see more information about the stormwater retention and catch basins. He said that the basins should be cleaned and asked if there were any other ways to increase their capacity. John said that while catch basins are porous on Staten Island, it would not be feasible in Jamaica Bay due to high groundwater levels. The stakeholder asked for more information about the possibility of increasing the capacity of catch basins. John McLaughlin agreed to take the question back to his group.

Jamaica Bay Stakeholder Team
Meeting No. 3
January 11, 2006

The group chose a next meeting date of April 19th. Notes will be available prior to the meeting.

Jamaica Bay Stakeholder Team
Meeting No. 4
June 7, 2007

The fourth and final Jamaica Bay and Tributary Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on June 7th at the Ryan Visitor's Center in Floyd Bennett Field.
Stephen Whitehouse, Starr Whitehouse, started the meeting at 6:40 p.m. He made several announcements about upcoming meetings. Stephen asked for changes in the meeting notes from the third Stakeholder team meeting of January 11, 2007. Several changes were noted. A stakeholder requested that the notes be accompanied by a sign-in sheet showing who was present at the meeting. The notes will be revised and finalized.

John Gebrian, O'Brien and Gere, reviewed the Jamaica Bay and Tributary water quality issues. The main issue for water quality compliance is low dissolved oxygen (DO). Related concerns include odors and elevated nitrogen and pathogens levels. John said that the main source of nitrogen, carbon, and phosphorus in Jamaica Bay is loading from the area Water Pollution Control Plants (WPCP). John showed graphics depicting modeled DO, total and fecal coliform, and surface enterococci, comparing baseline conditions against a 100% CSO capture scenario. The graphs showed that eliminating CSOs would not bring all of the Bay and Tributaries into compliance, as CSO is only one of the sources of nutrient and pathogen loading in Jamaica Bay. John summarized that Jamaica Bay is in general attainment with coliform bacteria standards and may be in non-attainment with enterococci standards in the northern portions of the bay.

John presented the Waterbody/Watershed Facility (WB/WS) Plan for the 26th Ward WPCP drainage area. The project team examined a number of technologies and retained a group of alternatives for additional evaluation, including: sewer cleaning; in-line storage; tunnels and tanks; high level sewer separation (HLSS); and evaluation of Best Management Practices (BMPs) and Low Impact Developments (LIDs). A stakeholder asked which population projection numbers were used to create the baseline. John said that the population projections were the same as those that the Mayor's Office used in its PLANYC and that the project team extrapolated them beyond 2030. The stakeholder asked to see how the population projections were disaggregated and asked the project team to alert the Mayor's Office, so that they could be prepared to address this at the upcoming joint meeting between the Mayor's Office of Long Term Planning and Sustainability and DEP.

John explained that the team nd used cost benefit analysis to select a plan from the group of alternatives examined. Cost benefit analysis weighs the projected benefit against probable total project cost. The project team targeted the plan that achieves the maximum benefit per dollar, or the knee of the curve. John shared a table that showed the annual CSO and percent reduction in CSOs for different plans. John showed the cost benefit analysis of the different plans. The graph showed that differently sized CSO storage tunnels have little impact on water quality. John reviewed the components of the selected

WB/WS plan for the 26th Ward including: removal of sediment in sections of major sewers; expansion of the WPCP treatment capacity by 50 MG; continued and improved floatables capture; and evaluation of BMPs and LIDs. Other measures included in the plan—the dredging and aeration of Fresh Creek—will improve DO levels but not abate CSO loading. John explained that dredging was necessary in order to have the depth required by the aeration facilities. The probable total project cost is $454.5M. A stakeholder asked whether the figure only includes the costs of projects that solely treat CSO related issues. Sue McCormick, New York State Department of Environmental Conservation (DEC), confirmed that it did. A stakeholder requested the figures for the operational costs of the WB/WS plans. Next, John showed tables comparing the WB/WS plan's projected percent compliance, measured in percent of hours in compliance, with the baseline, looking at dissolved oxygen, total coliform, and fecal coliform. A stakeholder asked if data, showing the daily spikes of different water quality indicators, would be available in the report. John confirmed that modeling reports will be available for review. A stakeholder noted that the WB/WS plan increases volume at Hendrix Creek. John explained that some of the conveyance improvements that greatly reduce total CSO volume moved some volume to Hendrix Creek. He said that the CSOs would be screened for floatables before entering the waterbody at Hendrix Creek.

Next, Kevin Ward of Hazen and Sawyer, described the WB/WS plan for the Jamaica WPCP drainage area. He outlined the different considered alternatives: HLSS in Laurelton, part of the consent order; increasing the WPCP to 250 MGD, also part of the consent order; additional conveyance; sewer system improvements; inline storage in Bergen Basin; storm sewer system build out as part of the Southeast Queens Drainage Plan; storage tanks and tunnels; and the evaluation of BMPs and LIDs. He showed a table that described the annual CSO and the percent reduction for different plans. He noted that increasing the capacity of the WPCP resulted in little water quality improvement in Bergen Basin because of existing constrictions in the conveyance system. He also noted that in-line storage is problematic because the area is relatively flat which can cause back-ups and flooding. There are already many flooding complaints, shown plotted on a map of a portion of the drainage area. Kevin showed the cost-benefit analysis of the alternatives analyzed . The recommended WB/WS plan includes: sewer system improvements; the implementation of the South-East Queens Drainage Plan which includes HLSS at Laurelton; and an evaluation of BMPs and LIDs. Dredging and aeration in Bergen and Thurston Basin is also included. The probable total project cost is $94.3M, which does not include implementation of the HLSS in Laurelton, as this is not solely a CSO abatement project. A stakeholder said the benefits of the plan could be negated by Port Authority's behavior. Sue McCormick said that DEC is concerned about Port Authority's impact as well. A stakeholder asked how advanced the dredging plans were at this stage in the project. Kevin said that the plans to date mainly look at area and material quantity, as aeration requires a specifically sized water column, which will drive the depth of dredging, with an additional allowance to cap the bottom with two feet of clean sand. Stephen said that the design and permitting process for dredging would be extensive and will include public hearings. Many issues, such as disposal, will be treated at that time. A stakeholder asked what was known about bottom sediment at the dredging sites. John said that, since prior work has been done on Hendrix Creek, they have a sense of the type of sediment there. Kevin said that previous studies indicate that the dredged material may require special handling but it will likely not be classified as hazardous material. A stakeholder asked when aeration had previously been used. Sue said that there is a pilot under construction on Newtown Creek at English Kills. Then, Kevin showed tables comparing the WB/WS plan projected percent compliance, with the baseline, looking at dissolved oxygen, total coliform, and fecal coliform. A stakeholder asked whether percent reduction is the same thing as percent capture. Kevin said that it was not and said that percent capture metrics will be included in the report.

