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July 2, 2013

Joseph DiMura, P.E.
Director
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New York State Department of Environmental Conservation
625 Broadway, 4th Floor
Albany, New York 12233-3506

Re: CSO Order on Consent (DEC Case No.CO2-20110512-25, modification to DEC Case No. CO2-20000107-8)
Appendix A, I. Alley Creek CSO
E.1. Submit Approvable Drainage Basin Specific LTCP for Alley Creek

Dear Mr. DiMura:

In accordance with Paragraph III.F of the above referenced CSO Order, the New York City Department of Environmental Protection (DEP) hereby submits to the New York State Department of Environmental Conservation (DEC) the Alley Creek Long Term Control Plan (LTCP).

DEP looks forward to receiving DEC's approval of the attached LTCP and as always, feel free to contact me at (718) 595-5045 regarding any questions you may have.

Sincerely,

Keith Mahoney for AM

Anthony Maracic, P.E.
Director of Capital Planning & Asset Management
Bureau of Wastewater Treatment

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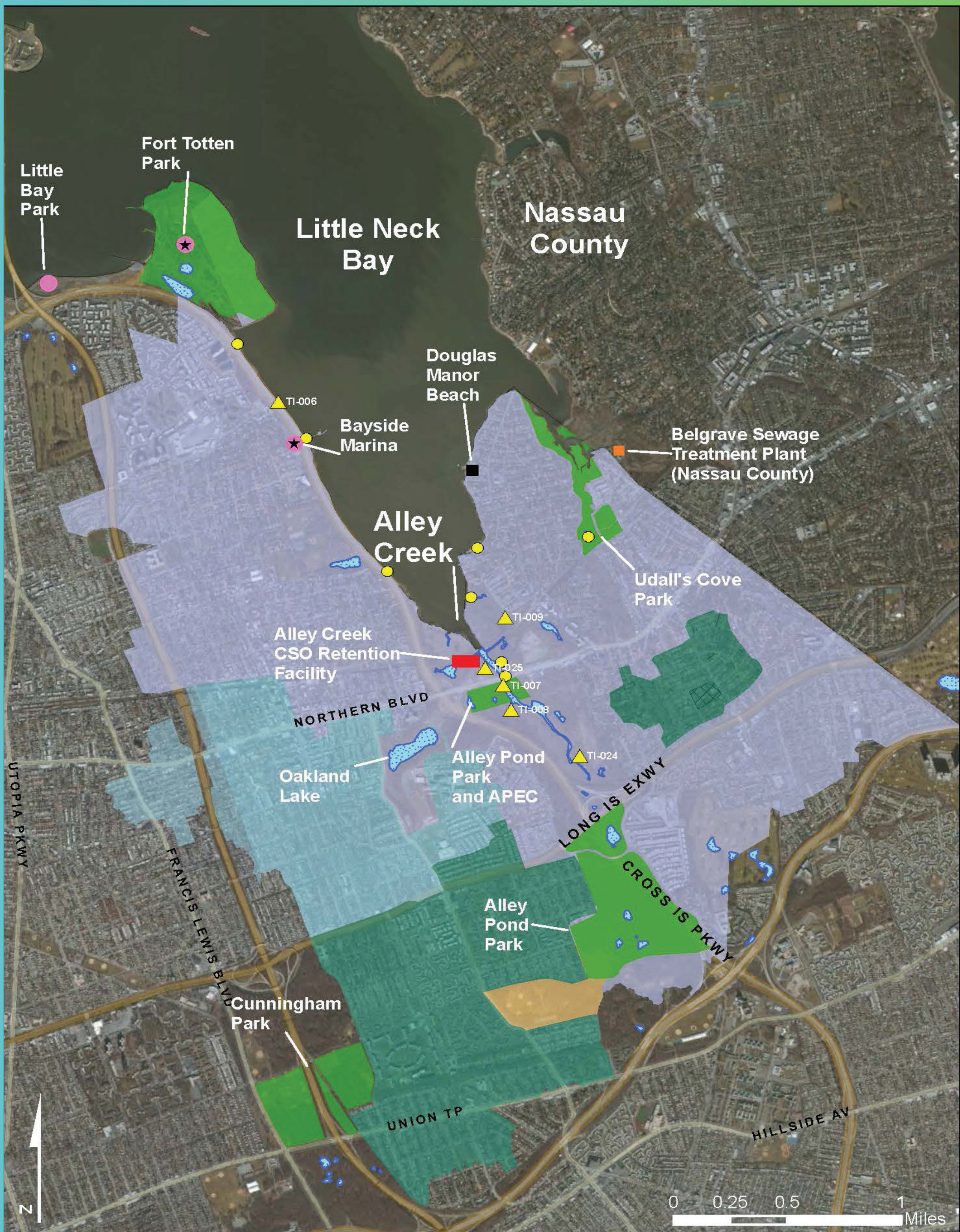
New York City Department of Environmental Protection

Capital Project No. WP-169
Long Term Control Plan II

Combined Sewer Overflow Long Term Control Plan for Alley Creek and Little Neck Bay



June 2013

Environmental Protection

Capital Project No. WP-169
Long Term Control Plan II

Combined Sewer Overflow Long Term Control Plan for Alley Creek and Little Neck Bay

June 2013

Aimee M. Boulet, P.E.
NY License No. 088137

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

Prepared by: AECOM USA, Inc.

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EXECUTIVE SUMMARY

This Long Term Control Plan (LTCP) for Alley Creek and Little Neck Bay was prepared pursuant to the Combined Sewer Overflow (CSO) Order on Consent (DEC Case No. CO2-20110512-25) as modified, March 8, 2012 (2012 Order on Consent). Under the 2012 Order on Consent, the New York City Department of Environmental Protection (DEP) is required to prepare and submit 11 LTCPs for submittal to the New York State Department of Environmental Conservation (DEC) by December 2017; the Alley Creek LTCP is the first of those 11 LTCPs to be completed.

The goal of each LTCP, as described in the LTCP Goal Statement in the 2012 Order on Consent, is to identify, with public input, appropriate CSO controls necessary to achieve waterbody-specific water quality standards (WQS) consistent with the CSO Control Policy and water quality goals of the Federal Clean Water Act (CWA) and related guidance. *Made part of the 2012 Order on Consent was a Goal Statement which included the following: "Where existing water quality standards do not meet the Section 101(a)(2) goals of the Clean Water Act, or where the proposed alternative set forth in the LTCP will not achieve existing water quality standards or the Section 101(a)(2) goals, the LTCP will include a Use Attainability Analysis examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State."*

Regulatory Requirements

The waters of the City of New York are subject to Federal and New York State regulation. Particularly relevant here is the CSO Control Policy, which provides guidance on the development and implementation of LTCPs. In New York State, CWA regulatory and permitting authority has been delegated to DEC.

DEC has adopted WQS for navigable waters. DEC has designated Little Neck Bay as a Class SB waterbody, which is defined as "suitable for fish, shellfish and wildlife propagation and survival." The best usages of Class SB waters are "primary and secondary contact recreation and fishing" (6 NYCRR 701.11). DEC has designated Alley Creek as a Class I water body, defined as "suitable for fish, shellfish and wildlife propagation and survival." The best usages of Class I waters are "secondary contact recreation and fishing" (6 NYCRR 701.13).

LTCP Planning Approach

The LTCP planning approach includes several phases, including waterbody and watershed characterization, public participation, alternatives evaluation, phased and adaptive implementation strategies and post-construction monitoring. This LTCP builds upon DEP's prior efforts, most notably the June 2009 "Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan Report" (WWFP). Since the issuance of the WWFP, a number of important projects have been completed, including the 5 million gallon (MG) Alley Creek CSO Retention Tank and extensive improvements to the upstream combined and separate collections systems. DEP also implemented other collection system improvements to ensure that wet weather flows to the Tallman Island Wastewater Treatment Plant (WWTP) would be sustained at two times design dry weather flow (2xDDWF) during rain events. In addition, DEP completed a $20 million wetland restoration project for the 16-acre northern section of the Alley Pond Park.

The Alley Creek and Little Neck Bay LTCP planning process included extensive outreach to stakeholders. A public outreach participation plan was developed and implemented throughout the process.

Watershed/Waterbody Characteristics

The Alley Creek and Little Neck Bay watershed comprises approximately 4,879 acres along the north shore of eastern Queens County, adjacent to the Nassau County border. The land surrounding Alley Creek is mostly parkland while the land surrounding Little Neck Bay is largely residential. Several parks are found within the watershed, most notable Alley Pond Park, which surrounds Alley Creek on its eastern, western, and southern shores. Current land uses for the watershed are shown in Figure ES-1.

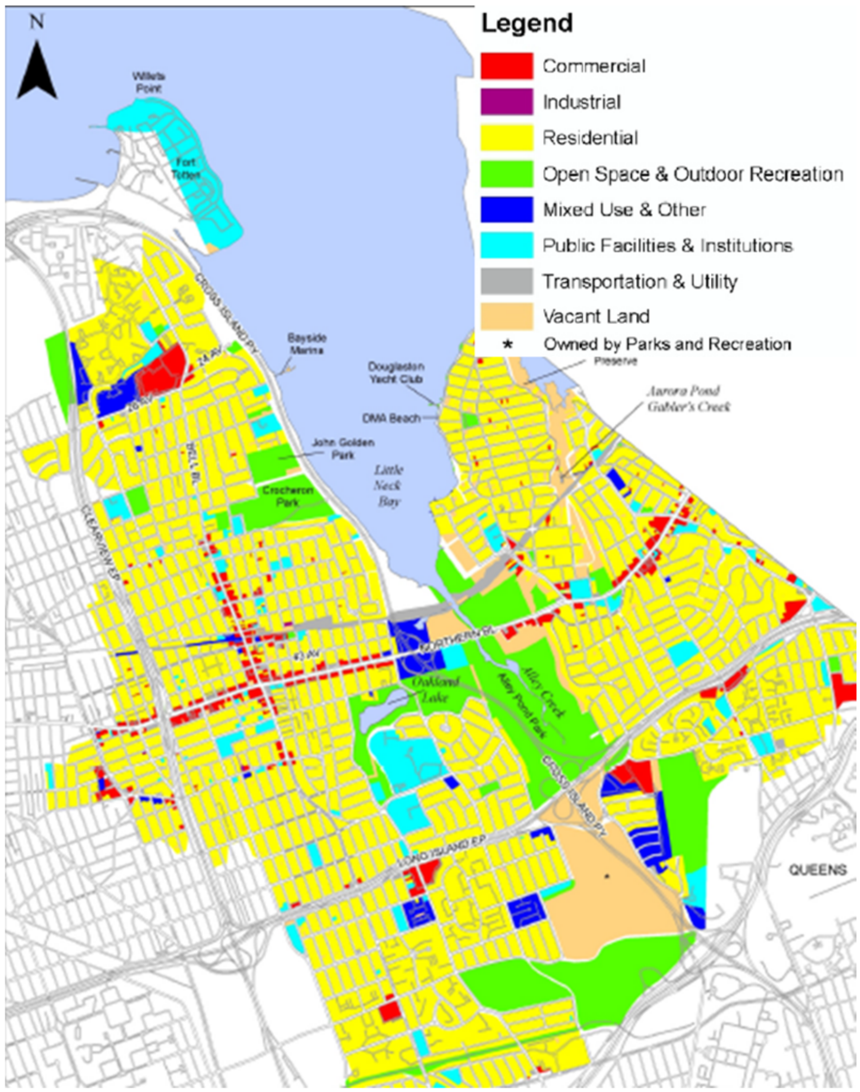


Figure ES-1. Alley Creek and Little Neck Bay Land Use

The Tallman Island WWTP, which has been providing full secondary treatment since 1978, has a design dry weather flow (DDWF) capacity of 80 million gallons per day (MGD), and is designed to receive a maximum flow of 160 MGD (2xDDWF) with 120 MGD (1.5xDDWF) receiving secondary treatment. Flows over 120 MGD receive primary treatment and disinfection. As shown on Figure ES-2, the watershed, which is tributary to the Tallman Island WWTP, contains a complex wastewater system comprised of combined, separate and storm sewers; interceptor sewers and pumping stations; several CSO and stormwater outfalls; and a CSO retention tank.

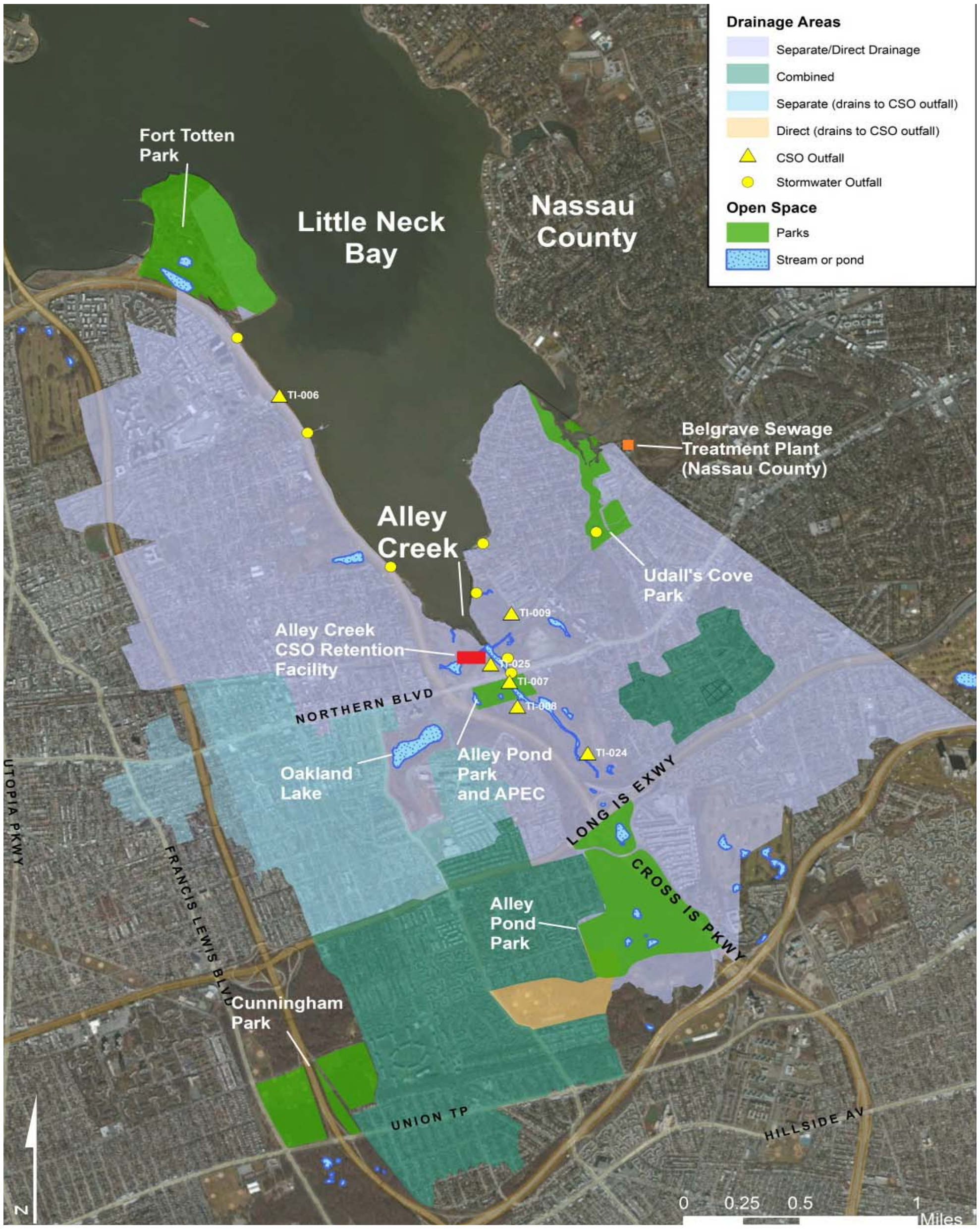


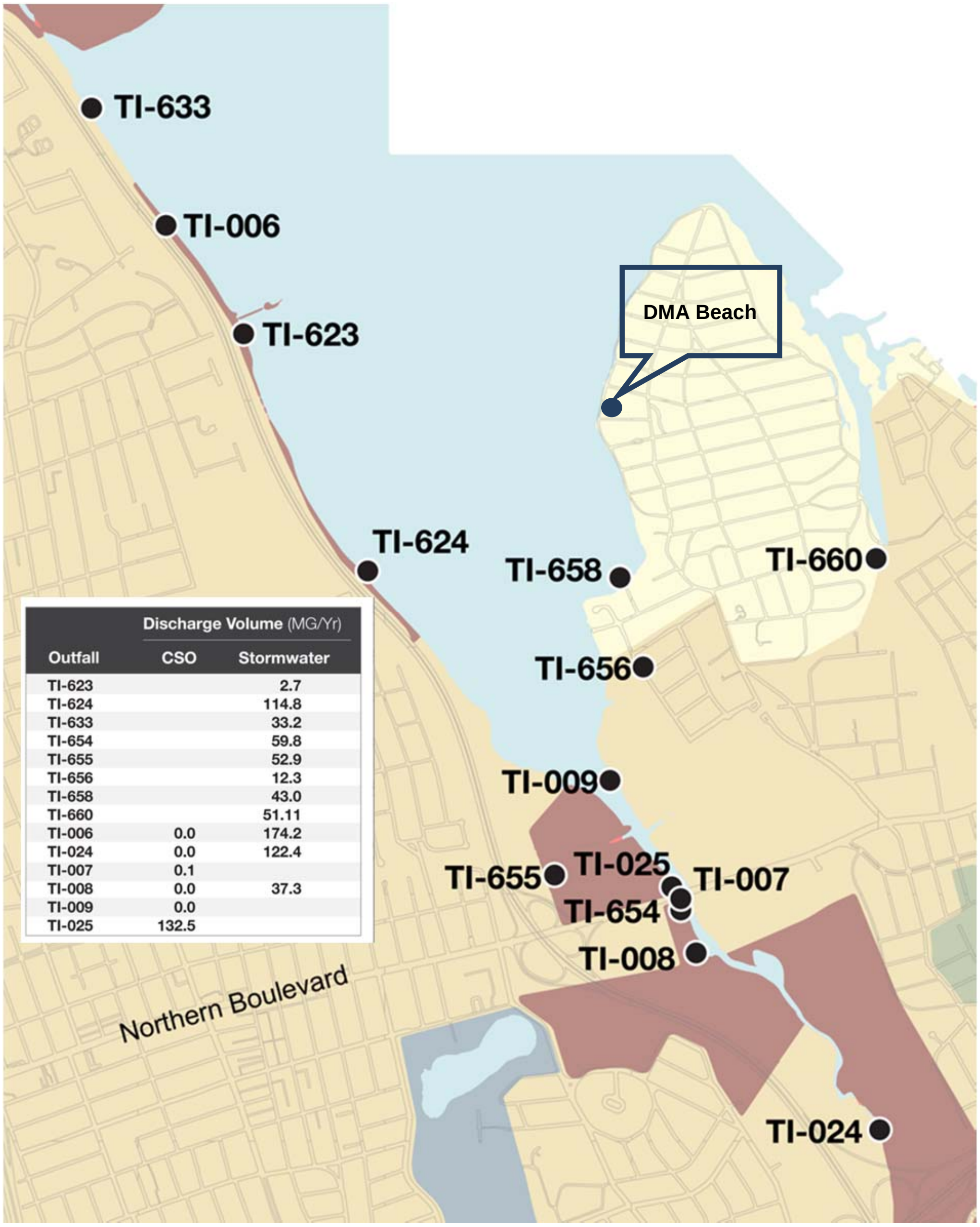
Figure ES-2. Watershed Characteristics

Several modifications have occurred within the collection system tributary to the Tallman Island WWTP since the InfoWorks (IW) model was calibrated in 2007. The IW model was subsequently revised accordingly. In addition to these physical model updates, DEP has made several other changes to the model as part of a citywide recalibration program to reflect enhancements in runoff methodology, sediments and other modeling inputs and parameters. The result of these extensive efforts resulted in watershed and water quality models that better represent the collection system and the receiving waterbody dynamics and simulations for use in the Alley Creek and Little Neck Bay LTCP.

There are two CSO control facilities within the Tallman Island WWTP sewershed: Flushing Creek CSO Retention Tank, also referred to as the Flushing Bay Retention Tank, with a total capacity of 43.4 MG: 28.4 MG of offline storage and 15 MG of inline storage in large outfall pipes, and the Alley Creek Retention Tank, which has an offline storage capacity of 5 MG.

The Tallman Island SPDES permitted CSO outfalls to Alley Creek are shown on Figure ES-3 and include TI-007, TI-008, TI-009, TI-024 and TI-025; CSO outfall TI-006 discharges to Little Neck Bay. It should be noted that TI-025 is the outfall for the Alley Creek CSO Retention Tank. Both TI-008 and TI-025 are also used to convey and discharge a large portion of stormwater. In addition, outfalls TI-007, TI-006 and TI-024 serve as emergency bypasses for pump stations, and therefore, are designated as CSO outfalls. Under normal operating conditions, TI-006 and TI-024 only discharge stormwater and TI-007 only discharges CSO during large precipitation events, typically less than once per year. Also shown on Figure ES-3 are the nine permitted stormwater outfalls discharging to Alley Creek and Little Neck Bay: TI-623, TI-624, TI-633, TI-653, TI-654, TI-655, TI-656, TI-658 and TI-660. The figure contains the annual discharge volumes for both the CSOs and stormwater outfalls.

The area on the eastern shore of Little Neck Bay, known as Douglas Manor, is a private residential community. The neighborhood is predominantly composed of single family residences served by on-site septic systems. Approximately 58 acres of drainage area generate runoff upstream of Shore Rd., a waterfront roadway that follows the alignment of the eastern shore of Little Neck Bay. The Douglas Manor Association manages a permitted private community beach known as DMA Beach along Shore Rd. As seen in Figure ES-3, the DMA Beach is located approximately 0.7 miles north of the mouth of Alley Creek, and approximately one mile downstream from the principal CSO outfall on Alley Creek, TI-025.



	Discharge Volume (MG/Yr)	
Outfall	CSO	Stormwater
TI-623		2.7
TI-624		114.8
TI-633		33.2
TI-654		59.8
TI-655		52.9
TI-656		12.3
TI-658		43.0
TI-660		51.11
TI-006	0.0	174.2
TI-024	0.0	122.4
TI-007	0.1	
TI-008	0.0	37.3
TI-009	0.0	
TI-025	132.5	

Figure ES-3. New York City Alley Creek and Little Neck Bay SPDES Permitted Outfalls

Waterbody Characteristics

Alley Creek and Little Neck Bay have been classified by DEC as I and SB waterbodies, respectively. The numerical WQS corresponding to these classifications are as shown in Figure ES-4. Dissolved oxygen is the numerical standard that DEC uses to establish whether a waterbody supports aquatic life uses. Bacteria concentrations are the numerical standard that DEC uses to establish whether a waterbody supports recreational uses. In addition to numerical standards, DEC has issued narrative criteria to protect aesthetics in all waters within its jurisdiction, regardless of classification.

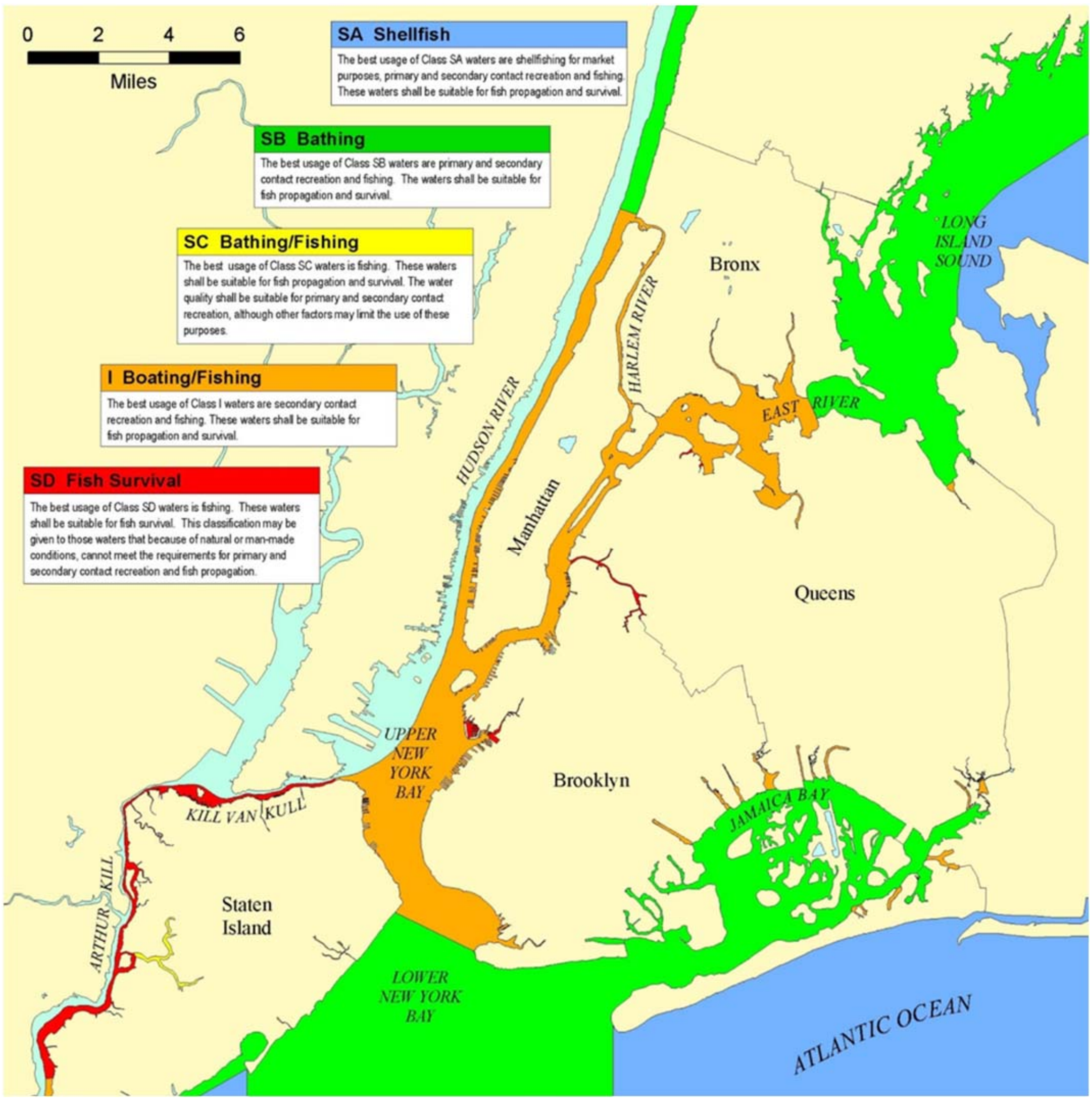


Figure ES-4. Surface Water Classifications and WQS

For designated bathing beach areas, the EPA criteria require an enterococcus reference level of 104 per 100 mL to be used by agencies for announcing bathing advisories or beach closings in response to pollution events. The DMA Beach is permitted to operate by the NYC Department of Health and Mental Hygiene (DOHMH). If the geometric mean (GM) is greater than 35 enterococci/100 mL, the key DOHMH criterion, the beach is closed pending additional analysis. If beach data are greater than 104 enterococci per 100 mL, a pollution advisory is posted on the DOHMH website. Additional sampling is initiated and the advisory is removed when water quality is acceptable for primary contact recreation. Although these are the existing DOHMH rules for bathing beaches, these operating criteria may change as a result of the recreational criteria recently promulgated by EPA.

Figure ES-5. Shoreline of Little Neck Bay and Alley Creek (Looking North)

Alley Creek, its shoreline, areas immediately adjacent to the water, and much of the surrounding drainage area of the creek are within Alley Pond Park. Access to Alley Creek is provided for by the park for passive, non-contact recreation. There are hiking trails that offer views of the water. Another significant, passive use of Alley Creek is for environmental education associated with wetlands habitat. The Alley Pond Environmental Center, located near the mouth of Alley Creek, offers an extensive naturalist program with outreach to local schools. The Alley Pond Environmental Center is located southeast of the intersection between the Cross Island Parkway and Northern Boulevard, on the western shore of the creek (Figure ES-5).

The CSO Control Policy requires that the LTCP give the highest priority to controlling overflows to sensitive areas, which in the case of Little Neck Bay, is the DMA Beach. Accordingly, the LTCP devoted significant attention to this beach as part of the analysis of WQS attainment.

Analysis of WQS attainment in Alley Creek and Little Neck Bay was based on data collected from the DEP Harbor Survey in 2009 and 2012 and from sampling performed in late 2012 during the development of the Alley Creek and Little Neck Bay LTCP. These data, the compilation of 2009 to 2012 Harbor Survey data and the data collected as part of the LTCP, indicate that the pathogen concentrations within Alley

Creek are elevated, with the data period GMs for enterococci at approximately 500 org/100ml and for fecal coliform bacteria near 2,000 org/100ml.

Pathogen levels within Little Neck Bay are significantly lower with period GM concentrations of less than 10 org/100ml for enterococci and are between 10 and 100ml for fecal coliform bacteria. Locally at DMA Beach, enterococci concentrations, as measured by the DOHMH, have a period GM that is very close to the maximum 30-day GM standard of 35 org/100ml. Between 2009 and the end of 2012 the water quality at DMA Beach was in compliance with the maximum 30-day GM enterococci standards from a low of 5 percent of the time in 2011 to a high of 67 percent of the time in 2012. Additional targeted sampling was conducted as part of the Alley Creek and Little Neck Bay LTCP. Its primary purpose was to further evaluate the spatial extent of the area within Little Neck Bay that experiences elevated pathogen concentrations as a result of the high concentrations of pathogens found in Alley Creek and at the DMA shoreline. These sampling locations and the results are shown in Figure ES-6.

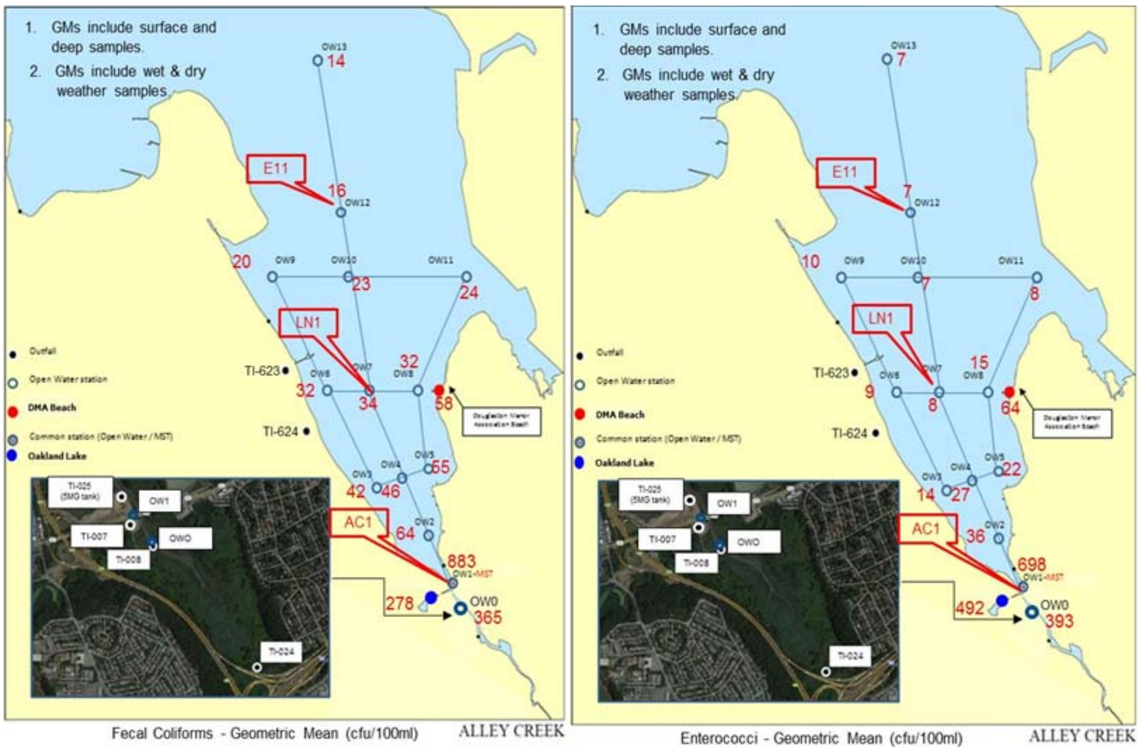


Figure ES-6. Synoptic Summary of LTCP Sampling Program

The results of this program revealed the highest levels of bacteria concentrations in Alley Creek and the mixing zone area of inner Little Neck Bay. Also noted was localized contamination at the DMA Beach. As shown in Figure ES-6, the high concentrations drop significantly as one moves from the mouth of Alley Creek to the open waters of the Bay. This is also the case for the samples collected at DMA Beach.

CSO Best Management Practices

In accordance with the SPDES permit requirements, annual reports summarizing the citywide implementation of the 13 Best Management Practices (BMPs) are submitted to DEC annually on April 1st. To date, DEP has submitted annual reports covering calendar years 2003 through 2012. Typical reports are divided into 13 sections, one for each of the BMPs in the SPDES permits. Each section of the annual reports describes ongoing DEP programs, provides statistics for initiatives occurring during the preceding calendar year, and discusses overall environmental improvements.

Status of Grey Infrastructure Projects Recommended in the WWFP

The grey infrastructure elements of the 2009 WWFP:

- New diversion chamber (Chamber 6) to direct CSO to the new Alley Creek CSO Retention Tank and to provide tank bypass to TI-008
- New CSO Retention Tank (5 MG Alley Creek Retention Tank)
- New 1,475 foot long multi-barrel outfall sewer extending to a new outfall on Alley Creek (TI-025)
- New CSO outfall, TI-025, for discharge from the Alley Creek Tank
- Fixed baffle at TI-025 for floatables retention, minimizing release of floatables to Alley Creek
- Upgrade of Old Douglaston Pumping Station to empty tank and convey flow to Tallman Island WWTP after the end of the storm

These WWFPs elements were all operational by 2011.

Post-Construction Monitoring

DEP conducted post-construction compliance monitoring (PCM) for the Alley Creek CSO Retention Tank consisting of sample collection at one location in Alley Creek (Station AC1) and one location in Little Neck Bay (Station LN1). In addition, DEP collected water quality samples at two other locations in the affected water body during November and December 2012: near the mouth of Alley Creek (Stations OW0 and OW1), and in Little Neck Bay near Station LN1 (Station OW2). Figure ES-6 presents a map of these station locations.

The results of the PCM revealed that the Alley Creek CSO Retention Tank has exceeded expectations for water quality improvement. Based upon the IW modeling analyses, the tank reduced 2012 pollutant loadings of both total suspended solids (TSS) and biochemical oxygen demand (BOD) by 85 percent, versus the pre-tank condition, thereby exceeding the annual-average target reductions of 70 and 66 percent, respectively. The tank also fully captured combined sewage and associated floatables for 100 of the 125 rainfall events in 2012. During the 25 events in 2012 when the tank did overflow, floatables removal at the tank was enhanced by means of an underflow baffle. Retained floatables are removed either at trash racks at the Old Douglaston PS or the influent screens at the Tallman Island WWTP. Overall, the facility performance has met or exceeded its predicted CSO volumetric control.

Green Infrastructure

The Alley Creek and Little Neck Bay watershed has one of the smallest total combined sewer impervious areas among the list of New York City's managed watersheds, totaling 1,490 acres, which are significantly controlled by existing CSO facilities and sewer enhancements. Therefore, as part of this LTCP, DEP assumes no investment in green infrastructure (GI) implementation in the right-of-way or onsite public properties. This GI investment decision takes into account water quality with WWFP improvements in place, and the potentially more effective allocation of GI resources in other watersheds that can provide more water quality benefits for the same level of implementation. DEP, however, does expect approximately 45 acres of area to be managed through onsite private GI implementation in the Alley Creek and Little Neck Bay watershed by 2030. This acreage would represent three percent of the total combined sewer impervious area in the watershed, and assumes new development based on a detailed review of New York City Department of Buildings (DOB) building permit data from 2000 to 2011.

Baseline Conditions and Performance Gap

Key to development of the LTCP for Alley Creek and Little Neck Bay is the assessment of water quality within each waterbody. For this LTCP, water quality was assessed using the East River Tributary Model (ERTM) water quality model, which was created and calibrated during the development of the WWFP in 2007. The model as applied was modified to significantly increase the grid resolution in Little Neck Bay and was recalibrated using DEP water quality monitoring data, DOHMH DMA Beach monitoring data and the synoptic water quality sampling data collected in 2012 as part of this LTCP. The water quality model was used to calculate ambient pathogen concentrations within the waterbodies for a set of baseline conditions. Baseline conditions were established in accordance with the guidance established by DEC to represent future conditions. Specifically, the design year was established as 2040; Tallman Island WWTP will receive peak flows at 2xDDWF; grey infrastructure would be limited to that which was recommended in the 2009 WWFPs; and waterbody specific GI application rates would be based on the best available information. In the case of Alley Creek and Little Neck Bay, GI was assumed to have 3 percent coverage. In addition, the LTCP assumed future conditions with some amount of dry weather sources of bacteria in the upper portions of Alley Creek.

These water quality assessments were conducted using continuous water quality simulations; one year (2008 rainfall) simulation for dissolved oxygen assessment and a longer term 10-year (2002 to 2011 rainfall) simulation for pathogens. The gap between calculated baseline dissolved oxygen and pathogen concentrations and the WQS was then calculated as the difference between the computed concentrations and the standards.

The results of the 10-year simulation indicated that enterococci concentrations calculated for the baseline within Little Neck Bay are divided into areas that are in compliance with the enterococci standards a high percent of the time (outer Little Neck Bay) and tidal mixing zone in inner Little Neck Bay where compliance with the standards ranges from a low of 68 to a high of 92 percent. The DMA Beach area of the Bay was calculated to be in compliance with the enterococci standard of a monthly GM of 35 cfu /100mL approximately 92 percent of the time. During the recreation or bathing season, the majority of the Bay is in compliance greater than 96 percent of the time. The small transition zone in the inner Bay immediately adjacent with Alley Creek is projected to be in compliance between 84 and 92 percent of the time. Also during the bathing season, the DMA Beach is calculated to comply with the SB enterococci standards 100 percent of the time per model predictions. Values were not assessed for Alley Creek proper since Alley Creek's current Class I designation does not designate an enterococci limit.

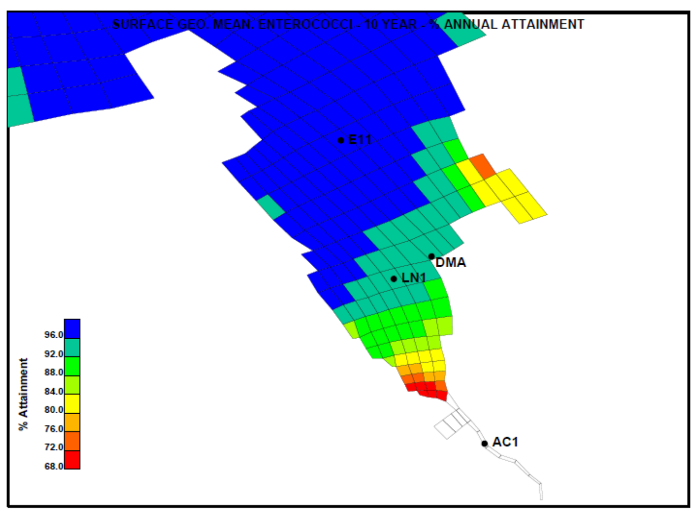


Figure ES-7. Enterococci Annual Attainment

As these projected pathogen concentrations are not in full compliance with applicable WQS, additional assessments were made to determine the level of CSO control required to bring the waterbodies into compliance. These analyses indicated that even with an hypothetical 100 percent control of all CSOs, the WQS will not be met at all times in Little Neck Bay. Further it was also determined that Alley Creek could not support the next highest classification, Class SB, even with 100 percent control of all CSOs. Accordingly, UAAs were prepared for both waterbodies.

With respect to DO concentrations, Alley Creek was not predicted to be in full compliance, under the baseline conditions, with the never less than 4 mg/l Class I standard. Portions of Little Neck Bay show higher level of compliance but not full compliance. With very high baseline attainment in both waterbodies, complete CSO removal does not result in complete compliance with the Class I standard in Alley Creek and Class SB in Little Neck Bay.

Public Outreach and Coordination

DEP followed a comprehensive public participation plan in ensuring engagement of interested stakeholders in the LTCP process. Stakeholders included both citywide and regional groups, a number of whom offered comments at public meetings held on the LTCP. DEP will continue to gather public feedback on waterbody uses and will provide the public UAA-related information at the third Alley Creek and Little Neck Bay Public Meeting in Fall 2013.

It should be noted that at the second of two public meetings conducted to date, there was a high degree of public support for DEP's findings that additional grey infrastructure based-CSO controls was not warranted due to the improvements made from the 2009 WWFP.

Evaluation of Alternatives

This LTCP developed and evaluated various CSO control measures and watershed-wide alternatives using a three-step procedure:

Step 1: Screening of Potential Control Measures
Step 2: Development and Ranking of Control Measures
Step 3: Final Evaluation and Selection of Preferred Watershed-Wide Alternative

An overview of the three-step procedure is as shown in Figure ES-8. Each alternative is evaluated considering several parameters, including: feasibility of construction and implementation; improvements to the waterbody in terms of water quality parameters and aesthetics; significant reductions in the number of CSO events and annual CSO volume; and construction costs. Overall, the methodology for ranking control measures transforms from being highly qualitative to more quantitative as the steps progress.

Step 1 qualitatively judges their ability to meet the LTCP goals and to identify fatal flaws that could disqualify a control measure. In Step 2, the resulting, most favorable control measures are then rated using non-economic criteria or metrics covering the following three categories:

- Environmental Benefits/Performance
- Community and Societal Impacts
- Implementation and O&M Considerations

The highest ranked control measures then pass on to Step 3, where they form watershed-wide alternatives, and are evaluated in greater detail using economic criteria and water quality attainment criteria such as reductions of both CSO discharge volume and bacteria loading. The cost and performance estimates are used to perform the cost performance or knee-of-the-curve (KOTC) analysis.