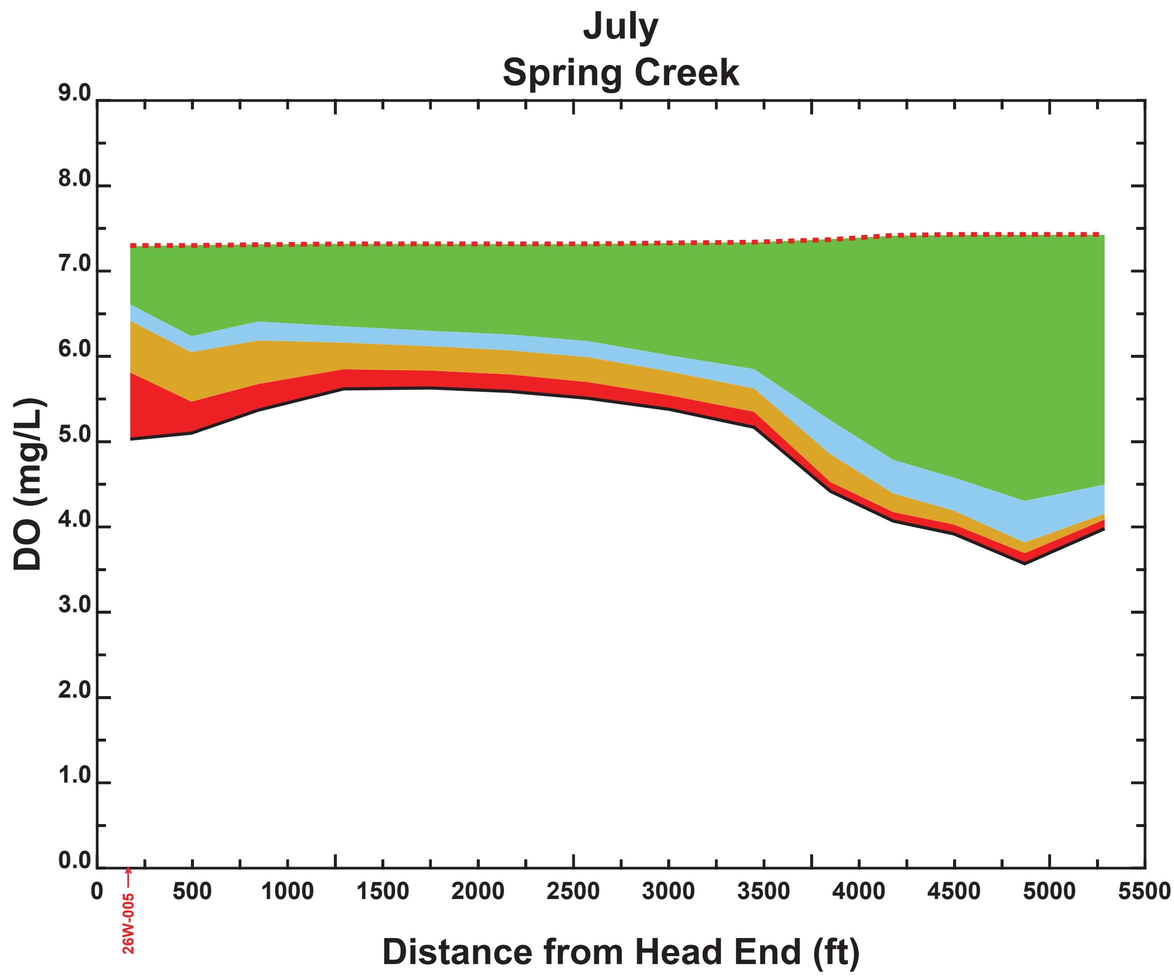
Stephen explained next steps. Stephen said that when the meeting notes are completed, stakeholders will be informed and they will have 30 days to comment. The project team is on track for a submittal in late June. Since the comments will be received after the first submittal of the report, the finalized notes will be included later. Simultaneous to the submittal for DEC, the plans will be available to the public. When DEP receives comments from DEC, they will initiate a 60 day formal comment period. 2017 is the final submittal date for all of the LTCPs but individual projects will begin prior to that date. Sue McCormick, DEC, stressed that stakeholders were welcome to give comments throughout the process. The floor was opened for questions.