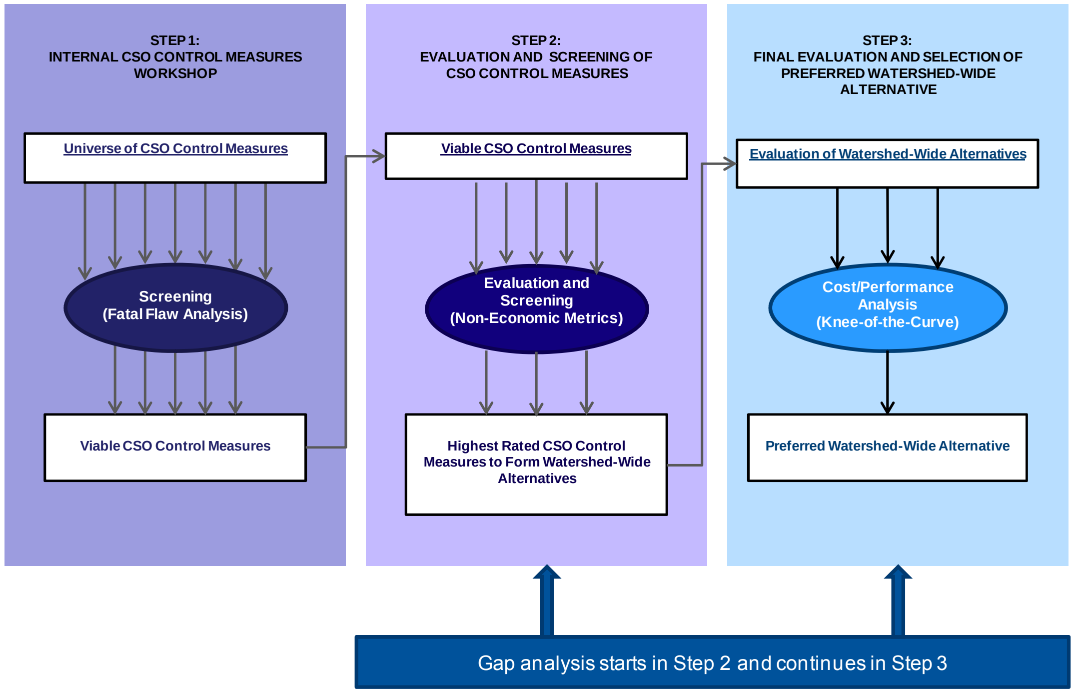


Figure ES-8. Three-Step LTCP Evaluation and Screening Alley Creek and Little Neck Bay Alternatives

Control measures that were evaluated through Step 3 are summarized in Table ES-1.

Table ES-1. Alley Creek and Little Neck Bay Alternatives Summary

Alternative	CSO Volume (MGY)	AAOV Reduction[1] Percent	Enterococci Reduction[2] Percent	Present Worth May 2013 ($ Million)[3]
Baseline Conditions	132	0	0	$0
4A. 10 Percent Green Infrastructure (GI)	112	15	5.4	$63
3A. 2.4 MG Additional Upstream Retention	98	25	15.0	$113
2A. 3.0 MG Additional Downstream Retention	98	25	10.5	$93
3B. 6.7 MG Additional Upstream Retention	65	50	28.5	$173
2B. 6.5 MG Additional Downstream Retention	65	50	21.1	$156
1. High Level Sewer Separation (HLSS)	65	51	-5.4	$658
5. Hybrid – HLSS plus 3.0 MG Retention	38	71	0.1	$751
2C. 12 MG Additional Downstream Retention	33	75	31.8	$310
2D. 29.5 MG Additional Downstream Retention	0	100	42.2	$569

[1] CSO Average Annual Overflow Volume (AAOV) reduction from baseline conditions.

[2] includes both CSO and stormwater; reduction from baseline conditions.

[3] Based on Probable Bid Cost plus O&M cost for 20-year life, assuming 3 percent interest.

One high level sewer separation (HLSS) alternative was developed for the combined sewer system (CSS) that is tributary to Regulators 46 and 47. The CSS associated with these regulators is west of Alley Pond Park.

Retention alternatives reduce overflows by intercepting combined sewage in an offline or inline storage element during wet weather for controlled release into the WWTP after the storm event. Two candidate locations for siting additional retention facilities were identified:

- Downstream near the existing CSO Retention Tank (including both adjacent to the existing tank and to the south of Northern Boulevard)
- Upstream of the existing tank at the CSO regulators for the CSS area (within the interchange for the Long Island and Clearview Expressways)

Four retention alternatives were developed near the downstream location. Two alternatives were developed for the upstream location, both located within the interchange for the Long Island and Clearview Expressways and designed to capture CSO flow from Regulators 46 and 47.

Because it is unlikely that HLSS alone would be capable of reducing CSO volume beyond 50 percent, a hybrid combination of HLSS with additional retention was developed. This hybrid HLSS-Retention alternative essentially combines HLSS for the areas upstream of Regulators 46 and 47 with a new retention tank located downstream at the Alley Creek Retention Tank site. It should also be noted that HLSS alone would increase the overall pollutant loading to the waterbodies (Alternative 1) since the flows and pollutant loads that were captured and sent to the WWTP for small to moderate storms are now discharged directly into the waterbodies.

Initially, two GI alternatives that would employ additional GI beyond the baseline were identified, but one was subsequently determined to be infeasible due to siting difficulties. Only one GI alternative, sized for 10 percent of the combined sewer service area in the Alley Creek and Little Neck Bay watershed, was carried through to the economic evaluation.

CSO Reductions and WQ Impact of Retained Alternatives

A summary of the alternatives developed for the Alley Creek and Little Neck Bay LTCP is presented in Table ES-1along with their expected CSO AAOV performance and cost. Under baseline conditions, Alley Creek and Little Neck Bay are in nearly 100 percent attainment with current DO standards, but Little Neck Bay is not in attainment with all bacterial standards. Therefore, discussion of CSO control performance for the alternatives will focus on bacterial standards.

Percent of CSO capture ranges from 0 percent (baseline) to 100 percent AAOV reduction (additional 29.5 MG downstream retention) with costs spanning up to $751M (additional 3.0 MG downstream retention with HLSS). With respect to bacterial discharges, the best performing alternative was 100 percent retention (Alternative 2D) from TI-025, which reduces the overall fecal loading to the waterbodies by roughly 50 percent and the enterococcus loading by 42 percent at a cost of $569M. Because of the pollutants contained in stormwater, none of the CSO control alternatives can eliminate all of the bacteria discharged to Alley Creek and Little Neck Bay. HLSS (Alternative 1) was the poorest performing alternative, yielding a net increase in enterococci. Although HLSS reduces CSO and its associated pollutants, it also significantly increases the volume of annual stormwater discharges. As noted above for HLSS, the increased pollutant loads associated with the increased stormwater exceeded the benefits from the reduced CSO.

Figure ES-9 shows the present worth of the retained alternatives compared to annual total enterococci loading reduction. The enterococci loading is represented with two vertical axes. One axis shows percent enterococcus loading reductions at TI-025 (the CSO outfall for the existing Alley Creek Tank) and represents the reduction of enterococcus from CSO sources. The other axis shows percent enterococcus loading reduction based on all sources – CSO and stormwater. Because CSO is not the only source of bacteria and some alternatives (notably HLSS) affect stormwater discharge volumes in addition to CSO volumes, attainment of standards cannot be evaluated based on enterococcus discharged at TI-025 alone. Therefore, the axis representing total enterococcus from all sources was selected as the primary axis. The cost curve was based on selected alternatives judged to be the most cost-effective. The less cost-effective alternatives, shown in red, were excluded from the curve. The resulting curve does not show a clear knee-of-curve, but the curve does start to flatten as the enterococci reduction increases, indicating that increasing reductions become less cost-effective.

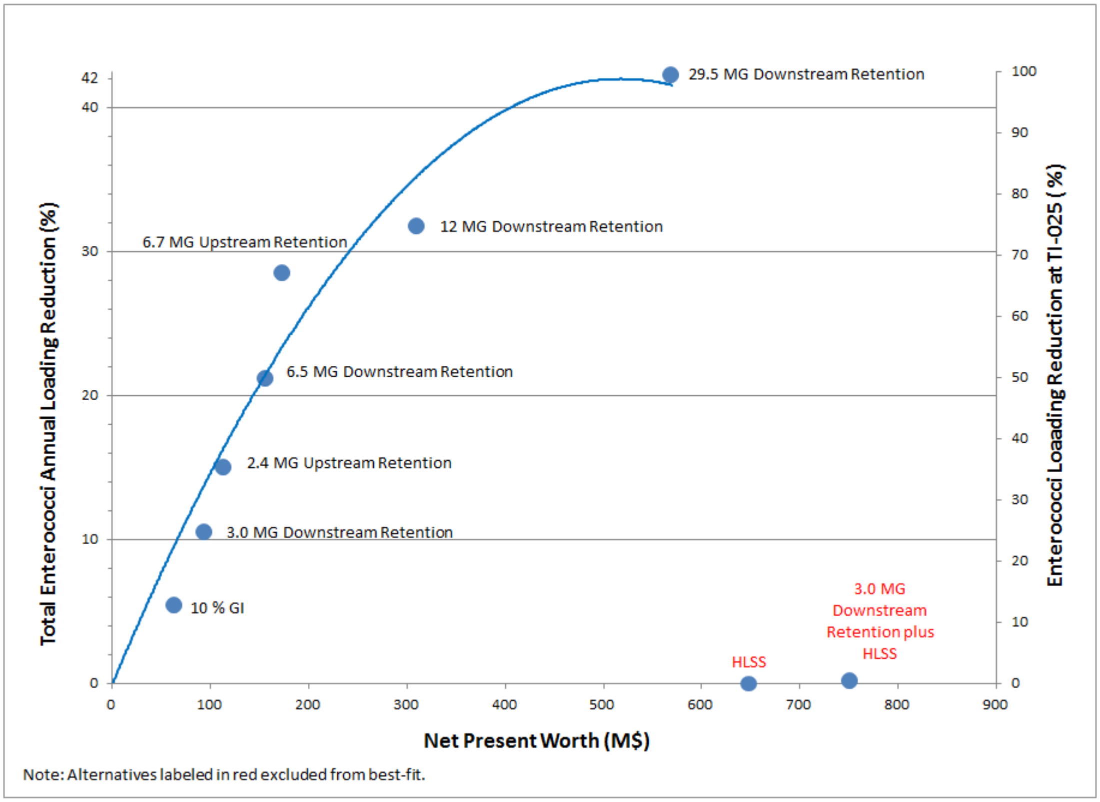


Figure ES-9. Cost vs. Total Enterococci Loading Reduction

Plots showing annual attainment of WQS aid in evaluating the performance of proposed alternatives. Attainment of fecal coliform standards occurs essentially 100 percent of the time for both Alley Creek and Little Neck Bay under baseline conditions and therefore was not plotted. Figure ES-10 shows the modeled improvement in enterococci attainment versus net present worth at locations E11, LN1, OW2 and at DMA Beach for each alternative. Attainment of enterococci standards for Little Neck Bay varied with time of year and location in the bay. At the northern end of the bay, the performance gap was small, with attainment occurring 98.5 percent of the time at sampling location E11 under baseline conditions. The improvements shown at E11 are marginal, rising just 0.2 percent for the alternative with the greatest improvement (Alternative 2B – 29.5 MG Downstream Retention). At DMA Beach, baseline conditions are in attainment with Class SB standards approximately 93.4 percent of the time. Capturing 100 percent of the CSO resulted in only a 1.4 percent increase in attainment, with all other alternatives having a lesser degree of improvement. The cost attainment curve for sampling location LN1 is essentially identical to the curve for DMA Beach.

Figure ES-10 also shows the ability of each alternative to attain Class SB WQS at station OW2 in the mixing zone between Alley Creek and Little Neck. Baseline conditions are in attainment with these standards approximately 78.9 percent of the time. Capturing 100 percent of the CSO resulted in only a 3 percent increase in attainment, with all other alternatives having a lesser degree of improvement. Overall, results show that capturing additional volumes of CSO, regardless of the degree of capture, does not significantly improve attainment of the WQS. These marginal improvements come at a significant cost – up to $569M for the 29.5 MG Downstream Retention alternative because the remaining non-attainment of standards is caused by other, non-CSO sources of pollutants.

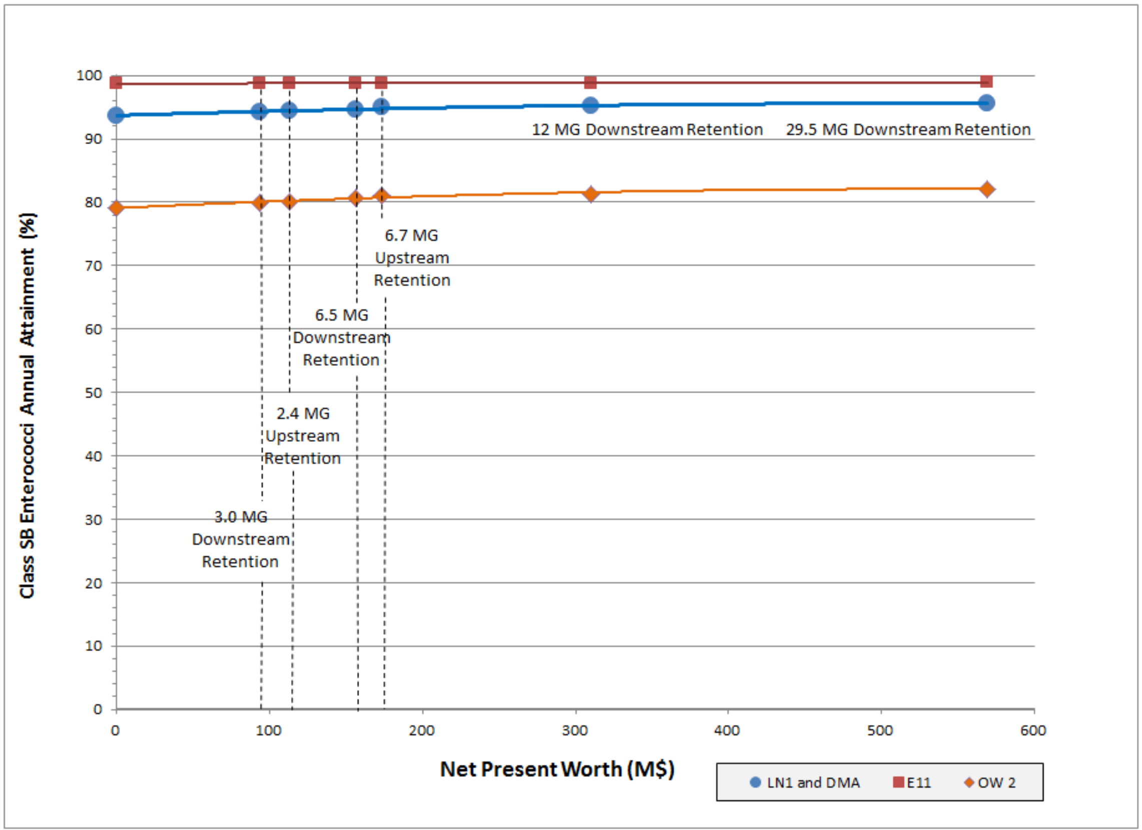


Figure ES-10. Cost Versus Enterococci Attainment

Long Term CSO Control Plan Implementation

Based on the outcome of the facility planning and water quality improvement evaluations completed as part of the LTCP, and the progress made from implementing the recommendations of the 2009 WWFP and earlier DEP facility plans, DEP does not recommend the implementation of new grey infrastructure to further address the CSO discharges in the watershed. As demonstrated throughout the LTCP, the remaining minor gaps in attaining WQS remaining are primarily due to non-CSO sources.

Although not required by this LTCP, DEP will continue to investigate the localized, non-CSO sources of pollution in the upper Alley Creek watershed, including the direct drainage into Oakland Lake and other such tributaries. While it is currently understood that waterfowl comprise a significant portion of these pollutant loadings, this should be quantified to the extent practical. A work plan for such investigations will be developed by DEP complementing ongoing data collection programs such as the PCM, the Harbor Survey (HS) and Sentinel Monitoring (SM) programs, enhancing the source characterization and supporting potential variations of designated uses in the future.

Use Attainability

The Alley Creek and Little Neck Bay LTCP was developed to comply with the requirements of the EPA CSO Control Policy, including applicable guidance documents, and the broader CWA goal that the waterbodies shall support fishable and swimmable water quality, where attainable. The LTCP reveals that Alley Creek currently meets the Class I bacteria criteria but cannot support the next highest Class SB standard even with 100 percent CSO control. It also shows, however, that Alley Creek is not suitable for contact recreation due to several natural and manmade factors. As such, a UAA has been prepared and is attached to the LTCP as a means to formalize the suitability of continued Class I designation for Alley Creek.

Unlike Alley Creek, the Class SB Little Neck Bay, while classified for primary contact recreation, does not fully comply with all of its applicable bacteria criteria on an annual basis. The Class SB enterococci criteria are generally not met in the mixing zone between Alley Creek and Little Neck Bay, primarily as the result of wet weather discharges and to a lesser extent base flow contamination from natural sources. There are, however, limited opportunities for secondary contact uses of this portion of the bay and no designated public or private beaches. As such, DEP propose to develop new CSO advisories for this transition zone between Alley Creek and Little Neck Bay, similar to its ongoing CSO advisories in other NYC waterways. This advisory will focus on the duration subsequent to rainfall when pursuing primary contact recreation is not advisable in this transition zone of the Bay.

1.0 INTRODUCTION

This LTCP for Alley Creek and Little Neck Bay was prepared pursuant to the Combined Sewer Overflow (CSO) Order on Consent (DEC Case No. CO2-20110512-25) as modified, March 8, 2012 (2012 Order on Consent). Under the 2012 Order on Consent, DEP is required to prepare and submit 11 LTCPs for submittal to DEC by December 2017; the Alley Creek LTCP is the first of those 11 LTCPs to be completed[1].

1.1 Goal Statement

The following is the LTCP Introductory Goal Statement, which appears as Appendix C in the 2012 Order on Consent. It is generic in nature, so that waterbody-specific LTCPs will take into account, as appropriate, the fact that certain waterbodies or waterbody segments may be affected by the City's concentrated urban environment, human intervention and current waterbody uses, among other things. DEP will identify appropriate water quality outcomes based on site-specific evaluations in the drainage basin specific LTCP, consistent with the requirements of the CSO Control Policy and CWA.

> *The New York City Department of Environmental Protection submits this Long Term Control Plan (LTCP) in furtherance of the water quality goals of the federal Clean Water Act and the State Environmental Conservation Law. We recognize the importance of working with our local, State, and federal partners to improve water quality within all City-wide drainage basins and remain committed to this goal.*
>
> *After undertaking a robust public process, the enclosed LTCP contains water quality improvement projects, consisting of both grey and green infrastructure, which will build upon the implementation of the U.S. Environmental Protection Agency's (EPA) Nine Minimum Controls and the existing Waterbody/Watershed Facility Plan projects. As per EPA's CSO Control Policy, communities with combined sewer systems are expected to develop and implement LTCPs that provide for attainment of water quality standards and compliance with other Clean Water Act requirements. The goal of this LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific water quality standards, consistent with EPA's 1994 CSO Policy and subsequent guidance. Where existing water quality standards do not meet the Section 101(a)(2) goals of the Clean Water Act, or where the proposed alternative set forth in the LTCP will not achieve existing water quality standards or the Section 101(a)(2) goals, the LTCP will include a Use Attainability Analysis examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State. The Use Attainability Analysis will assess the waterbody's highest attainable use, which the State will consider in adjusting water quality standards, classifications, or criteria and developing waterbody-specific criteria. Any alternative selected by a LTCP will be developed with public input to meet the goals listed above.*
>
> *On January 14, 2005, the NYC Department of Environmental Protection and the NYS Department of Environmental Conservation entered into a Memorandum of Understanding (MOU), which is a companion document to the 2005 CSO Order also executed by the parties and the City of New York. The MOU outlines a framework for coordinating CSO long-term planning with water quality standards reviews. We remain committed to this process outlined in the MOU and understand that approval of this LTCP is contingent upon our State and federal partners' satisfaction with the progress made in achieving water quality standards, reducing CSO impacts, and meeting our obligations under the CSO Orders on Consent.*

[1] DEP requested and received an extension to July 2, 2013, to submit this LTCP.

This Goal Statement has guided the development of Alley Creek and Little Neck Bay LTCP and UAA.

1.2 Regulatory Requirements (Federal, State, Local)

The waters of the City of New York are subject to Federal and New York State regulation. The following sections provide an overview of the regulatory issues relevant to long term CSO planning. Detailed discussions of regulatory requirements are provided in the June 2009, Alley Creek and Little Neck Bay WWFP (DEP, 2009).

1.2.a Federal Regulatory Requirements

The CWA established the regulatory framework to control surface water pollution, and gave EPA the authority to implement pollution control programs. The CWA established the National Pollutant Discharge Elimination System (NPDES) permit program. NPDES regulates point sources discharging 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, the NPDES permit program is administered by the DEC, and is thus a State Pollution Discharge Elimination System (SPDES) program. New York City has had an approved SPDES program since 1975. Section 303(d) of the CWA and 40 CFR §130.7 (2001) require states to identify water bodies that do not meet water quality standards and are not supporting their designated uses. These waters are placed on the Section 303(d) List of Water Quality Limited Segments (also known as the list of impaired water bodies). The List identifies the pollutant or stressor causing impairment and establishes a schedule for developing a control plan to address the impairment. Placement on this list can lead to the development of a Total Maximum Daily Load (TMDL) for each water body and associated pollutant/stressor on the list. Pollution controls based on the TMDL serve as the means to attain and maintain water quality standards for the impaired water body. Alley Creek was included in the 2010 list of impaired water bodies for dissolved oxygen and Little Neck Bay was included for pathogen impairments due to CSO discharges, storm discharges and urban runoff. However, as shown in Table 1-1, these waterbodies, which are under the CSO Order, have been delisted from the 2012 303(d) list (updated February 2013) as a Category 4b waterbody for which required control measures other than a TMDL (i.e., consent order) are expected to restore uses. Further, the Category 4a notation has been applied to Little Neck Bay, which indicates that the waterbody already has a TMDL (Long Island Sound TMDL).

Table 1-1. 2012 DEC 303(d) Impaired Waters Listed and Delisted (with Source of Impairment)

Waterbody	Pathogens	DO/Oxygen Demand	Floatables
Little Neck Bay	(1)Urban/Storm/CSO	(4a)Municipal, Urb, CSOs	
Alley Creek		(4b)Urban/Storm/CSO	(4b)CSOs, Urban/Storm

Parts Definition

(1) Individual Waterbodies with Impairment Requiring a TMDL

(4a) Impaired Waters NOT INCLUDED on the NYS 2012 Section 303(d) List because TMDL development is not necessary since a TMDL has already been established for the segment/pollutant.

(4b) Impaired Waters NOT INCLUDED on the NYS 2012 Section 303(d) List because a TMDL is not needed, other required control measures are expected to result in restoration in a reasonable period of time.

1.2.b Federal CSO Policy

The 1994 EPA CSO Control Policy provides guidance to permittees and NPDES permitting authorities on the development and implementation of a LTCP, in accordance with the provisions of the CWA. The CSO policy was first established in 1994 and codified as part of the CWA in 2000.

1.2.c New York State Policies and Regulations

The State of New York has established WQS for all navigable waters within its jurisdiction. Little Neck Bay is classified as an SB waterbody. A Class SB waterbody is defined as "suitable for fish, shellfish and wildlife propagation and survival". The best usages of Class SB waters are "primary and secondary contact recreation and fishing" (6 NYCRR 701.11). Alley Creek is classified as a Class I waterbody. A Class I waterbody is defined as "suitable for fish, shellfish and wildlife propagation and survival". The best usages of Class I waters are "secondary contact recreation and fishing", (6 NYCRR 701.13) Interstate Environmental Commission (IEC).

The States of New York, New Jersey and Connecticut are signatories 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, including Alley Creek and Little Neck Bay. The IEC has recently been incorporated into and is now part of the New England Interstate Water Pollution Control Commission (NEIWPCC), a similar multi-state compact of which NYS is a member. The IEC is now a district of NEIWPCC. Both waterbodies are classified as Type A under the IEC system. Details of the IEC classifications are presented in Section 2.2.

1.2.d Administrative Consent Order

The City and DEC have entered into Orders on Consent to address CSO issues, including the 2005 CSO Order on Consent, which was issued to bring all DEP CSO-related matters into compliance with the provisions of the CWA and the New York State Environmental Conservation Law (ECL), and requires implementation of LTCPs. The 2005 Order on Consent required DEP to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for City-wide long-term CSO control, in accordance with the 1994 EPA CSO Control Policy. The 2005 Order on Consent was modified as of April 14, 2008, to change certain construction milestone dates. In addition, DEP and DEC entered into a separate Memorandum of Understanding (MOU) to facilitate WQS reviews in accordance with the EPA CSO Control Policy. The last modification that occurred prior to 2012 was in 2009, which addressed the completion of the Flushing Creek CSO Retention Tank.

In March 2012, DEP and DEC amended the 2005 Order to provide for incorporation of GI into the LTCP process as proposed under the City's 2010 Green Infrastructure Plan, and to update certain project plans and milestone dates. In doing so, some of the grey infrastructure projects planned earlier were eliminated from the Order.

1.3 LTCP Planning Approach

The LTCP planning approach includes several phases, including a characterization phase - an assessment of current waterbody and watershed characteristics, system operation and management practices, the status of current green and grey infrastructure projects, and an assessment of current system performance. DEP gathers the majority of this information from field observations, historical records, and analysis of studies and reports. The next phase is the identification and analysis of alternatives to reduce the frequency of wet weather discharges and improve water quality. DEP expects that alternatives will include a combination of green and grey infrastructure elements and will be carefully evaluated using both the collection system and receiving water models. Following the analysis of alternatives, DEP will develop a recommended plan along with an implementation schedule and strategy. If the proposed alternative will not achieve existing WQS or the Section 101(a)(2) goals of CWA, the

LTCP will include a UAA examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State.

1.3.a Integrate Current CSO Controls from Waterbody/Watershed Facility Plans (Facility Plans)

This LTCP builds upon prior efforts by capturing the findings and recommendations from the previous facility planning documents for this watershed and integrating the findings into the LTCP.

In June 2009, DEP issued the Alley Creek and Little Neck Bay WWFP. The WWFP, which was prepared pursuant to the 2005 Order on Consent, includes an analysis and presentation of operational and structure modifications targeting the reduction of CSOs and improve the overall performance of the collection and treatment system within this watershed. Several of the recommended improvements, which were selected to target the attainment of existing WQS, were set forth in earlier facilities planning efforts and have been completed; these include the 5 MG Alley Creek CSO Retention Tank and extensive improvements to the upstream combined and separate collections systems within the Alley Creek watershed.

Wet weather flows to the Tallman Island WWTP were limited to less than 2xDDWF due to certain characteristics of the associated conveyance system. These problems, however, were comprehensively examined in the *Facility Plan for Delivery of Wet Weather Flow to the Tallman Island WPCP* (HydroQual, 2005b). As a result of this examination, DEP modified Regulator TI-R09 (increased open area of side-overflow windows, raised weir) and Regulator TI-R10 was removed and replaced with a section of pipe. DEP incorporated these improvements into the baseline conditions for this LTCP.

1.3.b Coordination with DEC

As part of the LTCP process, DEP and DEC work closely together to share ideas, track progress, and work toward developing strategies and solutions to address wet weather challenges in the New York Harbor Complex.

Representatives from DEP and DEC, along with their technical consultants conducted regularly scheduled technical meetings during the development of the Alley Creek and Little Neck Bay LTCP. The purpose of these meetings was to discuss many of the plan components including but not limited to technical analysis, the proposed recommended plan and resulting water quality benefits as well as coordination for public meetings and other stakeholder presentations. On a quarterly basis, DEC, DEP, and outside technical consultants convene for a larger progress meeting that typically includes technical staff as well as representatives from DEP and DEC's legal departments and department chiefs who oversee the execution of the program.

In addition to structured meetings, DEP and DEC typically co-host LTCP-related public meetings, sharing the responsibility for presentation of material and execution of the workshop or event.

1.3.c Watershed Planning

DEP prepared its CSO WWFPs before the emergence of GI as an established method for reducing stormwater runoff; consequently the WWFPs did not include a full analysis of GI alternatives for controlling CSOs. In comments on DEP's CSO WWFPs, community and environmental groups voiced widespread support for GI and urged that DEP place greater reliance upon that sustainable strategy. Including GI in the LTCPs is consistent with the 2012 Order and recent EPA guidance. To the extent that GI installations are feasible in any given area, the use of GI will lead to the achievement of better water quality and sustainability benefits than using solely grey technologies. A sustainable approach includes the management of stormwater at its source, through the creation of vegetated areas and other GI, Bluebelts and Greenstreets, green parking lots, green roofs, and other technologies discussed in detail in Section 5 of this report.

1.3.d Public Participation Efforts

A concerted effort was made during the Alley Creek and Little Neck Bay LTCP planning process to involve all relevant and appropriate stakeholders and keep public and stakeholders informed about the project. A public outreach participation plan was developed and implemented throughout the process which is posted and continuously updated on DEP's LTCP program website (www.nyc.gov/dep/ltcp). Specific objectives of this initiative included the following:

- Develop and implement an approach that would reach all stakeholders;
- Integrate the public outreach efforts with all other aspects of the planning process; and
- Take advantage of other on-going public efforts being conducted by DEP and other City agencies as part of other related programs.

The public participation efforts for this Alley Creek and Little Neck Bay LTCP are summarized in Section 7 in more detail.

2.0 WATERSHED/WATERBODY CHARACTERISTICS

This section summarizes the major characteristics of the Alley Creek and Little Neck Bay Watershed and Waterbody, building upon earlier documents that present a characterization of the area, most recently the WWFP for Alley Creek and Little Neck Bay (DEP, 2009) that describes the characteristics of the watershed and waterbody.

2.1 Watershed Characteristics

The Alley Creek and Little Neck Bay watershed is urbanized and sub-urbanized, comprised primarily of residential areas with some commercial, industrial, and open space/outdoor recreation areas. The most notable outdoor recreation area within this watershed is the Alley Pond Park, located along the banks of Alley Creek, south of the Little Neck Bridge (Northern Boulevard).

This subsection contains a summary of the watershed characteristics as they relate to the sewer system configuration, performance, and impacts to the adjacent waterbodies as well as the modeled representation of the collection system used for analyzing system performance and CSO control alternatives.

2.1.a Description of Watershed

The Alley Creek and Little Neck Bay watersheds comprise approximately 4,879 acres, located on the north shore of eastern Queens County, adjacent to the Nassau County Border. The land surrounding Alley Creek is mostly parkland while that surrounding Little Neck Bay is largely residential. Several parks are found within the watershed; most notable is the Alley Pond Park which surrounds Alley Creek on its eastern, western, and southern shores. As described later in this section, the area is served by a complex wastewater system comprised of combined, separate and storm sewers; interceptor sewers and pumping stations; several CSO and stormwater outfalls; and a CSO retention tank.

Although the watershed has undergone major changes as this part of the City has developed, significant effort and interest by the citizens living in the area and New York City agencies has resulted in recognition of the ecological, environmental and educational value of Alley Creek and its tidal wetlands. In contrast to the filling in of wetlands and "hardening" of the shoreline with bulkheads that characterizes most of New York City's pre-colonial wetlands much of Alley Creek's wetlands and the Little Neck Bay wetlands in Udalls Cove are designated parks.

The urbanization of Alley Creek and Little Neck Bay has led to the creation of CSSs and stormwater systems that discharge to the creek and bay. Combined sewage, which does not overflow through one of the CSO structures, is conveyed to the Tallman Island WWTP for treatment. As shown in Figure 2-1, Alley Creek and Little Neck Bay are located along the western edge of the Tallman Island WWTP tributary area.

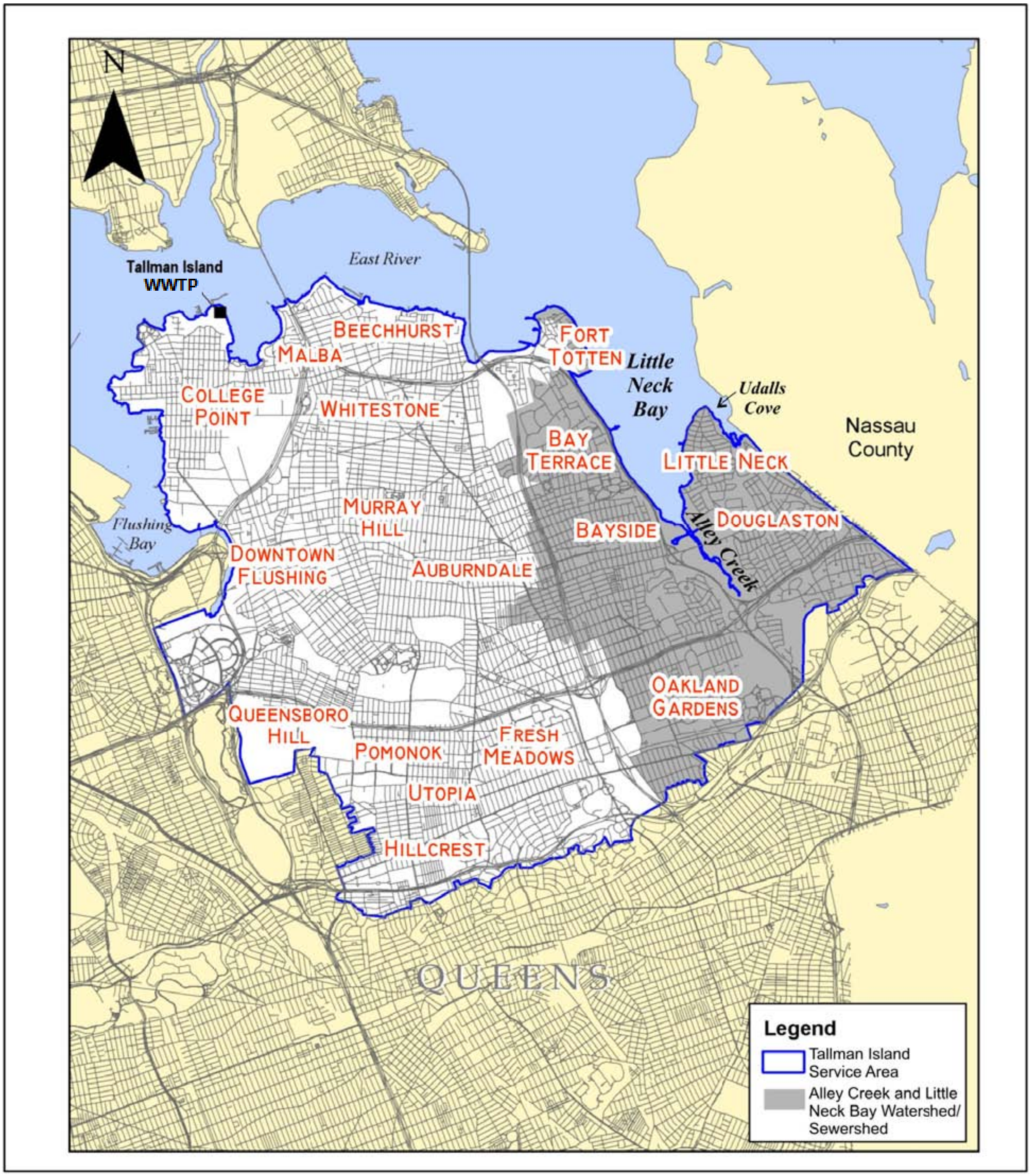


Figure 2-1. Alley Creek and Little Neck Bay Watershed within Tallman WWTP

As a residential community within New York City, several large and notable transportation corridors cross the watershed providing access between dense commercial and residential areas. These access routes include the Cross Island Parkway, the Long Island Expressway, the Grand Central Parkway, and the Long Island Railroad (Figure 2-2). These transportation corridors limit access to some portions of the waterbody and need to be taken into consideration when developing CSO control solutions.

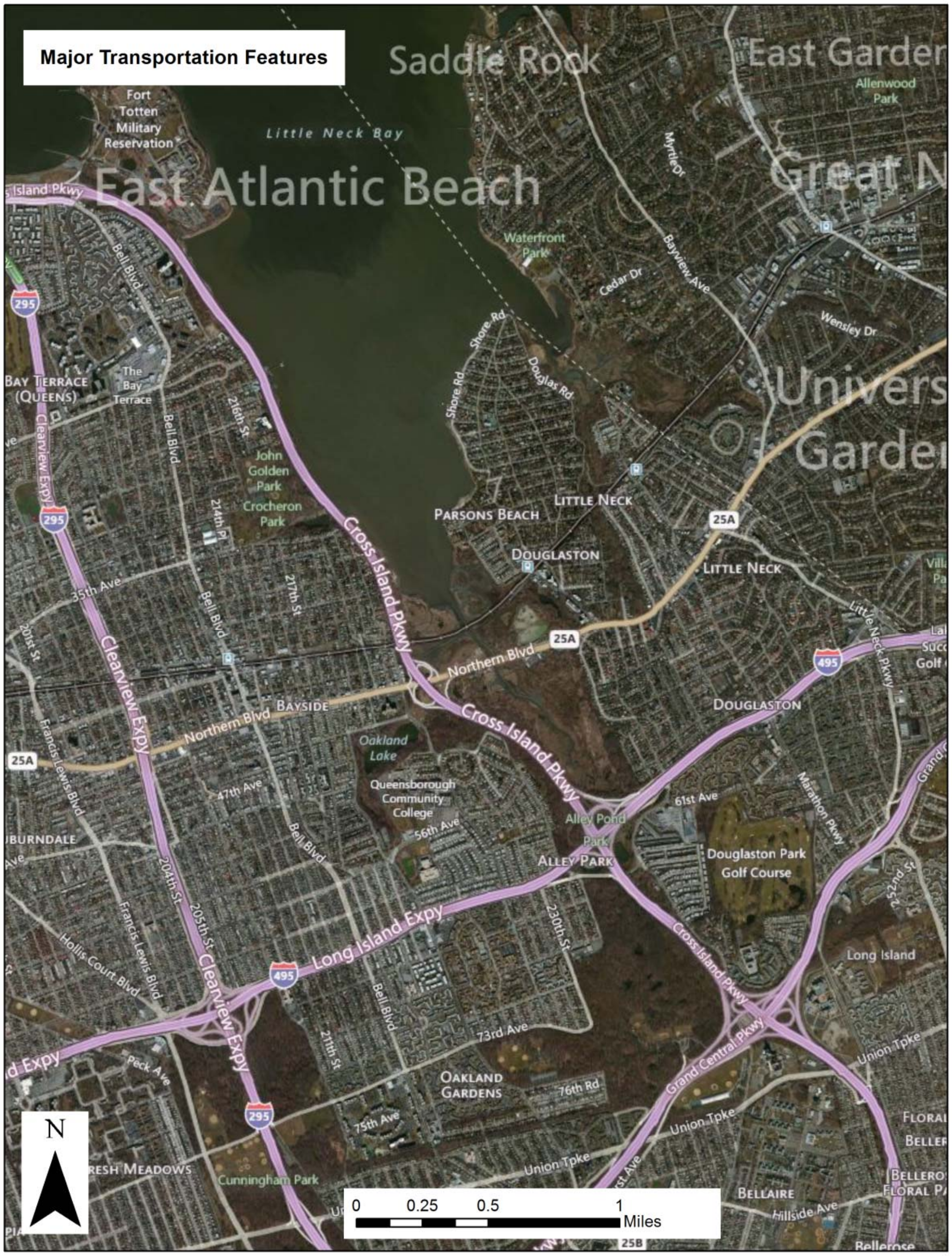


Figure 2-2. Major Transportation Features of Alley Creek and Little Neck Bay

2.1.a.1 Existing and Future Land Use and Zoning

Current land use for the watershed is shown in Figure 2-3 and generally aligns with the established zoning. Starting at the northeast edge of the waterbody within New York City, land immediately southeast of Udalls Cove is zoned C3 (commercial local retail), while surrounding land is zoned for low density residential, detached and attached (R1-2, R-2 and R3-1). The whole Douglaston Peninsula is zoned for detached housing on large lots (R1-2). The land immediately surrounding Alley Creek is designated parkland. The residential area to the east of the creek is R1-2, while that to the west is R2. Residential land on the western shore, north of the railroad tracks is zoned R3-2 and R2. Moving north, Crocheron Park and John Golden Park are designated parkland. The area between John Golden Park and Fort Totten is known as Bayside. Previous zoning allowed R5 (mid-density, including multi-story rowhouses). The New York City Department of City Planning (DCP) rezoned 350 blocks in the Bayside area of northeastern Queens, Community District 11 (CD11). Much of the area is now rezoned to contextual districts, permitting development of only one- and two-family homes, to maintain Bayside's longstanding neighborhood character. To curb recent development trends toward unusually large single-family houses in areas currently zoned R2, DCP established a new low-density contextual zoning district, R2A. This new district limits floor area and height and other bulk regulations that are different from the former R2 district (DEP website 2005). Fort Totten is zoned R3-1, C3 and NA-4. The NA-4 designation is a Special Natural Area District (SNAD). This protects the area by limiting modifications in topography, by preserving tree, plant and marine life, and natural water courses, and by requiring clustered development to maximize preservation of natural features. Generalized land use within the New York City portion of the Alley Creek and Little Neck Bay assessment area within the riparian area of 1/4 mile of Alley Creek and Little Neck Bay shoreline is shown in Figure 2-4. Land use within the Alley Creek, Little Neck Bay drainage area is summarized in Table 2-1. The main land use is residential with sizeable fractions of Open Space and Outdoor Recreation and Vacant Land.

Table 2-1. Land Use within the Alley Creek and Little Neck Bay Drainage Area

Land Use Category	Percent of Area	
	Riparian Area (1/4 mile radius) Percent	Drainage Area Percent
Commercial	1	4
Industrial	0	0
Open Space & Outdoor Recreation	29	15
Mixed Use & Other	2	3
Public Facilities	17	7
Residential	38	62
Transportation & Utility	2	1
Vacant Land	11	8

As of the report date, there are no proposed land use changes or major New York City development projects in the Alley Creek or Little Neck Bay assessment area.