- A stakeholder asked whether there would be a 197a review to approve the plan. Stephen said that he was not aware of this intent, but he would check
- A stakeholder asked how climate issues, sea level rise and wet weather conditions, were included. John said that they have not as there has been no consensus in the scientific community as to the local effects of climate change. John McLaughlin, DEP, said that a joint DEP and Columbia University study on climate change would be released soon. The stakeholder is frustrated that the public has not been involved in that effort.
- A stakeholder asked whether it was possible to outfit a basin with a flood gate and use it for CSO storage. John Gebrian says that the Environmental Protection Agency dictates that navigational waterways cannot be used for storage.
- A stakeholder asked whether new developments could be built with separated sewers. Stephen said that larger ones would. Wholesale sewer separation was not chosen because of the widespread disruption that its construction would cause.
- A stakeholder asked why piping CSOs into the ocean, as is done in Boston, was not considered. John said that it was considered but a number of constraints, including interstate negotiations with New Jersey, made it unfeasible.
- A stakeholder asked whether the modeled total CSO volume figure takes into account the storm flows from the HLSS projects. John said that it does.
- A stakeholder asked for an elaboration on the BMPs/LIDs program. Sue said that, by the time the LTCP is ready to ratify, certain BMP/LIDs projects will be included in the plan. Stephen added that the Mayor's Office is seeking legislation State legislation to authorize tax incentives for building green roofs.
- A stakeholder asked about the status of including BMPS on the Belt Parkway improvement projects. John McLaughlin said that they are working with the New

York City Department of Transportation and have developed BMP designs which will hopefully be included in construction.

APPENDIX E

COMPONENT ANALYSIS RESULTS



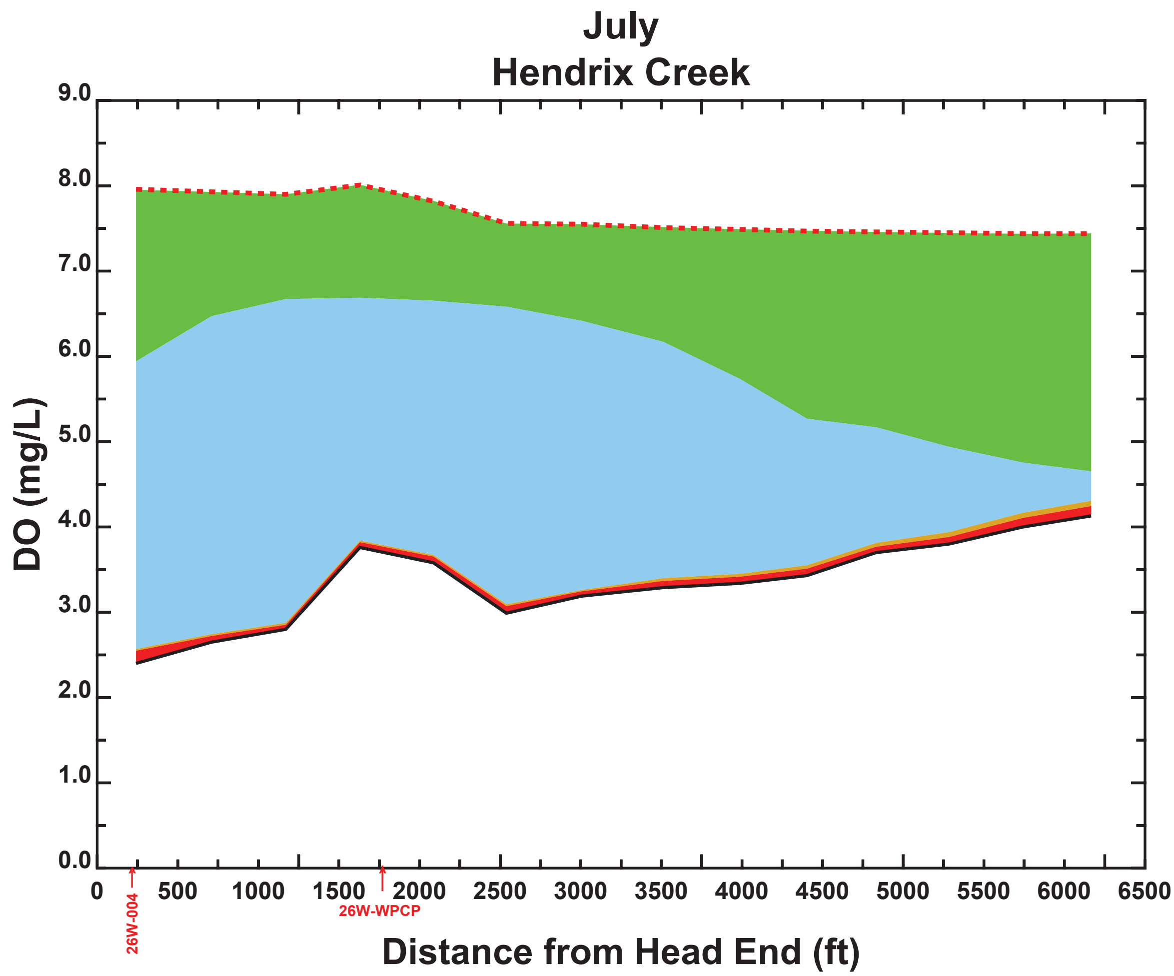
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Baseline