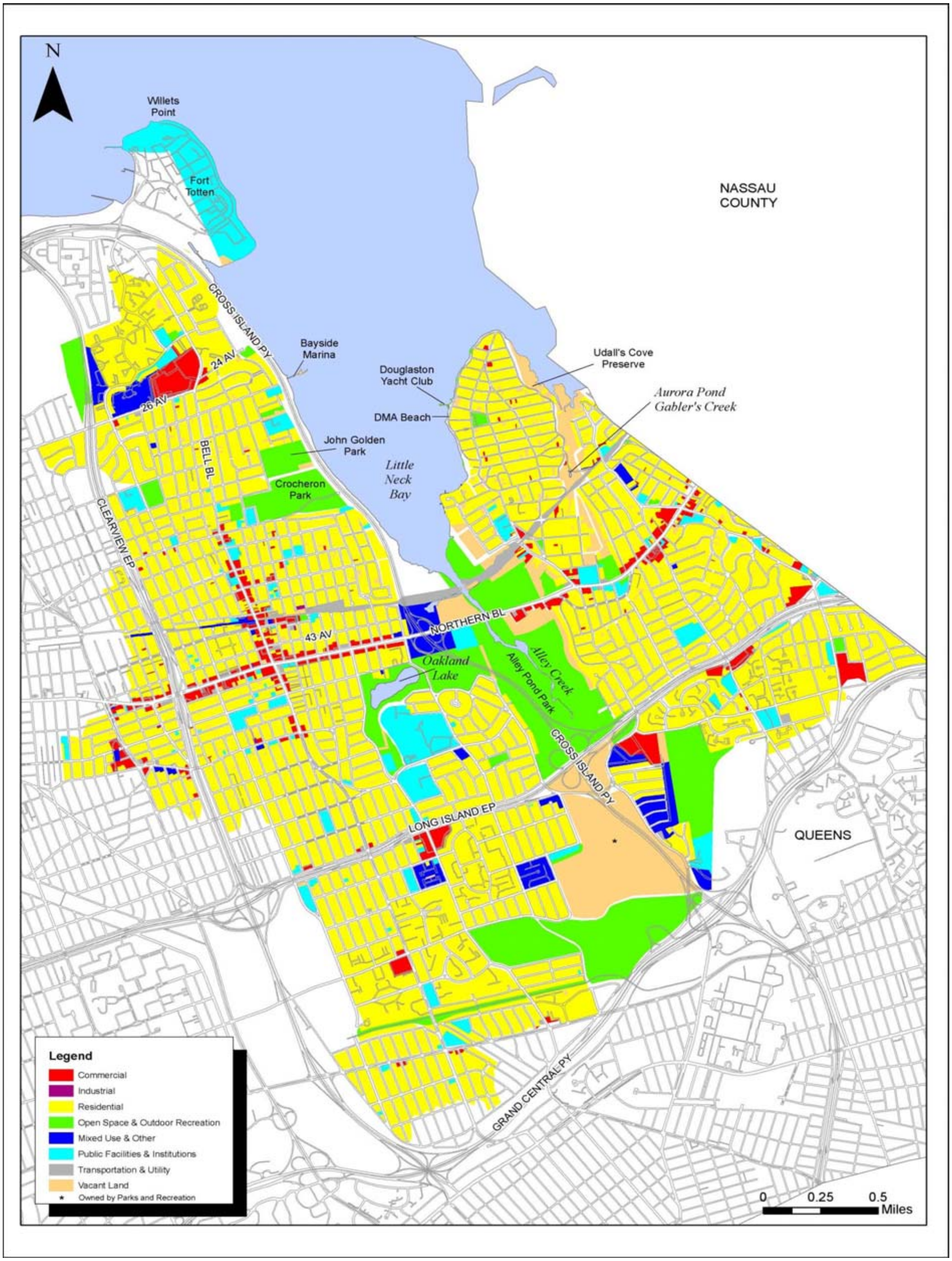


Figure 2-3. Land Use in Alley Creek/Little Neck Basin

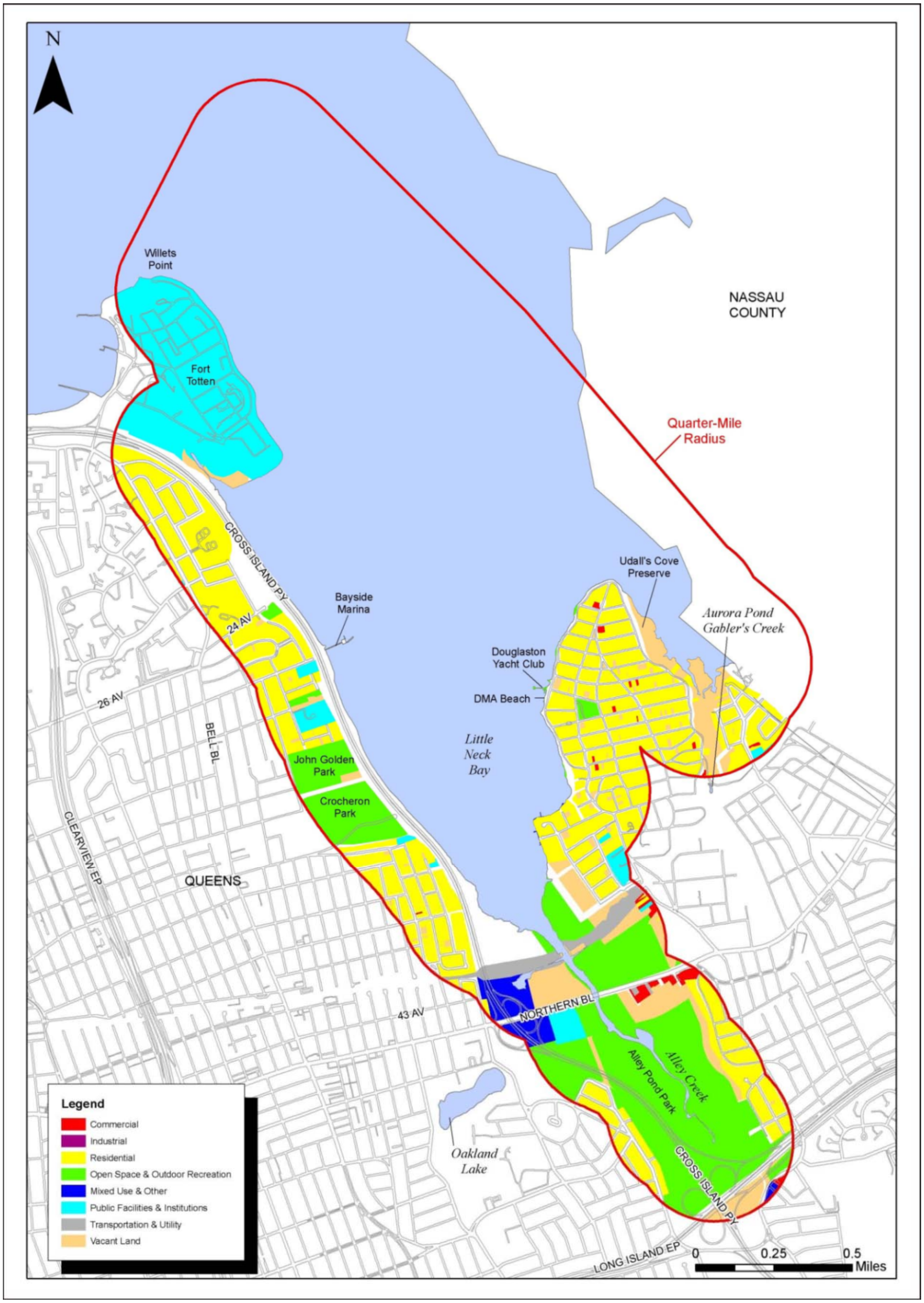


Figure 2-4. ¼ Mile Land Use in Alley Creek and Little Neck Bay

2.1.a.2 Permitted Discharges

The Belgrave WWTP, SPDES NY-0026841, located in Great Neck, Nassau County, discharges to the head of Udalls Cove (Little Neck Bay) near 34th Avenue and 255th Street. The Belgrave WWTP is a 2.0-MGD wastewater treatment facility discharging an average of 1.3 MGD of secondary treated, disinfected effluent (Figure 2-5).

In addition to the Belgrave WWTP, there are several permitted stormwater discharge points. These are discussed in more detail in Section 2.1.c.

Figure 2-5. Location of the Belgrave WWTP, Adjacent to Udalls Cove

2.1.a.3 Impervious Cover Analysis

Impervious surfaces within a watershed are those characterized by an artificial surface, such as concrete, asphalt, rock, or rooftop. Rainfall occurring on an impervious surface will experience a small initial loss through ponding on that surface, with the remaining rainfall volume becoming overland runoff that directly flows into the sewer system and/or separate stormwater system. The impervious surface is important when characterizing a watershed and CSS performance as well as construction of hydraulic models used to simulate the performance of the CSS.

A representation of the impervious cover was made in the 13 WWTPs combined area drainage models developed in 2007 to support the WWFPs submitted in 2009. However, efforts to update the model and the impervious surface representation are ongoing.

As the City started to focus attention on the use of GI to manage street runoff by either slowing it down prior to entering the combined sewer network or preventing it from entering the network entirely, it became clear that a more detailed evaluation of the impervious cover would be essential. In addition, the City realized that it would be important to distinguish between impervious surfaces that directly introduce runoff [Directly Connected Impervious Areas – (DCIA)] to the sewer system from those impervious surfaces that may not contribute any runoff to the sewers. For example, a rooftop with roof drains directly connected to the combined sewers (as required by the NYC Plumbing Code) would be an impervious surface that is directly connected. However, a sidewalk or pervious surface adjacent to a parkland may not contribute any runoff to the CSS.

In 2009 and 2010, DEP invested in the development of high quality satellite measurements of impervious surfaces required to conduct the analyses that improved the differentiation between pervious and impervious surfaces, as well as the different types of impervious surfaces. The data and the approach used are described in detail in the IW City-wide Model Recalibration Report (DEP, 2012a).

The result of this effort yielded an updated model representation of the areas that contribute runoff to the CSS. This improved set of data aided in model recalibration and provided the DEP with a better idea where GI can be deployed to reduce the runoff contributions from impervious surfaces that contribute flow to the collection system. The result of the recalibration efforts was a slight increase in the amount of runoff that enters the Tallman Island WWTP CSS.

2.1.a.4 Population Growth and Projected Flows

The Bureau of Environmental Planning and Analysis (BEPA) routinely develops water consumption and dry weather wastewater flow projections for DEP planning purposes. Water and wastewater demand projections were developed in 2012 by BEPA. An average per capita water demand of 75 gallons per capita per day was developed by BEPA to be representative of future uses. The year 2040 was established as the planning horizon and populations for that time were developed by the DCP and the New York Transportation Metropolitan Council.

The 2040 population projection figures were then used with the dry weather per capita sewage flows to set the dry weather sewage flows contained in the IW model for the Tallman Island WWTP sewershed. This was accomplished by using GIS tools to proportion the 2040 populations locally from the 2010 census information for each landside subcatchment, tributary to each CSO. Per capita dry weather sanitary sewage flows for these landside model subcatchments were established as the ratio of the year per capita dry weather sanitary sewage flow and 2040 estimated population for the landside model subcatchment within the Tallman Island WWTP service area.

2.1.a.5 Updated Landside Modeling

The Alley Creek and Little Neck Bay watershed is part of the overall Tallman Island WWTP system model (TI model). Several modifications to the collection system, which is tributary to the Tallman Island WWTP, have occurred since the model was calibrated in 2007. As the TI model has been used for analyses associated with the annual reporting requirements of the SPDES permit BMPs and PCM for the Flushing Bay CSO Retention Tank, many of these changes have already been incorporated into the model. Major changes to the modeled representation of the collection system that have been made since the 2007 update include:

- Representation of the Flushing Bay CSO Retention Tank for model simulations after May, 2007.
- Representation of the Alley Creek CSO Retention Tank for model simulations after March 10, 2011.
- Inclusion of the Bowery Bay drainage areas that contribute CSOs to Flushing Bay CSO Retention Tank and to TI-010. Because the overflows from three of the Bowery Bay High Level sewershed come to this tank through Park Avenue outfall, this model update was done to avoid the need to run the Bowery Bay model as precursor to every Tallman Island model run.

In addition to changes made to the modeled representation of the collection system configuration, several other changes have been made to the model, including:

- ***Runoff generation methodology***, including the identification of pervious and impervious surfaces. As described in Section 2.1.a.3 above, the impervious surfaces were also categorized into DCIAs and impervious runoff surfaces that do not contribute runoff to the collection system.

- ***GIS Aligned Model Networks.*** Historical IW models were constructed using record drawings, maps, plans, and studies. Over the last decade, the Bureau of Water and Sewer Operations (BWSO) has been developing a GIS system that will provide the most up-to-date information available on the existing sewers, regulators, outfalls, and pump stations. As part of the update and model recalibration, data from the GIS repository for interceptor sewers were used. The models will continue to evolve and be updated as more information becomes available from this source.

- ***Interceptor Sediment Cleaning Data.*** DEP recently completed a City-wide interceptor sediment inspection and cleaning program. From April 2009 to May 2011, approximately 136 miles of the City's interceptor sewers were inspected. Data on the average and maximum sediment in the inspected interceptors were available for use in the model as part of the update and recalibration process. Multiple sediment depths available from sonar inspections were spatially averaged to represent depths for individual interceptor segments included in the model.

- ***Evapotranspiration Data.*** Evapotranspiration (ET) is a meteorological input to the hydrology module of the IW model which represents the rate depression storage (surface ponding) is depleted and available for use for additional surface ponding during subsequent rainfall events. In previous versions of the model, an average rate of 0.1 inches/hour (in/hr) was used for the model calibration while no evaporation rate was used as a conservative measure during alternatives analyses. During the update of the model, a review of hourly ET estimates obtained from four National Oceanic and Atmospheric Administration (NOAA) climate stations [John F. Kennedy (JFK), Newark (EWR), Central Park, and LaGuardia (LGA)] for an 11-year period. These data were used to calculate monthly average ETs which was used in the updated model. The monthly variation enabled the model simulation to account for seasonal variations in ET rates which are typically higher in the summer months than winter months.

- ***Tidal Boundary Conditions at CSO Outfalls.*** Tidal stage can affect CSO discharges when tidal backwater in a CSO outfall reduces the ability of that outfall to relieve excess flow. Model updates took into account this variable boundary condition at the CSO outfalls that were influenced by tides. Water elevation based on the tides was developed using a customized interpolation tool that assisted in the computation of meteorologically adjusted astronomical tides at each CSO outfall in the New York Harbor complex.

- ***Dry Weather Sanitary Sewage Flows.*** Dry weather sewage flows were developed as discussed in Section 2.1.a.4 above. Hourly dry weather flow (DWF) data for 2011 were used to develop the hourly diurnal variation patterns at each plant.

- ***Precipitation.*** A review of the rainfall records for model simulations was undertaken as part of this exercise. This is discussed in Section 2.1.b below.

In 2012, thirteen of the City's landside models underwent recalibration after the updates and enhancements were complete. This effort and calibration results are included in the IW City-wide Recalibration Report (DEP, June 2012) required by the updated Order on Consent. Following this report, DEP submitted to DEC a Hydraulic Analysis report in December 2012. The general approach followed was to recalibrate the model in a stepwise fashion beginning with the hydrology module (runoff). The following summarizes the overall approach to model update and recalibration:

- ***Site scale calibration (Hydrology)*** – The first step was to focus on the hydrologic component of the model, which had been modified since October 2007 using updated satellite data. Flow monitoring data were collected in upland areas of the collection systems, remote from (and hence largely unaffected by) tidal influences and in-system flow regulation for use in understanding the runoff characteristics of the impervious surfaces. Data was collected in two phases - Phase 1 in the Fall of 2009 and Phase 2 in the Fall of 2010. These areas ranged from 15 to 400 acres in spatial extent. A range of areas with different land use mixes were selected to support the development of standardized set of coefficients that can be applied to other unmonitored areas of the City. The main purpose of this element of the recalibration was to adjust pervious and impervious area runoff coefficients to provide the best fit of the runoff observed at the upland flow monitors.

- ***Area-wide recalibration (Hydrology and Hydraulics)*** – The next step in the process was to focus on larger areas of the modeled systems where historical flow metering data was available and which were still un-impacted by tidal backwater conditions and were not subjected to any flow regulation. Where necessary, runoff coefficients were further adjusted to provide reasonable simulation of flow measurements made at the downstream end of these larger areas. The calibration process then moved downstream further into the collection system where flow data were available in portions of the conveyance system where tidal backwater conditions could exist as well as potential backwater conditions from throttling at the WWTPs. The flow measured in these downstream locations would further be impacted by regulation at in-system control points (regulator, internal reliefs, etc.). During this step in the recalibration, minimal changes were made to runoff coefficients elements.

The result of this effort is a model with a better representation of the collection system and its tributary area for the Tallman Island WWTP basin, which includes Alley Creek and Little Neck Bay. This updated model will be used for alternatives analysis as part of this LTCP. A comprehensive discussion of the recalibration effort can be found in the IW City-wide Recalibration Report.

2.1.b Review and Confirm Adequacy of Design Rainfall Year

DEP has been consistently applying the annual precipitation characteristics of 1988 to the landside models to develop pollutant loads from combined and separately sewered drainage areas. To date, 1988 has been considered to be representative of long-term average conditions, and therefore has been used for analyzing facilities where "typical" conditions, rather than extreme conditions, serve as the basis of design in accordance with federal CSO policy of using an "average annual basis" for analyses. The selection of 1988 as the average condition was however re-considered in light of the increasing concerns over climate change, and potential for more extreme and potentially more frequent storm events. Recent landside modeling analyses in the City have used the 2008 precipitation pattern to drive the runoff-conveyance processes, along with the 2008 tide observations, which DEP believes to be more representative than 1988 conditions as a typical year.

The Alley Creek WWFP was based on 1988 rainfall conditions, but future baseline/alternative runs will be performed using 2008 as the "typical" precipitation year. A comparison of these rainfall years which led to the selection of 2008 are shown in Table 2-2.

Table 2-2. Comparison of Rainfall Years for Collection System Modeling

	WWFP JFK 1988	Present Day Average 1969-2010	Present Best Fit JFK 2008
Annual Rainfall (in)	40.7	45.5	46.3
July Rainfall (in)	6.7	4.3	3.3
November Rainfall (in)	6.3	3.7	3.3
Number of Very Wet Days (>2.0 in)	3	2.4	3
Average Peak Storm Intensity (in/hr)	0.15	0.15	0.15

2.1.c Description of Sewer System

The Alley Creek and Little Neck Bay watershed/sewershed is divided between two major political jurisdictions: (i) the Borough of Queens within New York City and (ii) Nassau County, Long Island. Most of the Queens County portion of the watershed is served by the Tallman Island WWTP and associated collection system, as shown on Figure 2-6. The Douglas Manor neighborhood, on the east bank of Little Neck Bay in Queens, is principally served by on-site septic systems. Wastewater management in the Nassau County portion of the watershed is accomplished by three sanitary sewer districts: 1) the Belgrave Water Pollution Control District, 2) the Great Neck Water Pollution Control District and 3) the Village of Great Neck. The treated effluent from the Belgrave WWTP discharges to Udalls Cove, on the east side of Little Neck Bay. The treatment plants for the other two districts discharge to Manhasset Bay on the east side of the Great Neck Peninsula. In addition, there are properties that use on-site septic systems, which are not in the service areas of these three sewer districts. The locations of the three wastewater treatment facilities and the respective sewershed boundaries are as shown in Figure 2-6.

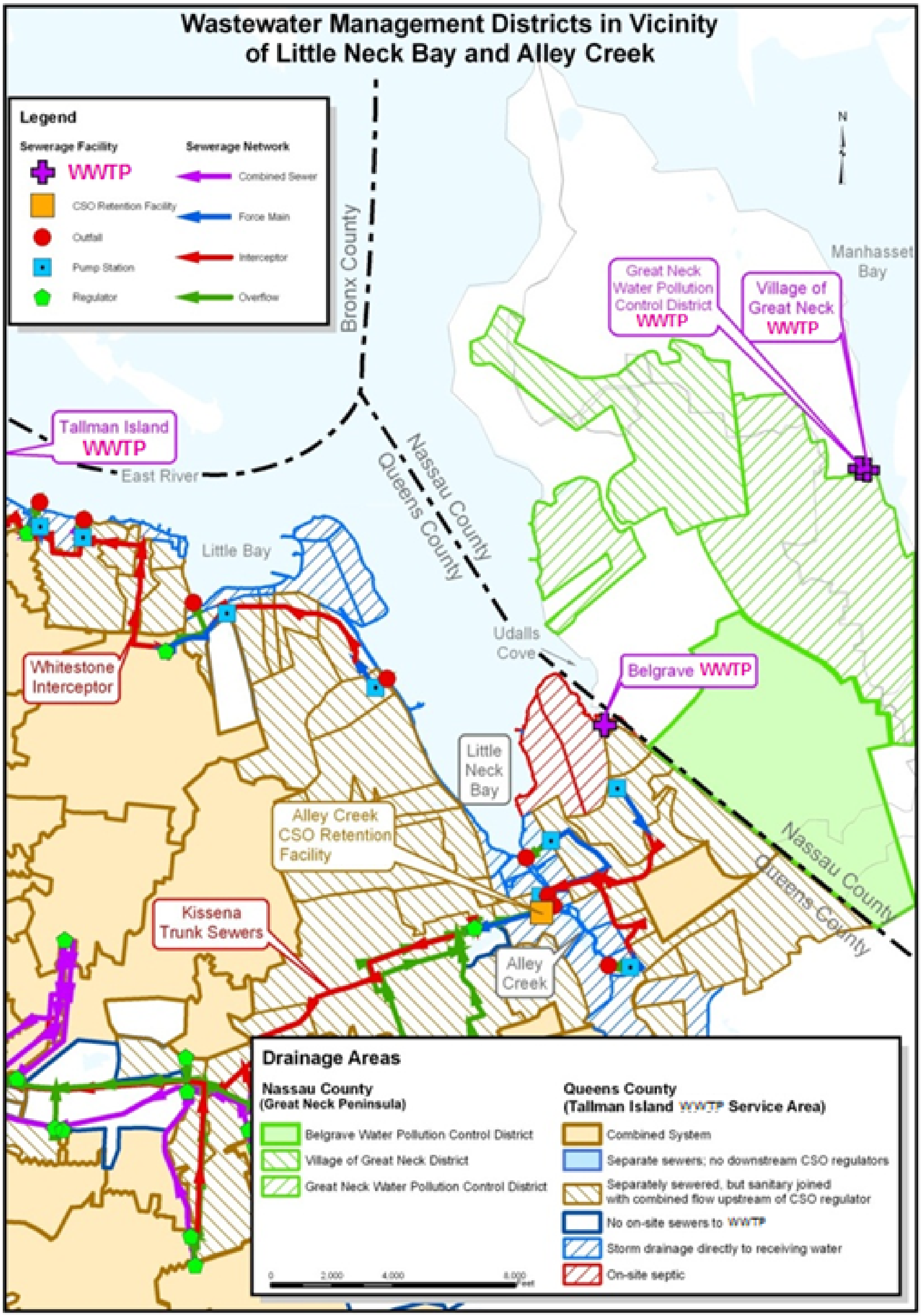


Figure 2-6. Alley Creek Wastewater Service Areas

This section describes the major features of the Tallman Island WWTP tributary area, including the Alley Creek and Little Neck Bay watershed.

2.1.c.1 Overview of Drainage Area and Sewer System

Alley Creek and Little Neck Bay are served by the Tallman Island WWTP. The Tallman Island sewershed includes sanitary and combined sewersheds, as summarized in Table 2-3. The service area of Tallman Island includes:

- Sixteen pumping stations, five serving combined system areas
- Forty-nine combined sewer flow regulator structures
- Twenty-four CSO discharge outfalls (two of which are permanently bulkheaded)

Table 2-3. Tallman Island WWTP Drainage Area[1]: Acreage Per Sewer Category

Sewer Area Description	Area (acres)
Combined	**8,032**
Separate Fully separated Watershed separately sewered, but with sanitary sewage subsequently flowing into a combined interceptor and stormwater either discharging directly to receiving water or into combined interceptor	**4,893** (610 acres) (4,283 acres)
Total	**12,925**

[1]There is an additional 2,171 acres of area that, for facility planning and certain permitting purposes is considered to be part of the Tallman Island drainage area that does not contribute to the WWTP. This includes areas with direct drainage of stormwater to water courses (either directly or via storm sewers), other areas not served by piped drainage systems (e.g., parks and cemeteries), and areas that use "on-site" septic systems (Douglas Manor on Douglaston Peninsula).

The Tallman Island WWTP is located at 127-01 134th Street, in the College Point section of Queens, on a 31-acre site adjacent to Powells Cove, leading into the Upper East River, and bounded by Powells Cove Boulevard. The Tallman Island WWTP serves a sewered area in the northeast section of Queens, including the communities of Little Neck, Douglaston, Oakland Gardens, Bayside, Auburndale, Bay Terrace, Murray Hill, Fresh Meadows, Hillcrest, Utopia, Pomonok, Downtown Flushing, Malba, Beechhurst, Whitestone, College Point, and Queensboro Hill (Figure 2-7). The total sewer length, including sanitary, combined, and interceptor sewers, that feeds into the Tallman Island WWTP is 490 miles.

The Tallman Island WWTP has been providing full secondary treatment since 1978. Processes include primary screening, raw sewage pumping, grit removal and primary settling, air-activated sludge capable of operating in the step aeration mode, final settling, and chlorine disinfection. The Tallman Island WWTP has a DDWF capacity of 80 MGD, and is designed to receive a maximum flow of 160 MGD (2xDDWF) with 120 MGD (1.5xDDWF) receiving secondary treatment. Flows over 120 MGD receive primary treatment and disinfection.

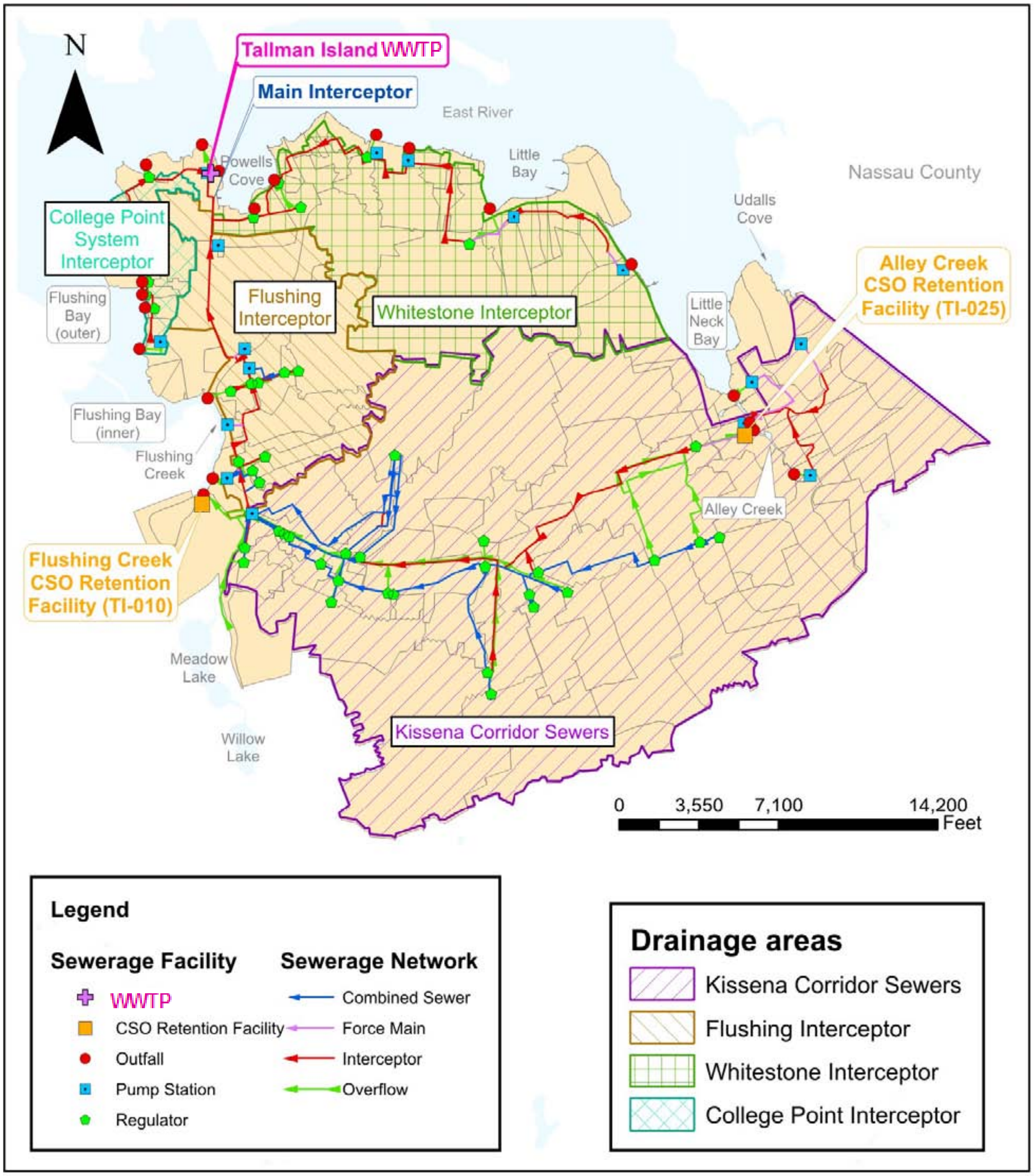


Figure 2-7. Tallman Island WWTP Service Area

The Tallman Island WWTP includes four principal interceptors: the Main Interceptor, the College Point Interceptor, the Flushing Interceptor, and the Whitestone Interceptor.

- The Main Interceptor is directly tributary to the Tallman Island WWTP, and picks up flow from the other three interceptors.

- The College Point Interceptor carries flow from sewersheds to the west of the treatment plant, discharges in the Powell's Cove Pump Station, which discharges into the Main Interceptor within the WWTP premises.

- The Flushing Interceptor can be considered an extension of the Main Interceptor south of the Whitestone connection and serves most of the areas to the south in the system. The Flushing Interceptor also picks up flow from the southeast areas of the system, along the Kissena Corridor Interceptor (via trunk sewers upstream of the TI-R31 regulator) and from the Douglaston area. The Alley Creek area drains to Tallman Island WWTP via the Kissena Corridor Interceptor.

- The Whitestone Interceptor discharges to the Main Interceptor from the west side, shortly upstream of the College Point interceptor connection, via gravity discharge. The Whitestone conveys flow from the area east of the treatment plant along the East River.

This service area also includes two CSO retention facilities planned, designed and constructed based on the East River Facility Planning and WWFP. The first one is the Flushing Bay CSO Retention Tank with a total capacity of 43.4 MG (28.4 MG of offline storage and 15 MG of inline storage in large outfall pipes). This facility has been operational since May 2007. Post event, retained flow is pumped to the upper end of the Flushing Interceptor, upstream of Regulator TI-09. This structure was reconstructed in 2005 to provide adequate capacity to convey both sanitary flows and dewatered flow from the retention tank subsequent to wet weather periods.

The second facility is the Alley Creek Retention Tank built in 2010 which was operational as of March 11, 2011. This tank has an offline storage capacity of 5 MG. During wet weather, flows that reach the TI-008 CSO regulator are directed to the offline storage tank by the diversion weir in Chamber 6 of the Alley Creek CSO Retention Tank. When the storage tank reaches capacity, excess water overflows the storage basin and is discharged to Alley Creek through Outfall TI-025, after receiving floatables control. The retention tank provides some degree of primary settling. Post-event dewatering of this tank is done through the upgraded Old Douglaston PS which has a peak capacity of 8.5 MGD.

Tallman Island Non-Sewered Areas

There are areas within the Tallman Island service area that are considered direct drainage areas and on-site septic areas (Figure 2-8). These are areas where stormwater drains directly to receiving waters without entering the CSS. Generally, these are shoreline areas adjacent to waterbodies, and were delineated based on topography and the resultant direction of stormwater sheet flow. In addition, the on-site septic areas, located in the northern portion of Douglaston Peninsula, are unsewered. Stormwater flows across lawns and down gutters to Little Neck Bay. Further, near surface groundwater flow is a potential source of pollutants to Little Neck Bay.

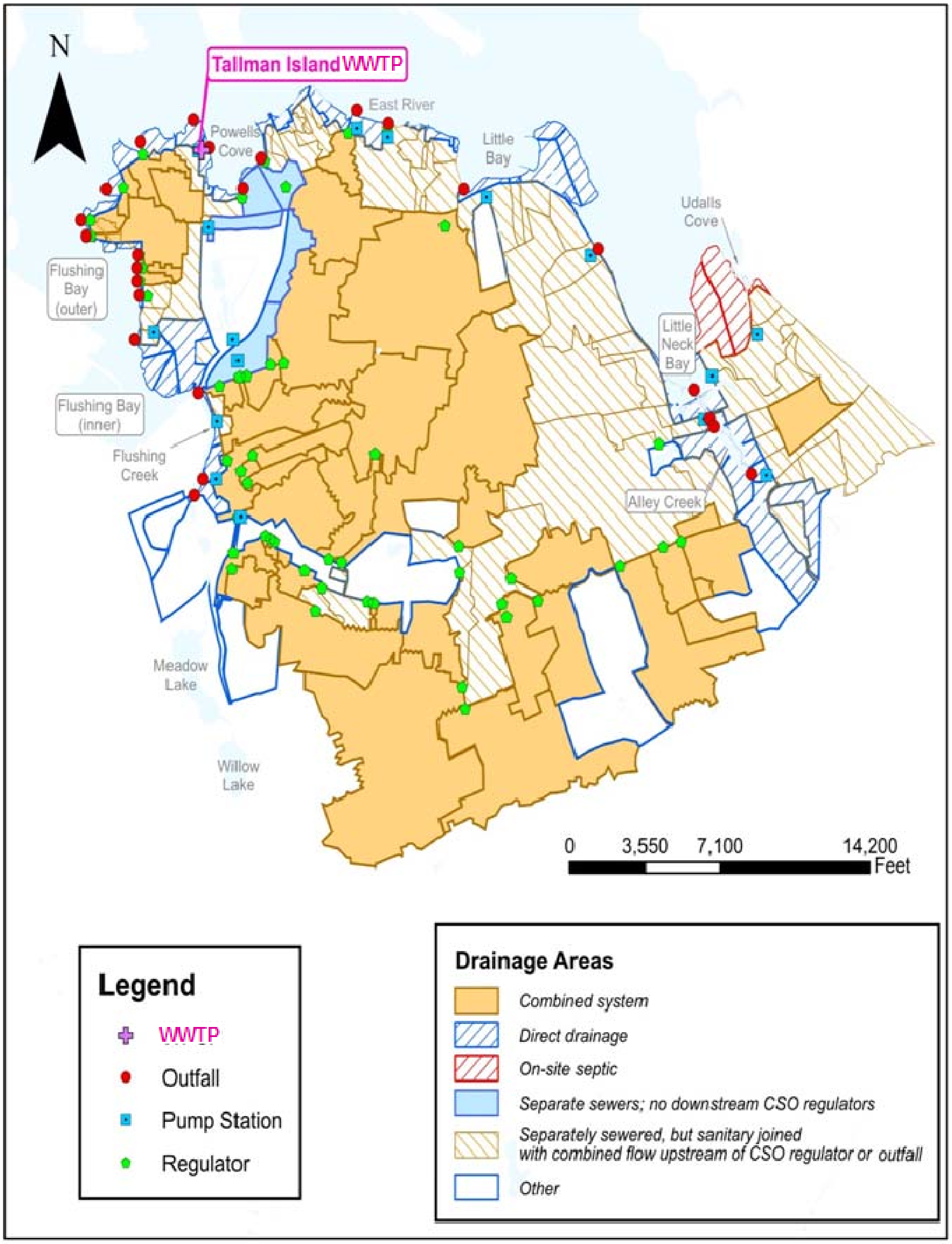


Figure 2-8. Tallman Island WWTP Drainage Area

Tallman Island Stormwater Outfalls

There are nine permitted stormwater outfalls discharging to Alley Creek and Little Neck Bay, as shown on Figure 2-9 below. The stormwater outfalls are TI-623, TI-624, TI-633, TI-653, TI-654, TI-655, TI-656, TI-658 and TI-660. These outfalls drain stormwater runoff from the separate sanitary sewer areas around Alley Creek and Little Neck Bay. While runoff from these areas does not enter the combined system the direct stormwater discharges to Alley Creek and Little Neck Bay can impact water quality.

Tallman Island/Alley Creek CSOs

The Tallman Island SPDES permit CSO outfalls to Alley Creek are TI-007, TI-008, TI-009, TI-024 and TI-025. CSO outfall TI-006 discharges to Little Neck Bay. The locations of Alley Creek and Little Neck Bay SPDES CSO outfalls are shown on Figure 2-9. It should be noted that TI-025 is the CSO outfall for the Alley Creek CSO Retention Tank. It should also be noted that TI-008 and TI-025 are used to convey and discharge a large portion of stormwater. In addition, the outfalls TI-007, TI-006 and TI-024 serve as emergency bypasses for pump stations, and therefore, are designated as CSO outfalls. Under normal conditions, TI-006 and TI-024 discharge stormwater from their tributary areas and TI-007 can overflow during large precipitation events.

Wet weather flows in the CSS, with incidental sanitary and stormwater contributions as summarized above result in overflows to the nearby waterbodies when the flows exceed the hydraulic capacity of the system, or the specific capacity of the local regulator structure.

Douglas Manor

The area on the eastern shore of Little Neck Bay known as Douglas Manor, The neighborhood is predominantly composed of single family residences served by on-site septic systems, built in individual lots zoned as R1-1 and R1-2, except the Douglaston Club House, which is a 3-story structure, with a 17,100 sq. ft. building area, located on a 102,060 sq. ft. lot zoned for open space/outdoor recreation. Approximately 58 acres of drainage area generate runoff upstream of Shore Rd, a waterfront roadway that follows the alignment of the eastern shore of Little Neck Bay. The Douglas Manor Association (DMA) manages a permitted private community beach known as DMA Beach along Shore Rd. The location of DMA Beach and Douglaston Club House, and photos depicting the overall residential land use of the neighborhood can be seen in Figure 2-10.

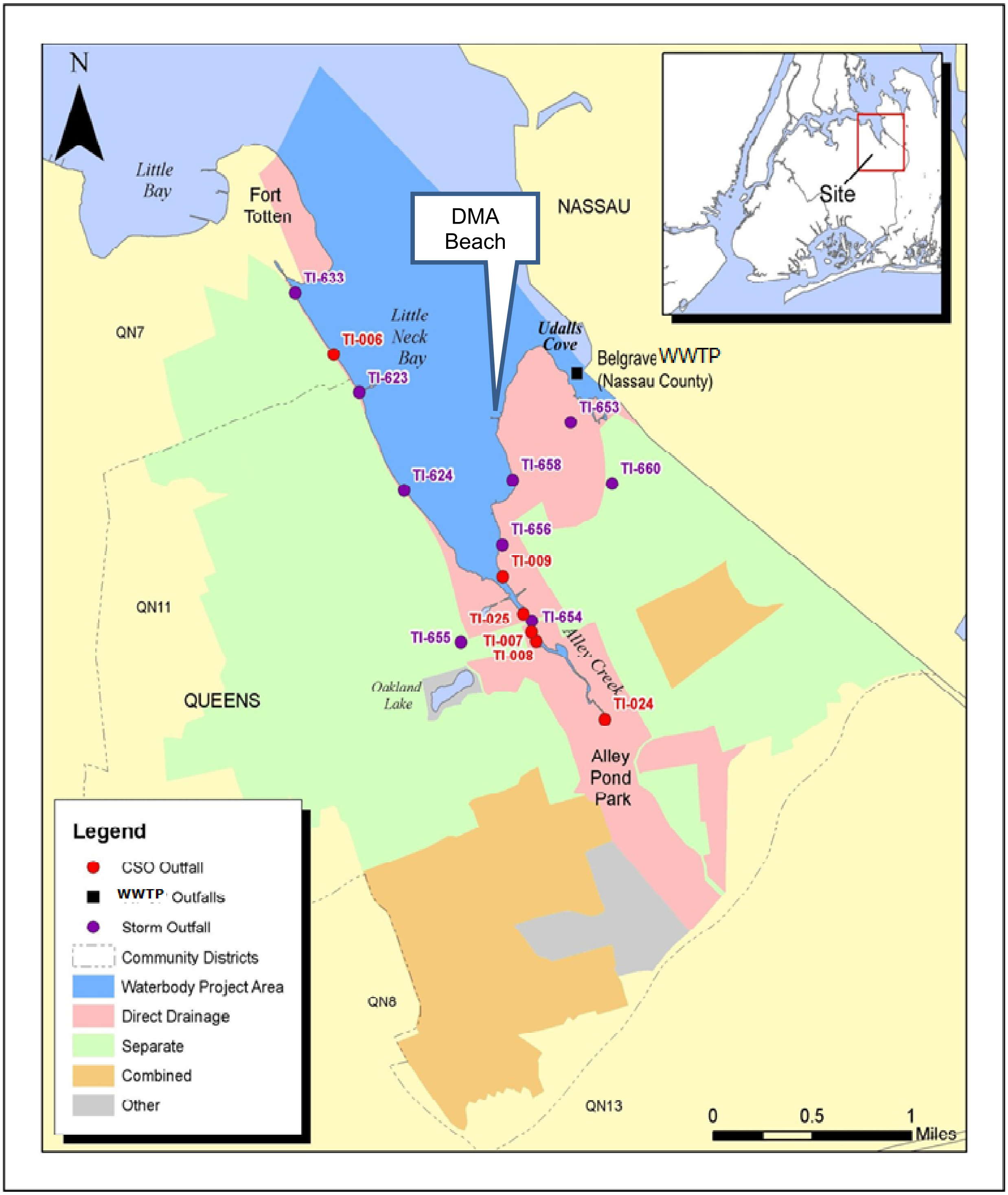


Figure 2-9. Alley Creek and Little Neck Bay SPDES Permitted Outfalls

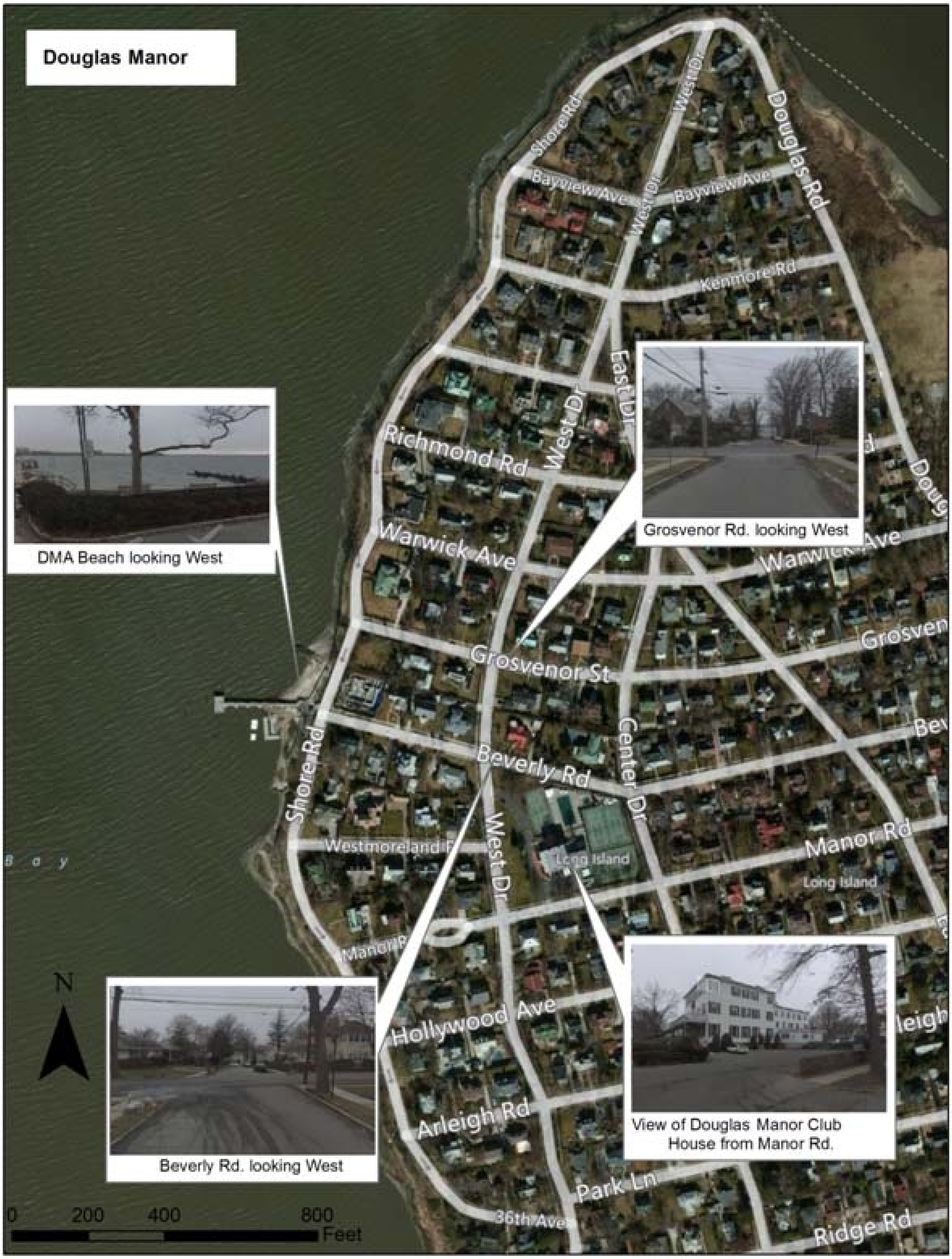


Figure 2-10. Douglas Manor Community

2.1.c.2 Stormwater and Wastewater Characteristics

The pollutant concentrations found in wastewater, combined sewage, and stormwater can vary based on a number of factors including flow rate, runoff contribution, and the matrix of the waste discharged to the system from domestic and non-domestic customers. Since the matrix of these waste streams can vary, it can be challenging to identify a single concentration of pollutants to use for analyzing the impact of discharges from these systems to receiving waters.