July 1988, DO Deficit Components, Baseline



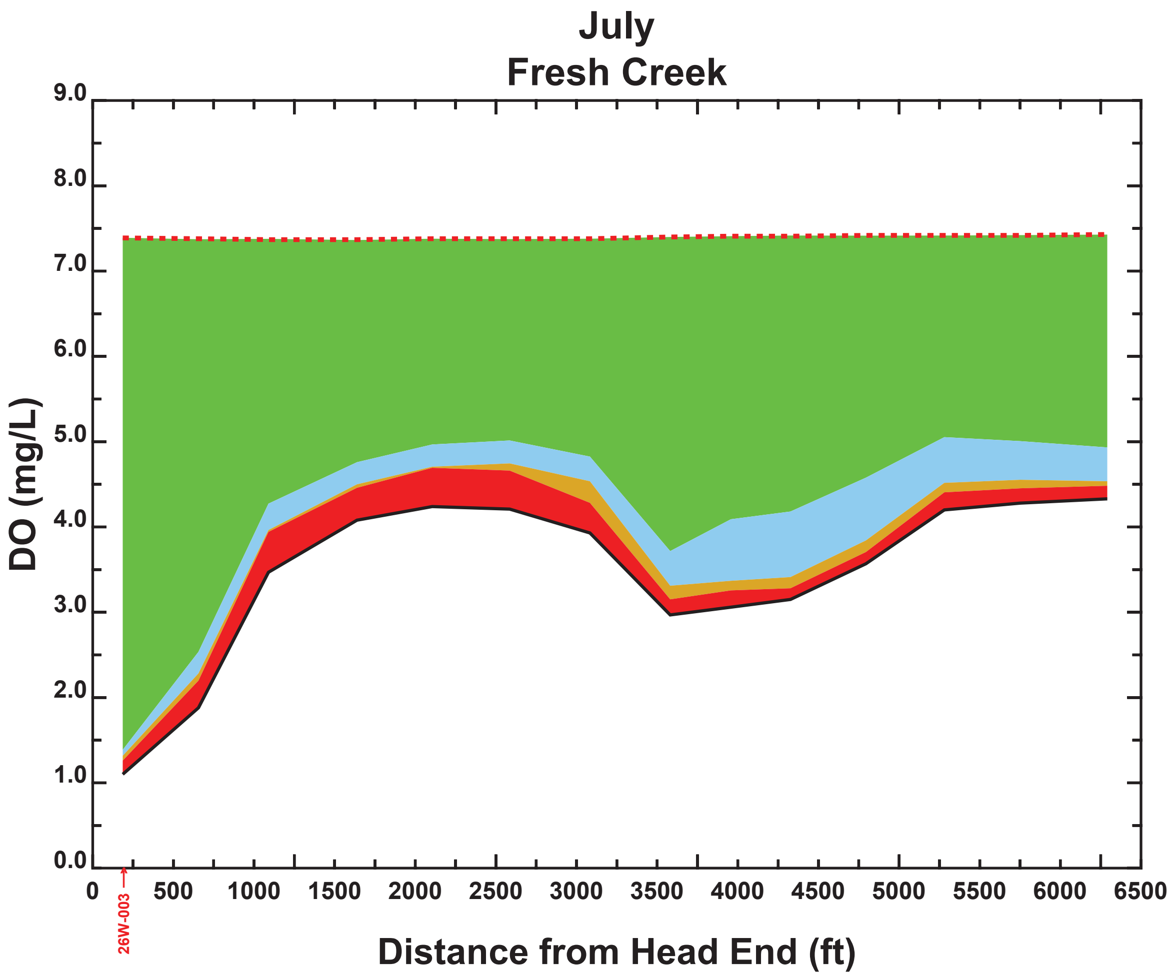
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Baseline

July 1988, DO Deficit Components, Baseline



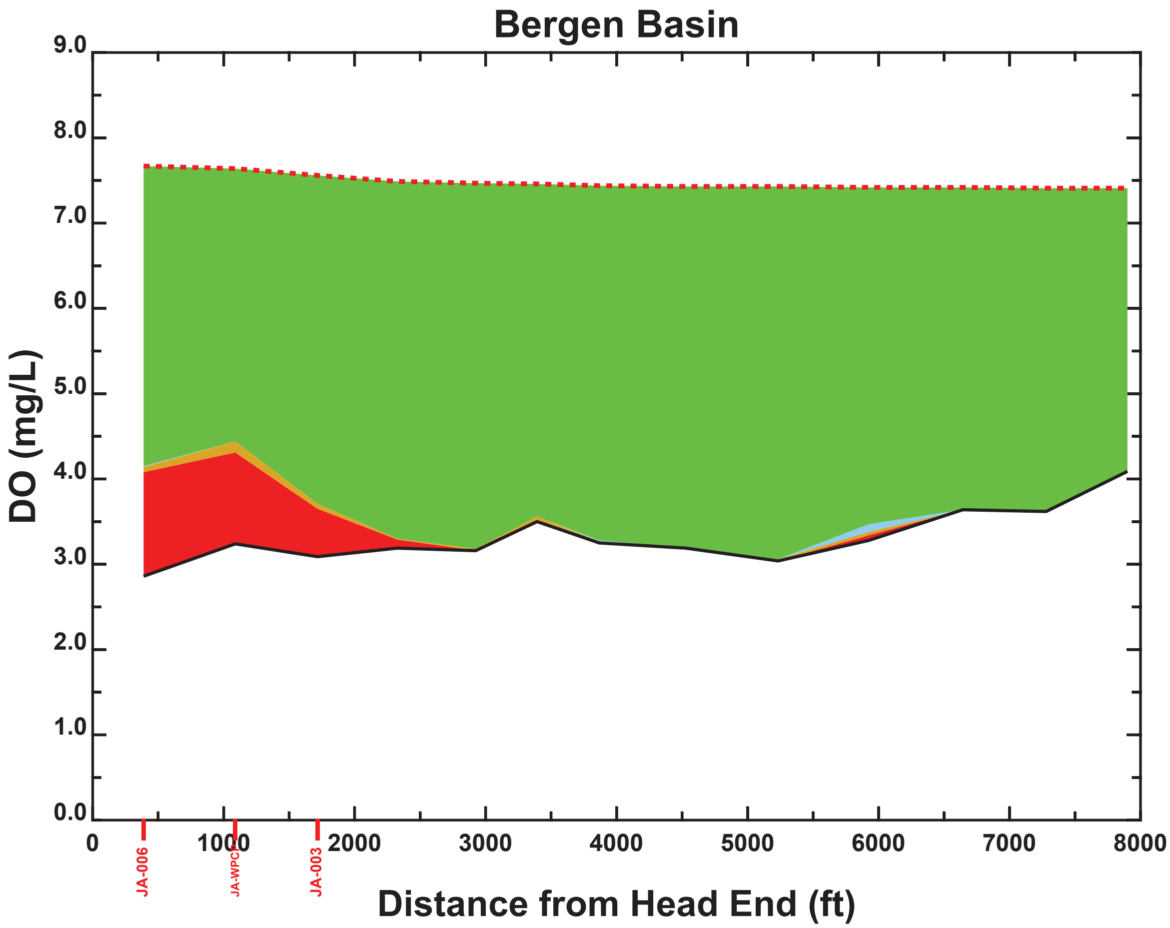
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Baseline

July 1988, DO Deficit Components, Baseline



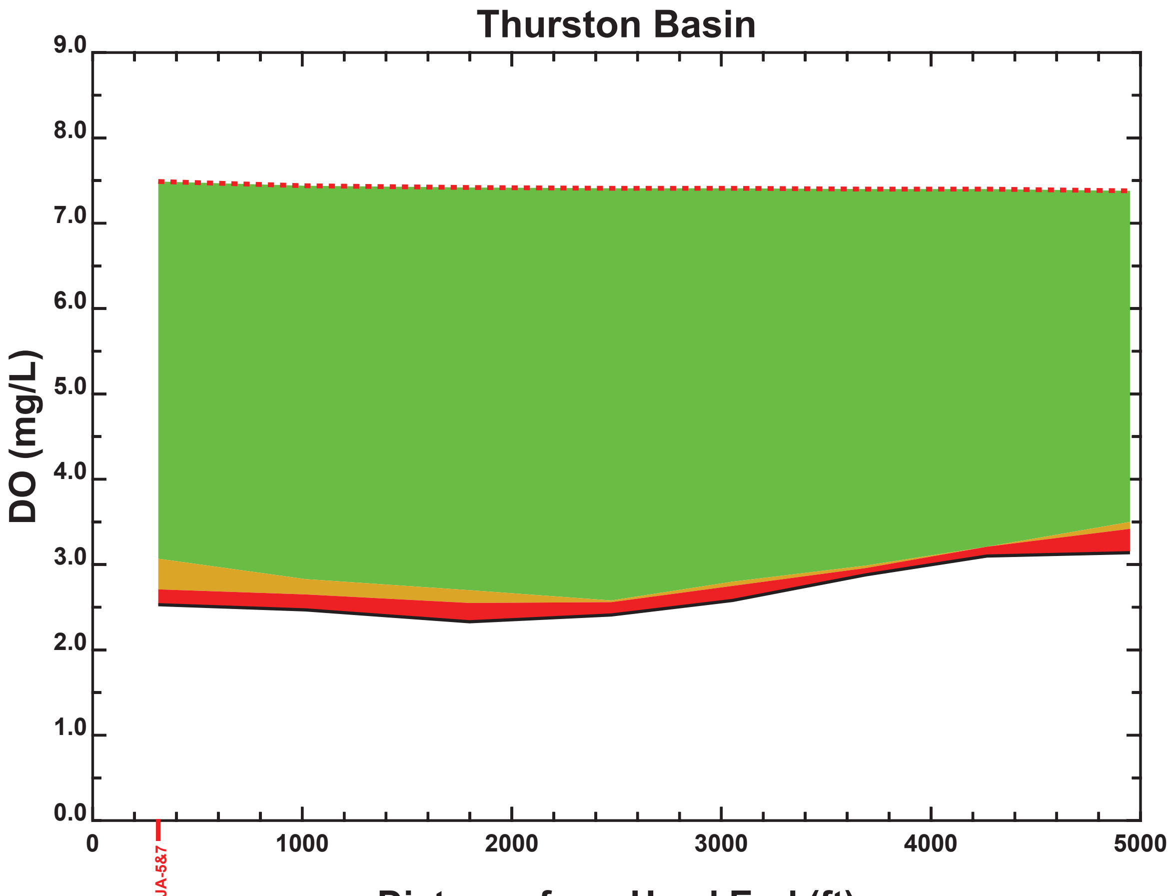
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica WPCP
Level 1 BNR at Rockway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to BC
Deficit Related to WPCP
Deficit Related to SW
Deficit Related to CSO
Baseline

July 1988, DO Deficit Components, Baseline



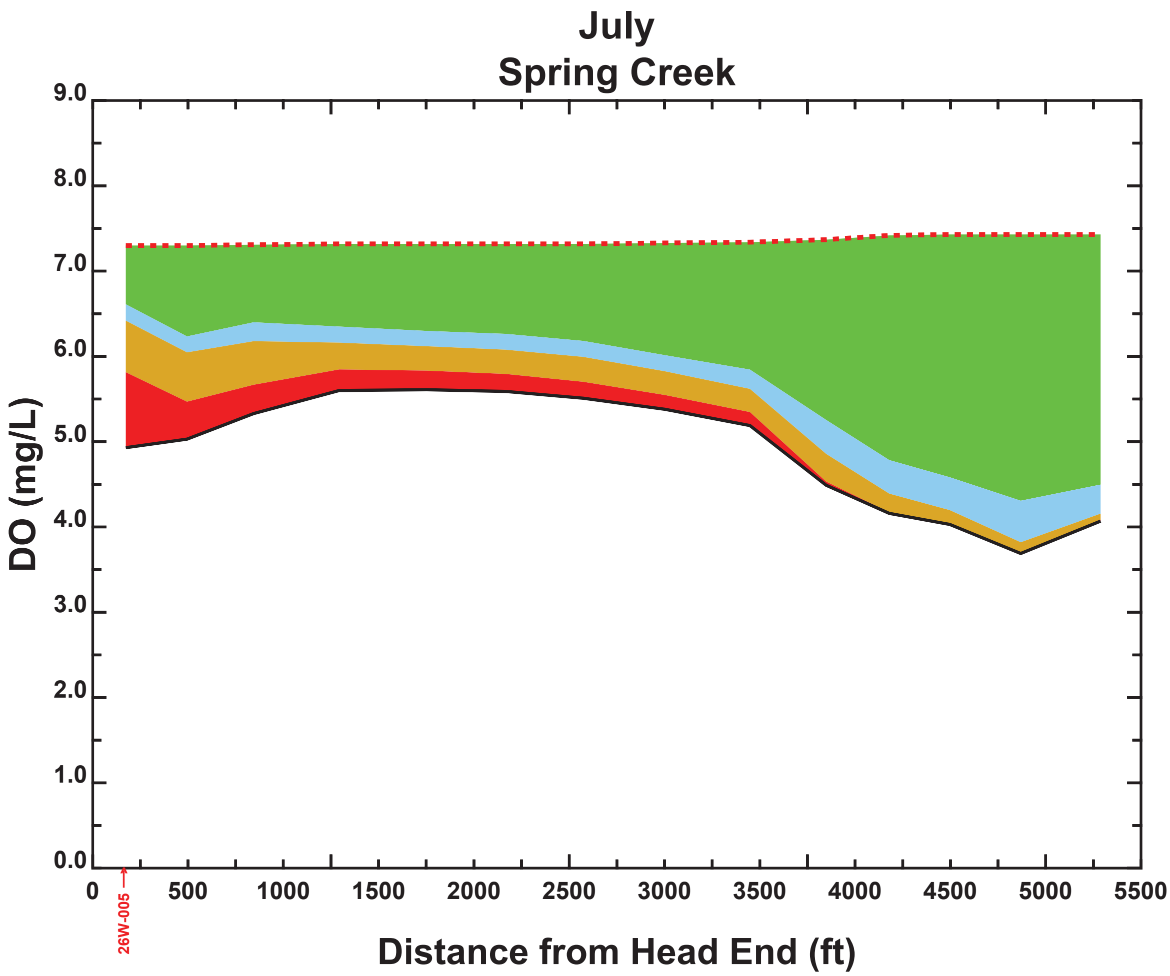
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica WPCP
Level 1 BNR at Rockway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to BC
Deficit Related to SW
Deficit Related to CSO
Baseline