To more effectively characterize pollutant loads from CSO discharges, the EPA's Nationwide Urban Runoff Program (NURP) developed the concept of the Event Mean Concentration (EMC). EMC is a function of total constituent mass, the total runoff volume, and percent amount of impervious cover in the sub-watershed (EPA, 1983).

Data collected from sampling events were used to calculate EMCs for CBOD, TSS, total coliform bacteria, fecal coliform bacteria and enterococci. Tables 2-4 and 2-5 show both the sanitary and stormwater concentrations for discharges to Alley Creek and Little Neck Bay from both the Tallman Island WWTP service area and from Nassau County, respectively. Influent dry-weather samples at the WWTP were used to model sanitary concentrations (HydroQual, 2005b). Previously collected City-wide sampling data from Inner Harbor Facility Planning Study (DEP, 1994) was combined with data for the EPA Harbor Estuary Program (HydroQual, 2005a) to develop the stormwater concentrations.

Effluent data was taken from DEC discharge monitoring reports (DMR) submitted for the Belgrave WWTP by the Nassau County Department of Public Works as shown on Table 2-6. The plant discharges an average of 1.3 MGD. Total coliform, fecal coliform and enterococci are assumed to be negligible since the facility provides disinfection.

Table 2-4. Sanitary and Stormwater Discharge Concentrations, Tallman Island WWTP, Baseline Condition

Constituent	Sanitary Concentration	Stormwater Concentration
$CBOD_5$ (mg/L) [(1)]	140	15
TSS (mg/L) [(1)]	130	15
Total Coliform Bacteria (MPN/100mL) [(2,3)]	$25x10^6$	150,000
Fecal Coliform Bacteria (MPN/100mL) [(2,3)]	$4x10^6$	35,000
Enterococci (MPN/100mL) [(2,3)]	$1x10^6$	15,000

[(1)] HydroQual, 2005b.
[(2)] HQI Memo to DEP, 2005a.
[(3)] Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100 mL.

Table 2-5. Stormwater Discharge Concentrations, Nassau County, Baseline Condition

Constituent	Stormwater Concentration
$CBOD_5$ (mg/L) [(1)]	15
TSS (mg/L) [(1)]	15
Total Coliform Bacteria (MPN/100mL) [(2,3)]	50,000
Fecal Coliform Bacteria (MPN/100mL) [(2,3)]	25,000
Enterococci (MPN/100mL) [(2,3)]	15,000

[(1)] HydroQual, 2005b.
[(2)] HQI Memo to DEP, 2005a.
[(3)] Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100 mL.

Table 2-6. Belgrave WWTP (Nassau County) Discharge Baseline Condition - Effluent[1]

Constituent	Concentration
$CBOD_5$ (mg/L)	10
TSS (mg/L)	10
Total Coliform Bacteria (MPN/100mL) [2]	<200
Fecal Coliform Bacteria (MPN/100mL) [2]	<200
Enterococci (MPN/100mL) [2]	<200

[1] DEC, DMR data, 475 MG/yr.
[2] Disinfection practiced year-round.

A sampling program targeting CSO and other sources of pollutants contributing to Alley Creek and Little Neck Bay was implemented as part of this LTCP. Data was collected to supplement the flows/volumes and concentrations of various sources of pollutants to Alley Creek and Little Neck Bay. During dry weather, the flows and concentrations were collected from Oakland Lake and from a pond located south of the Long Island Expressway (LIE) which are the continuous sources of flow and pollutants to Alley Creek. Both fresh water impoundments support recreational activities such as bird-watching of diverse species of waterfowl that inhabit them and as such sampling of pathogens was a vital element of this sampling program. Additionally, as identified by the BWT illicit sewer connection tracking and removal enforcement program, illicit connections to the stormwater sewers were detected and those found were eliminated. These illicit connections generate a low flow contribution to upper Alley Creek, discharged through outfall TI-024 with a high concentration of pollutants; the locations described above are depicted in Figure 2-11. Sampling of this source was conducted to provide information to the water quality modeling tasks.

Sampling and data analyses and water quality modeling calibration resulted in the assignment of flows and pollutant loadings to these additional sources of pollution for inclusion in the calibration of the water quality model for the 2011 and 2012 period. These sources were assigned the following characteristics.

Table 2-7. Upper Alley Creek Source Loadings Characteristics

Source	Flow (MGD)	Enterococci (org./100 mL)	Fecal Coliform (org/100 mL)	BOD-5 (mg/L)
Oakland Lake flow through outfall TI-008	2.5	120	120	15
Upstream Pond	1.5	70	30	0
TI-024 Illicit Connections	0.04	1,000,000	4,000,000	15
TI-024 Infiltration	0.2	4,000	1,200	6.3

See Figures 2-9 and 2-11 for source locations

During wet weather conditions, Alley Creek and Little Neck Bay receive flow contributions from multiple stormwater outfalls, CSO that exceeds the retention capacity of the 5 MG tank at TI-025, and direct runoff from unsewered drainage areas along the eastern shore of Little Neck Bay, particularly at DMA, where the runoff originated by the impervious surfaces of the lots and public roadways, plus the rainfall volume that exceeds the infiltration capacity of the pervious surfaces, are discharged to Little Neck Bay in the vicinity of DMA Beach, at seven main locations depicted in Figure 2-12. Most of the runoff is conveyed as surface sheetflow or poorly defined shallow surface flow, until crossing a concrete retaining wall between Shore Road and the beach. The main runoff drainage paths of the approximately 14 acres contributing directly to DMA Beach can be seen in Figure 2-12. The New York City Department of Transportation (DOT) Capital Project HWQ-985, primarily intended to protect the concrete retaining wall from static force loads that compromise its stability, will divert runoff from the current discharge points on both sides of the pier at DMA Beach to a location farther south of the recreational area. The planned future configuration can be seen in Figure 2-13. This project is expected to be completed in 2016.

During dry weather, it is suspected that near surface ground water flows downslope toward Little Neck Bay from DMA carrying pathogens from septic systems with it. This suspected source of pollutants may also generate higher loadings during wet periods at a local geographical scale when the ground water flow is higher.

The following characteristics were associated with the dry and wet weather sources of pollutants suspected to be associated with the septic systems in DMA.

Table 2-8. DMA Source Loadings Characteristics

Source	Flow (MGD)	Enterococci (org./100 mL)	Fecal Coliform (org/100 mL)	BOD-5 (mg/L)
DMA groundwater inflow (continuous)	0.06	50,000	100,000	0
DMA stormwater	Calculated from rainfall and runoff coef..	300,000	700,000	15

Figure 2-11. Upper Alley Creek Point - Source Locations

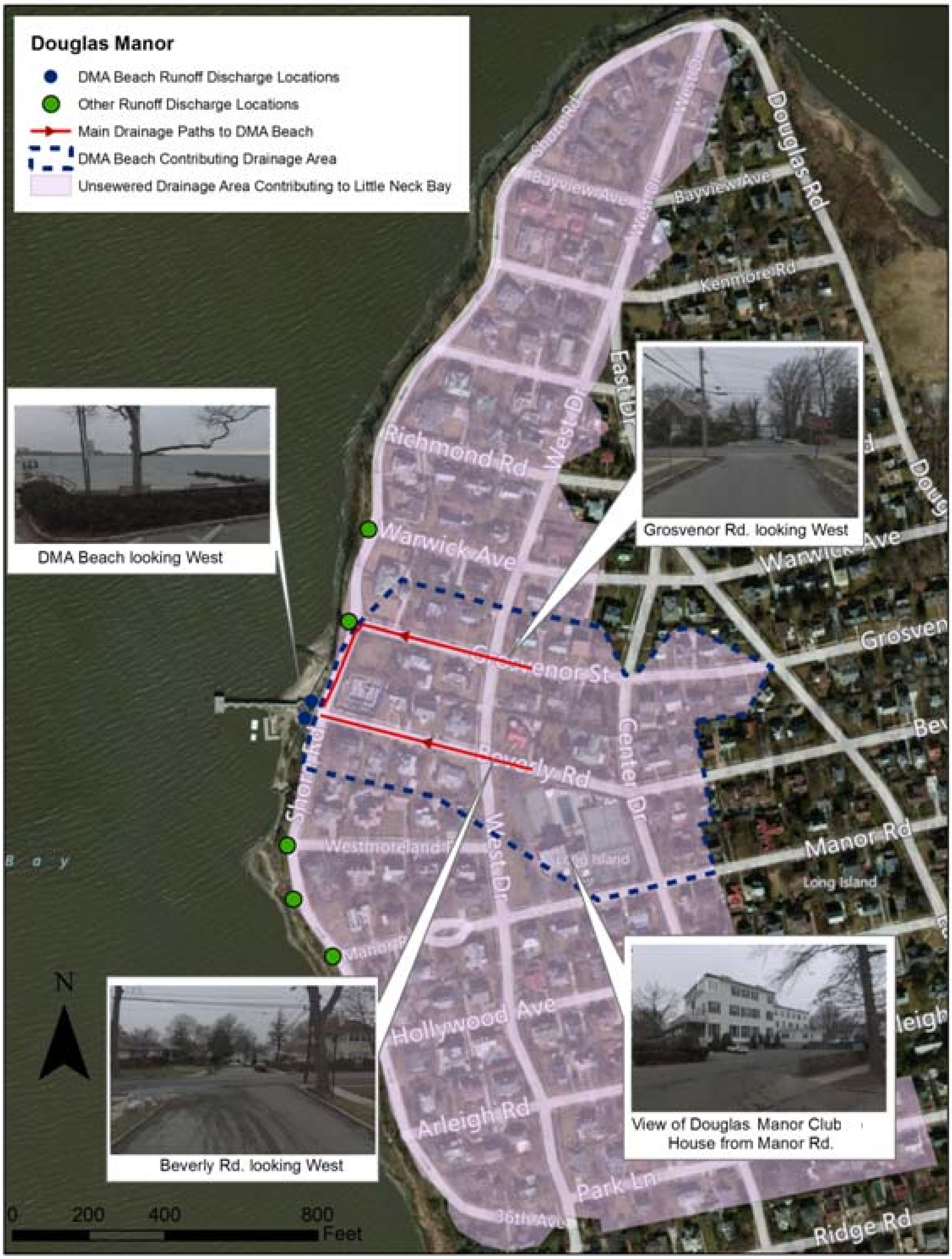


Figure 2-12. Little Neck Bay and DMA Beach Overland Drainage Characteristics

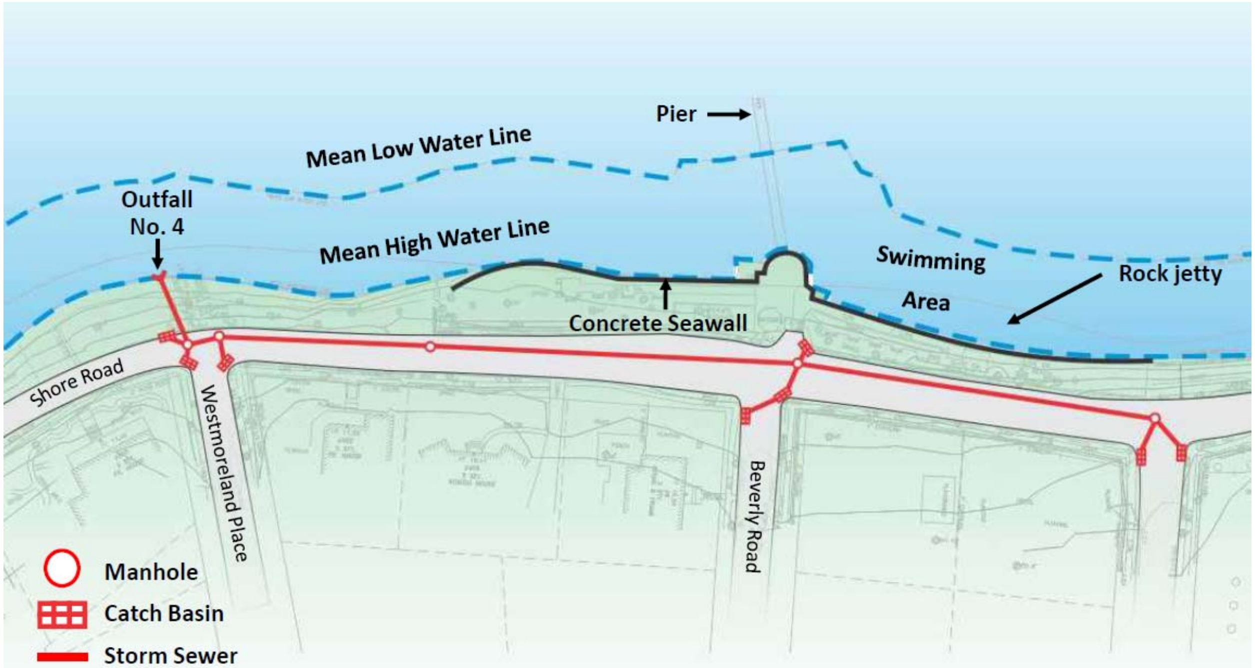


Figure 2-13. DMA Planned Drainage Improvements

2.1.c.3 Hydraulic Analysis of Sewer System

A City-wide hydraulic analysis was completed in December 2012 (an excerpt of which is included in this sub-section) to provide further insight into the hydraulic capacities of key system components and system responses to various wet weather conditions. Since the IW model was updated in the Alley Creek drainage area after this effort was completed, and in support of the development of this LTCP, the model results reported in this sub-section, while relevant for their intended use to document overall system-wide performance beyond the Alley Creek watershed, may differ slightly from volumes reported in the remainder of this LTCP report. The hydraulic analyses can be divided into the following major components:

- Annual simulations to estimate the number of annual hours that the WWTP is predicted to treat up to 2xDDWF for rainfall years 2008 and 2011, and with projected 2040 DWFs.
- Estimation of peak conduit/pipe flow rates that would result from a significant single event with projected 2040 DWFs.

A detailed presentation of the data was contained in the December 2012 Hydraulic Analysis Report submitted to DEC. The objective of each evaluation and the specific approach undertaken are briefly described in the following paragraphs.

Annual Hours at 2xDDWF for 2008 and 2011 with Projected 2040 DWFs

Model simulations were conducted to estimate the annual number of hours that the Tallman Island WWTP would be expected to treat 2xDDWF for two different precipitation years: 2008, which contained a total precipitation of 46.26 inches as measured at the JFK Airport, and 2011, which contained a total precipitation of 55.78 inches, an amount 20 percent higher than was observed in 2008. These simulations were conducted using projected 2040 DWFs for two model input conditions: a) the re-calibrated model conditions as described in the June 2012 IW City-wide Recalibration Report, and b) the Cost-Effective Grey (CEG) alternative defined for the service area. The CEG elements represent the CSO controls that became part of the 2012 Order on Consent. For these simulations, the primary input conditions that applied were as follows:

- Projected 2040 DWF conditions
- 2008 or 2011 tides and precipitation data
- WWTP at 2xDDWF capacity of 160 MGD
- No sediment in the combined sewers (i.e., clean conditions)
- Sediment in interceptors representing the sediment conditions after completion of the inspection and cleaning program completed in 2011 and 2012
- No green infrastructure

The CEG conditions applicable to the Tallman Island service area included the two CSO retention facilities and Whitestone Interceptor and associated sewer/regulator improvements. Due to the construction of Flushing Bay Retention Tank and associated Regulator TI-09 improvements in 2005 and completion of the Alley Creek Retention Tank in 2011, the recalibrated models include both of these facilities. Therefore, the Whitestone Interceptor and associated sewer/regulator improvements are the primary difference between pre-CEG and CEG scenarios. Key observations/findings are summarized below:

- Simulation of the 2008 annual rainfall year resulted in a prediction that the Tallman Island WWTP would operate at its 2xDDWF capacity for 49 hours under the no-CEG condition. When the CEG conditions were applied in the model, the annual number of hours at 2xDDWF increased to 99 hours. Simulation of the 2011 annual rainfall year resulted in the number of hours at or above 2xDDWF to be 99 hours under the no-CEG conditions. When the CEG conditions were applied in the model, the annual number of hours at 2xDDWF increased to 155 hours.
- The total volume (dry and wet weather combined) treated at the plant annually for the 2008 non-CEG condition was predicted to be about 24,038 MG, while the 2008 with-CEG condition resulted in a prediction that 24,301 MG would be treated at the plant, an increase of 263 MG. Similar volumes treated at the plant for the 2011 rainfall year were 23,686 MG and 23,902 MG, respectively, an increase of 216 MG during the wetter 2011 year.
- The total AAOV predicted for the outfalls in the Tallman Island service area were as follows:
    - 2008 non-CEG: 2,163 MG
    - 2008 with CEG: 2,098 MG
    - 2011 non-CEG: 3,608 MG
    - 2011 with CEG: 3,534 MG

The above results indicate an increased annual volume being delivered to the WWTP, an increase in the number of hours at the 2xDDWF operating capacity, and a decrease in annual average overflow volumes (AAOV) from the outfalls in the service area.

Estimation of Peak Conduit/Pipe Flow Rates

Data tables were prepared that contained information on several pipe characteristics, along with calculation of the theoretical, unsurcharged, full-pipe flow capacity of each sewer included in the model.

To test out the conveyance system response under what would be considered a large storm event condition, a single-event storm was selected from the historical record that was estimated to approximate a five-year return period in terms of peak hourly intensity as well as total depth.

The selected single event was simulated in the model for two conditions, the first being prior to implementation of CEG conditions, and the second with the CEG conditions implemented. The maximum flow rates and maximum depths predicted by the model for each sewer segment in the model were retrieved and aligned with the other pipe characteristics. Columns in the tabulations were added to indicate whether the maximum flow predicted for each conduit exceeded the unsurcharged, full-pipe flow, along with a calculation of the maximum depth in the sewer as a percentage of the pipe full height. It was suspected that potentially, several of the sewer segments could be flowing full, even though the maximum flow may not have reached the theoretical maximum full-pipe flow rate for reasons such as downstream tidal backwater, interceptor surcharge or other capacity-limiting reasons. The resulting data was then scanned to identify the likelihood of such capacity-limiting conditions, and also provide insight into potential areas of available capacity, even under large storm event conditions. Key observations/findings of this analysis are described below.

- Capacity exceedances for each sewer segment were evaluated in two ways for both interceptors and combined sewers:
  - Full flow exceedances, where the maximum predicted flow rate exceeded the full-pipe unsurcharged flow rate. This could possibly be indicative of a conveyance limitation.
  - Full depth exceedances, where the maximum depth was greater than the height of the sewer segment. This could possibly be indicative of either a conveyance limitation or a backwater condition.
- For the single storm event simulated, the model predicted that between 66 and 77 percent (by length) of the interceptor sewer segments would exceed full-pipe capacity flow for the non-CEG and CEG scenarios, respectively. About 30 to 37 percent (by length) of the upstream combined sewers would exceed their full-pipe flow under the same scenarios.
- Between 78 and 93 percent (by length) of the interceptors were predicted to flow at full depth or higher. Between 56 and 59 percent (by length) of the combined sewers were also predicted to flow at full depth, and 72 percent of the combined sewers flowed at least 75 percent full.
- The results for the system condition with CEG improvements showed that the overall peak plant inflow and HGL near the plant improved, in comparison to the non-CEG conditions in the Tallman Island service area.
- About 72 percent of the combined sewers (by length) reached a depth of at least 75 percent under the CEG simulations. This indicates that little additional potential exists for in-line storage capability in the Tallman Island system.

2.1.c.4 Identification of Sewer System Bottlenecks, Areas Prone to Flooding and History of Sewer Backups

The DEP has made substantial improvements to the Alley Creek drainage system, in which over $90M was spent under Contract ER-AC1 to help eliminate some historical flooding issues. These drainage system improvements took place between from December 2002 through December 2006 and consisted of installing larger combined sewers in certain segments of the sewershed to increase conveyance capacity; constructing storm sewers in select drainage areas to reduce volume of storm water entering the combined system; and construction of associated combined and stormwater outfalls to discharge the excess wet weather flows. These drainage area improvements have substantially mitigated these historical flooding issues.