July 1988, DO Deficit Components, Baseline



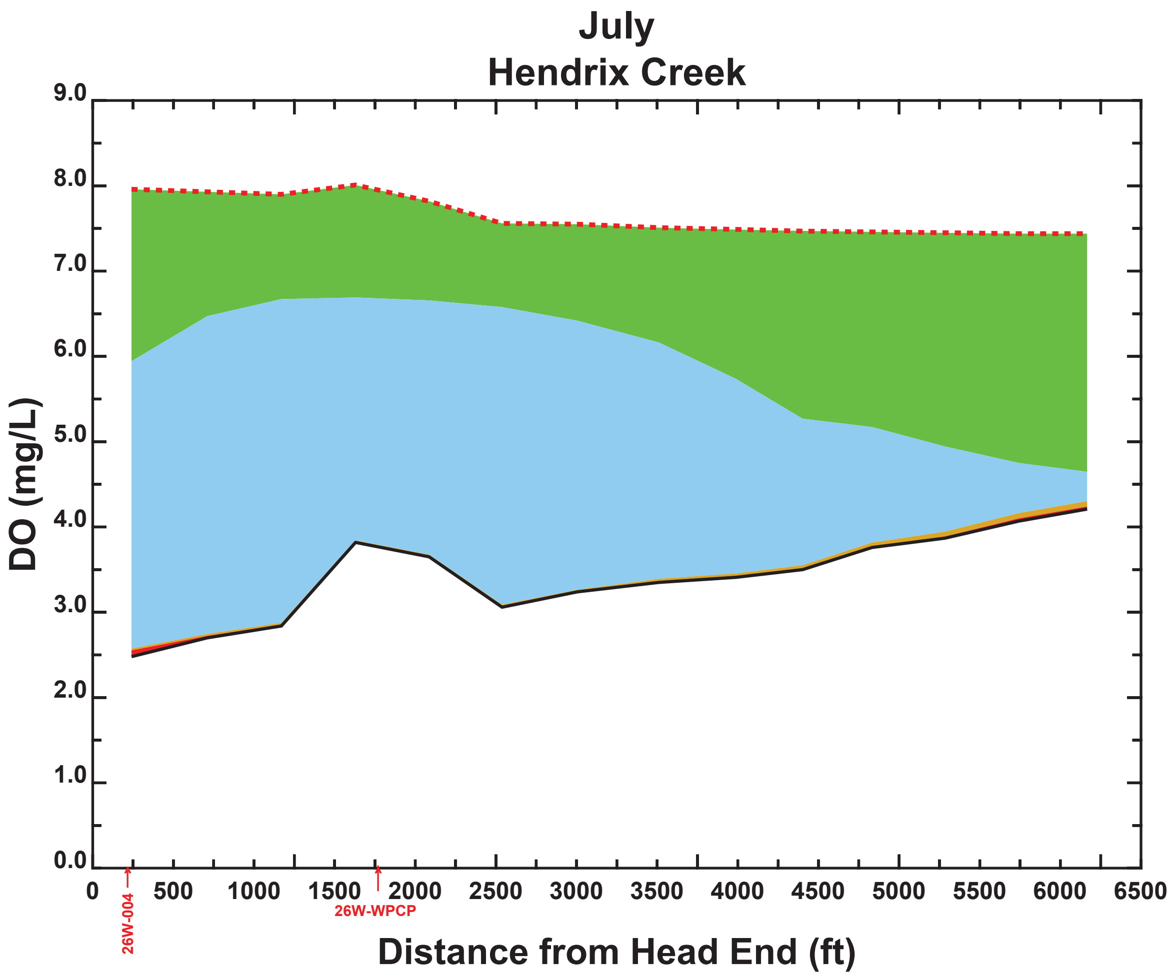
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Alternative 2

July 1988, DO Deficit Components, Alternative 2



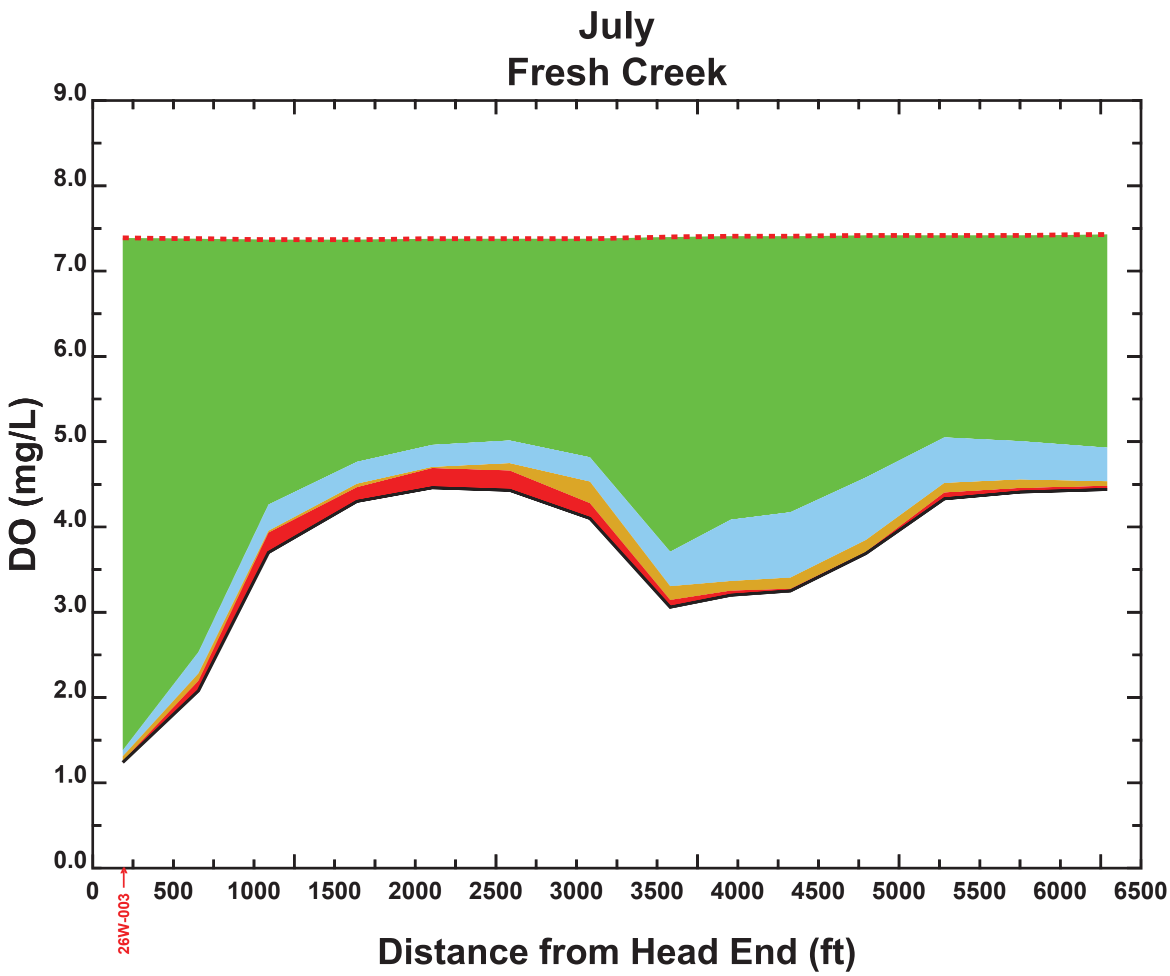
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

- DO Saturation
- Deficit Related to NCM BC
- Deficit Related to NCM WPCP
- Deficit Related to NCM SW
- Deficit Related to NCM CSO
- Alternative 2

July 1988, DO Deficit Components, Alternative 2



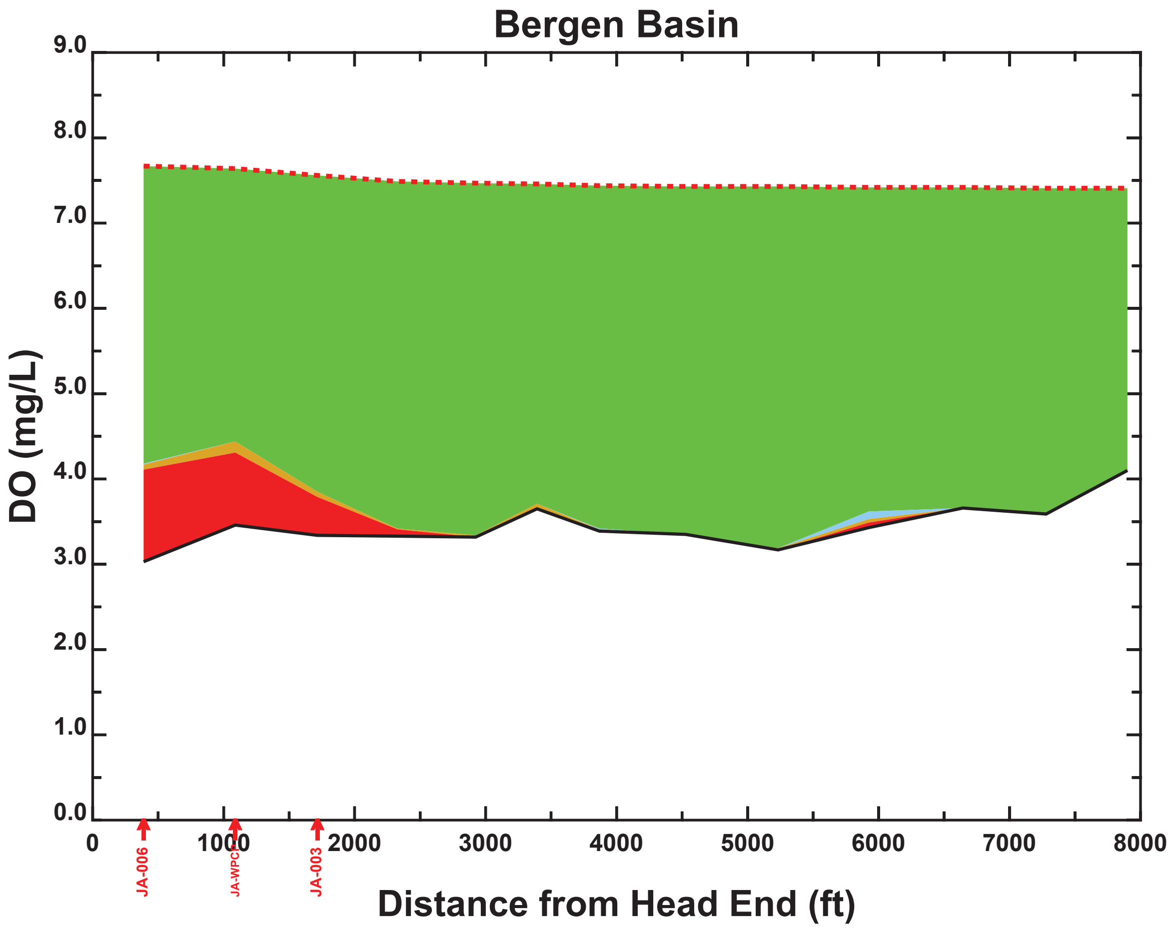
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica Ward WPCP
Level 1 BNR at Rockaway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to NCM BC
Deficit Related to NCM WPCP
Deficit Related to NCM SW
Deficit Related to NCM CSO
Alternative 2

July 1988, DO Deficit Components, Alternative 2



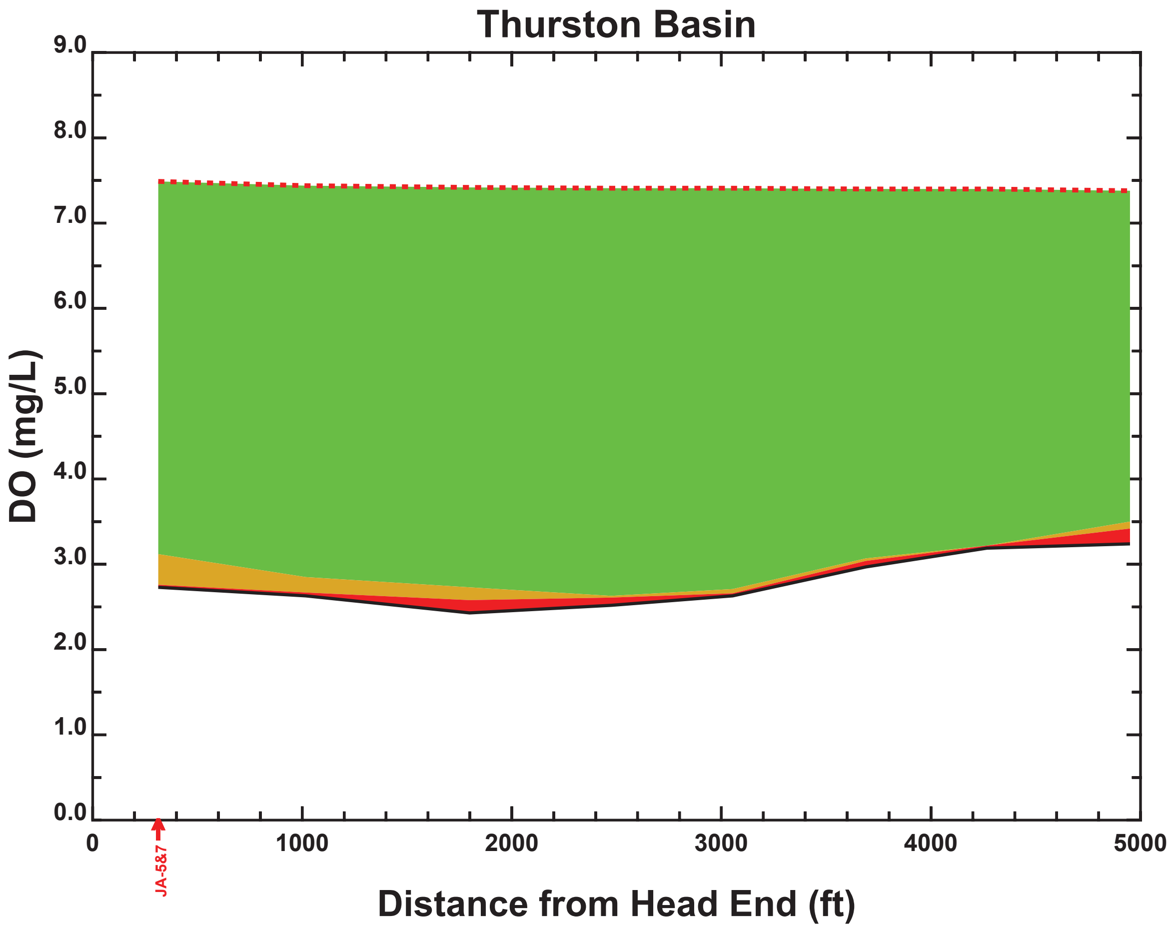
CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica WPCP
Level 1 BNR at Rockway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to BC
Deficit Related to WPCP
Deficit Related to SW
Deficit Related to CSO
Alternative 2

July 1988, DO Deficit Components, Alternative 2



CONDITIONS

1988 Weather and Tide Conditions
2045 Population Wastewater Flow
Level 3 BNR at 26th Ward WPCP
Level 2 BNR at Jamaica WPCP
Level 1 BNR at Rockway & Coney Island
Existing Bathymetry

LEGEND

DO Saturation
Deficit Related to BC
Deficit Related to SW
Deficit Related to CSO
Alternative 2

July 1988, DO Deficit Components, Alternative 2