DEP maintains the operation of the collection systems throughout the five boroughs using a combination of reactive and proactive maintenance techniques. The City's 311 system routes complaints of sewer issues to DEP for response and resolution. Though not every call reporting flooding or sewer back ups (SBUs) corresponds to an actual issue with the municipal sewer system, each call to 311 is responded to. Sewer functionality impediments identified during a DEP response effort are corrected as necessary.

2.1.c.5 Findings from Interceptor Inspections

In the last decade, DEP has implemented technologies and procedures to enhance its use of proactive sewer maintenance practices. DEP has many programs and staff devoted to sewer maintenance, inspection and analysis. GIS and CMMS systems provide DEP with expanded data tracking and mapping capabilities, and can facilitate identification of trends to allow provision of better service. As referenced above, reactive and proactive system inspections result in maintenance including cleaning and repair as necessary.

DEP also conducted a sediment accumulation analysis to quantify levels of sediments in the combined sewer system and to verify that the baseline assumptions are valid for this CSO LTCP. For this analysis the normal approximation to the hypergeometric distribution was used to randomly select a sample subset of sewers representative of the modeled system as a whole with a confidence level commensurate to that of the model itself. Field crews investigated each location and estimated sediment depth using a rod and tape. Field crews also verified sewer pipe sizes shown on the maps and noted physical conditions of the sewers. The data were then used to estimate the sediment levels as a percentage of overall sewer area. The aggregate mean for the entire City was approximately 1.25 percent with a standard deviation of 2.02 percent; the mean sediment accumulation in the Tallman Island drainage area was 1.00 percent with a standard deviation of 1.63 percent.

2.1.c.6 Status of Receiving Wastewater Treatment Plants (WWTPs)

The Alley Creek and Little Neck Bay basin within NYC is entirely within the Tallman Island WWTP tributary area. This facility is currently undergoing upgrades for Biological Nutrient Removal (BNR) and improvements that will enable the collection system and treatment facility to delivery, accept, and treat influent at twice the plant's design flow during any storm event.

2.2 Waterbody Characteristics

This section of the report describes the features and attributes of Alley Creek and Little Neck Bay. Characterizing the features of these waterbodies is important for assessing the impact of wet weather inputs as well as in the creation of approaches and solutions that mitigate the impact from wet weather discharges.

2.2.a Description of Waterbody

Alley Creek and Little Neck Bay are tidal waterbodies located in eastern Queens and western Nassau County, New York. Alley Creek is tributary to Little Neck Bay. Little Neck Bay is tributary to the East River. Alley Creek and Udalls Cove, an embayment of Little Neck Bay, have major areas of watershed preserved as parkland adjacent to the water. However, water quality in Alley Creek and Little Neck Bay is influenced by CSO and stormwater discharges. The following section describes the present-day physical and water quality characteristics of Alley Creek and Little Neck Bay, as well as, existing uses.

2.2.a.1 Current Waterbody Classification(s) and Water Quality Standards

New York State Policies and Regulations

In accordance with the provisions of the CWA, the State of New York has established WQS for all navigable waters within its jurisdiction. The State has developed a system of waterbody classifications based on designated uses that includes five saline classifications for marine waters. DEC considers the Class SA and Class SB classifications to fulfill the CWA goals. Class SC supports aquatic life and recreation but the primary and secondary recreational use of the waterbody is limited due to other factors. Class I support the CWA goal of aquatic life protection and supports secondary contact recreation. SD waters shall be suitable only for fish, shellfish and wildlife survival because natural or manmade conditions limit the attainment of higher standards. DEC has classified Alley Creek as Class I and Little Neck Bay as Class SB.

Numerical standards corresponding to these waterbody classifications are as shown in Table 2-9. Dissolved oxygen is the numerical standard that DEC uses to establish whether a waterbody supports aquatic life uses. Total and fecal coliform bacteria concentrations are the numerical standards that DEC uses to establish whether a waterbody supports recreational uses. In addition to numerical standards, New York State has narrative criteria to protect aesthetics in all waters within its jurisdiction, regardless of classification (see Section 1.2.c.). As indicated in Table 2-10, these narrative criteria apply to all five classes of marine waters.

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 IEC includes all tidal waters of greater New York City. Alley Creek and Little Neck Bay are interstate waters and are regulated by IEC as Class A waters. Numerical standards for IEC regulated waterbodies are shown in Table 2-11, while narrative standards are shown in Table 2-12.

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. IEC effluent quality regulations do not apply to CSOs if the CSS is being operated with reasonable care, maintenance, and efficiency. Although IEC regulations are intended to be consistent with State WQS, the three-tiered IEC system and the five New York State marine classifications in New York Harbor do not spatially overlap exactly.

EPA Policies and Regulations

For designated bathing beach areas, the EPA criteria require that an enterococcus reference level of 104 per 100 mL to be used by agencies for announcing bathing advisories or beach closings in response to pollution events. DMA is a private club given a permit to operate a beach by DOHMH. DOHMH uses a 30-day moving geometric mean (GM) of 35 enterococci. If the GM is greater than 35 enterococcus/100 mL, the beach is closed pending additional analysis. An enterococcus of 104 is an advisory upper limit used by DOHMH. If beach enterococcus data are greater than 104 per 100 mL, a pollution advisory is posted on the DOHMH website. Additional sampling is initiated and the advisory is removed when water quality is acceptable for primary contact recreation. Advisories are posted at the beach and on the agency web-site. In addition, there is a preemptive standing advisory for DMA Beach for no swimming for 48 hours after a rainfall of 0.2 inches in 2 hours or a rainfall of 0.4 inches in 24 hours.

For non-designated beach areas of primary contact recreation, which are used infrequently for primary contact, the EPA criteria require that an enterococcus reference level of 501 per 100 mL be considered indicative of pollution events.

Little Neck Bay is classified SB (primary contact recreation use). With the exception of the DMA Beach, Little Neck Bay is used infrequently for primary contact recreation. These reference levels, according to the EPA 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 are to be used for announcing beach advisories or beach closings in response to pollution events.

Table 2-9. New York State Numerical Surface WQS (Saline)

Class	Usage	Dissolved Oxygen (mg/L)	Total Coliform (MPN/100mL)	Fecal Coliform (MPN/100mL)	Enterococci (MPN/100mL)[(7]
SA	Shellfishing for market purposes, primary and secondary contact recreation, fishing. Suitable for fish, shellfish and wildlife propagation and survival.	≥ 4.8[(1)] ≥3.0[(2)]	≤ 70[(3)]	N/A	
SB	Primary and secondary contact recreation and fishing. Suitable for fish, shellfish and wildlife propagation and survival.	≥4.8[(1)] ≥3.0[(2)]	≤ 2,400[(4)] ≤ 5,000[(5)]	≤ 200[(6)]	≤ 35[(8)]
SC	Limited primary and secondary contact recreation, fishing. Suitable for fish, shellfish and wildlife propagation and survival.	≥4.8[(1)] ≥3.0[(2)]	≤ 2,400[(4)] ≤ 5,000[(5)]	≤ 200[(6)]	N/A
I	Secondary contact recreation and fishing. Suitable for fish, shellfish and wildlife propagation and survival.	≥ 4.0	≤ 10,000[(6)]	≤ 2,000[(6)]	N/A
SD	Fishing. Suitable for fish, shellfish and wildlife survival. Waters with natural or man-made conditions limiting attainment of higher standards.	≥ 3.0	N/A	N/A	N/A

- 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 the formula:

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

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.
(7) This standard, although not promulgated, is now an enforceable standard in New York State since the EPA established January 1, 2005 as the date upon which the criteria must be adopted for all coastal recreational waters
(8) 30-day moving geometric mean.

Table 2-10. New York State Narrative WQS

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 2-11. IEC Numeric WQS

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

Table 2-12. IEC 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.

In December 2012, the EPA released Recreational Water Quality Criteria (RWQC) recommendations that are designed to protect human health in coastal and non-coastal waters designed for primary recreation use. These recommendations were based on a comprehensive review of research and science that evaluated the link between illness and fecal contamination in recreational waters. The recommendations are intended as guidance to states, territories, and authorized tribes in developing or updating WQS to protect swimmers from exposure to pathogens found in water with fecal contamination.

The 2012 RWQC offers two sets of numeric concentration thresholds (Table 2-13) and includes limits for both the GM and a statistical threshold value (STV). The STV is a new limit and is intended to be a value that should not be exceeded by more than 10 percent of the samples taken.

Table 2-13. 2012 RWQC Recommendations

Criteria Elements	Recommendation 1 (estimated illness Rate 36/1,000)		Recommendation 2 (estimated illness Rate 32/1,000)	
Indicator	GM (cfu/100 mL)	STV (cfu/100 mL)	GM (cfu/100 mL)	STV (cfu/100 mL)
Enterococci (marine & fresh)	35	130	30	110
E. coli (fresh)	126	410	100	320

At this point, it is not known if these recommendations will be used by DEC to update water quality criteria. DEC has not adopted the RWQC at this time.

2.2.a.2 Physical Waterbody Characteristics

Alley Creek and Little Neck Bay are located in the northeastern corner of Queens near the Nassau County border. Alley Creek opens into the southeast end of Little Neck Bay. Little Neck Bay opens to the East River between Willets Point and Elm Point near the western portion of Long Island Sound. Udalls Cove, an embayment on the eastern shore of Little Neck Bay, spans the Queens, Nassau County border between Douglas Manor and Great Neck Estates.

Alley Creek is located at the southern end of Little Neck Bay and is contained within Alley Pond Park. The tidal tributary runs northward and its mouth opens to Little Neck Bay. The 624-acre park contains forests, several ponds, facilities for active recreation, salt marshes and wetlands, and the creek itself. The creek constitutes one of the few remaining undisturbed marsh systems in the City. The head of Alley Creek is near the intersection of the Cross Island Parkway and the Long Island Expressway. Freshwater flows to Alley Creek are stormwater and CSO discharge. Alley Creek water quality is also influenced by the saline water of Little Neck Bay.

Little Neck Bay comprises an area of approximately 1,515 acres. This open water fish and wildlife habitat extends to Fort Totten in the west, and the village of Elm Point, Nassau County in the east. The bay is bordered by residential development, Fort Totten and the Cross Island Parkway. Based on the DCP New York City Comprehensive Waterfront Plan entitled “Plan for the Queens Waterfront”, Little Neck Bay is one of the major waterfowl wintering areas on Long Island’s north shore. In addition to waterfowl use, Little Neck Bay is a productive area for marine fish and shellfish. As a result of the abundant fisheries in the bay and its proximity to the metropolitan New York area, Little Neck Bay is a regionally important recreational fishing resource.

Udalls Cove is located in the northeastern corner of Queens and extends into Nassau County. The New York City portion comprises an area of approximately 52 acres, from Little Neck Bay to the vicinity of Northern Boulevard. Most of Udalls Cove is mapped as parkland and managed by DPR as the Udalls Cove Preserve.

Little Neck Bay, Alley Creek, and Udalls Cove are located within the Coastal Zone Boundary and within a Special Natural Waterfront Boundary as designated by the DCP. All three waterbodies are also located within Significant Coastal Fish and Wildlife Habitats as designated by the New York State Department of State (DOS).

Shoreline Physical Characterization

Alley Creek is predominantly characterized by natural, vegetated shorelines, except for the footings of the bridges for the Long Island Railroad and Northern Boulevard. The Creek is contained within Alley Pond Park, except for the eastern shore north of the Long Island Railroad. Little Neck Bay is generally characterized by altered shorelines, mainly rip-rap, with some bulkhead from Bay Street to Shore Road and from Westmorland Drive to Bayview Avenue in Douglaston. Based on field observations, vegetation exists on the waterside of some of the altered areas of Parsons Beach and Douglaston. Natural, sandy and natural, vegetated areas do exist along the shores of Little Neck Bay in the inlet on the southeastern portion of Fort Totten, near the mouth of Alley Creek, along the Parsons Beach and Douglaston shore and in Udalls Cove. Most of the natural shoreline areas are within parkland. Small piers also exist along the shores, mainly along the Douglaston Peninsula.

Figures 2-14, 2-15 and 2-16 show shoreline typical for the regions of the study area. Figure 2-14 shows the rip-rap that typically fortifies much of the western shoreline of Little Neck Bay. Figure 2-15 shows the varied types of bulkheading, rip-rap and natural shoreline found along the eastern shoreline of Little Neck Bay. Figure 2-16 shows the natural shorelines typical around the southern end of Little Neck Bay and Alley Creek.

The shorelines of Udalls Cove, an embayment of Little Neck Bay, consist primarily of natural, vegetated areas. Intact, concrete bulkhead areas exist from Bayview Drive to the mouth of the cove. Along Virginia Point near the Nassau County border, dilapidated timber bulkheads exist among the wetland vegetation. Much of the shoreline along the western edge of the cove borders residential areas or the esplanade park that runs between Marinette Street and the water. These areas are natural in the sense that they lack riprap or bulkheading, although many of these areas are maintained by landscapers and may have been modified during road and property development.

In Udalls Cove, from the Long Island Railroad in the south to north of Sandhill Road, Gablers Creek runs through the wetlands of Aurora Pond and the cove. The Gablers Creek in this area is contained within a cobble-lined ditch. Physical shoreline conditions and shoreline habitat are as shown in Figure 2-17.

Shoreline Slope

Shoreline slope has been qualitatively characterized along shoreline banks where applicable and where the banks are not channelized or otherwise developed with regard to physical condition. Steep is defined as greater than 20 degrees or 80-foot vertical rise for each 200-foot horizontal distance perpendicular to the shoreline. Intermediate is defined as 5 to 20 degrees. Gentle is defined as less than 5 degrees or 18-foot vertical rise for each 200-foot horizontal distance. In general, the three classification parameters describe the shoreline slope well for the purposes of the LTCP project.

Gentle and intermediate slopes characterize the shorelines of Little Neck Bay, Alley Creek and Udalls Cove. The slope of the eastern shoreline of Little Neck Bay is generally characterized as intermediate. The slope of the western shoreline is generally characterized as gentle, with an area of intermediate shoreline located along Fort Totten. The slopes of both shorelines of Alley Creek are characterized as gentle. The slope of the eastern shoreline of Udalls Cove is characterized as gentle. The slope of the western shore is characterized as predominantly gentle, with one area of intermediate slope. The area of intermediate slope extends along the shoreline from Beverly Road to the mouth of the cove. Shoreline slopes are as shown in Figure 2-18.

Waterbody Sediment Surficial Geology/Substrata

The waterbody bottom of Little Neck Bay is generally characterized as sand. The waterbody bottom of Alley Creek is generally characterized as mud/silt/clay. These classifications have been assigned based on the following two sediment sampling programs which analyzed sediment grain size: grab samples taken at one HydroQual, Inc. sampling station in 2001; and grab samples taken at three HydroQual sampling stations in 2002 both done as part of a Use and Standards Attainment Study performed for DEP. For the purpose of defining surficial geology/substrata, those areas where bottom samples were more than 50 percent mud/silt/clay were designated as mud/silt/clay; those areas where bottom samples were more than 50 percent sand were designated as sand. Based on one Little Neck Bay grab sample taken by HydroQual in February 2001, bottom mud/silt/clay composition was approximately 16.50 percent, while sand composition was 83.50 percent.

HydroQual sediment sampling in July 2002 consisted of one grab collected at one station in Little Neck Bay and two in Alley Creek. Based on the sample obtained in Little Neck Bay, bottom mud/silt/clay composition was approximately 37.40 percent and sand composition was approximately 62.6 percent. Based on the two samples obtained in Alley Creek, bottom mud/silt/clay composition ranged from approximately 61.38 to 85.15 percent, while sand composition ranged from approximately 14.85 to 38.62 percent.

Waterbody Type

Little Neck Bay and the mouth of Udalls Cove are classified as embayments. Alley Creek and the portion of Udalls Cover south of Knollwood Avenue are classified as tidal tributaries. Freshwater sources to Udalls Cove are Gablers Creek, the Belgrave WWTP discharge and discharge from the freshwater wetlands located near the cove. Similarly, Alley Creek receives freshwater from stormwater and CSO discharge, from groundwater inflows and from the freshwater wetlands that are located near the creek. All of the waters in the Alley Creek and Little Neck Bay waterbody assessment area are tidal and saline.

Tidal/Estuarine Systems Biological Systems

Tidal/Estuarine Wetlands

Tidal/Estuarine generalized wetlands in the Alley Creek and Little Neck Bay watershed are shown in Figure 2-19 and are described in this section. According to the DEC tidal wetlands maps, there are numerous designated wetlands mapped throughout the study area. The western and eastern shorelines of Little Neck Bay support many areas of inter-tidal marshes from Willets Point to the mouth of Alley Creek with an area of coastal shoals, bars and mudflats mapped to the south and southwest of Fort Totten. Extensive wetlands have been mapped by the DEC on both shores of Little Neck Bay south of Parsons Beach and Crocheron Park and throughout Alley Creek. These extensive wetlands tend to be mapped with high marsh or salt meadow wetlands inland of inter-tidal marsh wetlands, and in some areas, most notably north of the Long Island Railroad and surrounding the mouth of Alley Creek, the wetland areas are mapped on the order of 1,000 feet wide. Formerly connected wetlands are also mapped immediately south of the Long Island Railroad, inland from Alley Creek.

Udalls Cove, an embayment of Little Neck Bay also supports extensive wetlands, generally with inter-tidal marsh wetlands and high marsh or salt meadow wetlands mapped inland of coastal shoals, bars and mudflats. The open waters of Little Neck Bay are generally mapped as littoral zone. The DEC maps designate three discontinuous inter-tidal wetland areas along the western bank of Little Neck Bay and Alley Creek from roughly 1,500 feet southeast of Willets Point, along the east and south shorelines of Fort Totten, and south to 23rd Street. Three other areas of discontinuous inter-tidal marsh wetlands are mapped from 28th Road to Crocheron Park. A continuous inter-tidal wetland area is mapped from 35th Avenue to the Long Island Railroad. South of the Long Island Railroad, inter-tidal marshes are mapped roughly from 440 to 520 feet and 880 to 1,500 feet south of Northern Boulevard and 1,860 feet south of Northern Boulevard to the head of Alley Creek. High marsh or salt meadow wetlands are mapped from 37th Avenue to the Long Island Railroad and from roughly 120 to 1,520 feet south of Northern Boulevard.

The DEC maps also show inter-tidal marsh wetlands along the eastern shorelines of Little Neck Bay and Alley Creek. Two areas of inter-tidal marsh wetlands are mapped from the pier at Beverly Road to Manor Road. Other areas of inter-tidal marsh wetlands exist from Arleigh Road to 233rd Street, from Regatta Place to Bay Street, and from just south of Bay Street to the Long Island Railroad. The DEC maps show inter-tidal marsh wetlands stretching along the eastern shore of Alley Creek from the Long Island Railroad to Northern Boulevard. South of Northern Boulevard, the inter-tidal marsh wetlands are not contiguous and are interspersed along the eastern shoreline from Northern Boulevard to the mouth of Alley Creek, from roughly 100 to 280 feet south of Northern Boulevard, from 360 to 1,380 feet south of Northern Boulevard, and from approximately 1,660 feet south of the boulevard to the head of the creek. High marsh or salt meadow wetlands are also mapped as interspersed along the eastern shoreline of Little Neck Bay and Alley Creek from Little Neck Road to the Long Island Railroad, adjacent to the south edge of the Long Island Railroad, from 100 to 720 feet south of Northern Boulevard, from approximately 780 to 800 feet south of Northern Boulevard, and from approximately 1,380 to 1,680 feet south of the boulevard.

Thin extensions of inter-tidal marsh wetlands, on the order of 20 to 60 feet wide, extend inland from both shorelines of Alley Creek along the southern edge of the Long Island Railroad, parallel to the train tracks. To the east of Alley Creek, these inter-tidal marsh wetlands extend roughly 840 feet inland along the train tracks, and two areas of formerly connected wetlands are mapped to the south of these inter-tidal wetlands, approximately 300 and 560 feet inland of the creek. To the west of Alley Creek, the inter-tidal wetlands extend inland approximately 240 feet along the railroad tracks with a small break between them and an area of formerly connected wetlands that extends inland for approximately another 1,000 feet.

In the New York City portion of Udalls Cove, the DEC has mapped inter-tidal marsh wetlands from the mouth to approximately 2,500 feet south of the mouth along both east and west shorelines. High marsh or salt meadow wetland areas are mapped in the study area from approximately 2,000 feet to 3,000 feet southeast of the mouth of the cove, along the western shoreline of the cove. Coastal shoals, bars and mudflats are mapped throughout the mouth and along the open water portions of Udalls Cove within the study area. The wetlands of Udalls Cove extend up to 1,600 feet from the western shoreline in New York City to the eastern shoreline in Nassau County.

The United States Fish and Wildlife Service National Wetlands Inventory (NWI) maps show extensive wetlands throughout the Little Neck Bay, Alley Creek, and Udalls Cove study area. The NWI mapped wetlands are shown in Figure 2-20. In the inlet between Forth Totten and Bay Terrace, three adjacent wetland areas - estuarine, inter-tidal, flat, regular (E2FLN); estuarine, inter-tidal, emergent persistent, irregular (E2EM1P); and palustrine, emergent, persistent, semi-permanent (PEM1F) - are mapped in series, stretching to the northwest from the mouth of the inlet on Little Neck Bay. Along the western shoreline of Little Neck Bay, two areas of estuarine, inter-tidal, beach/bar, regular (E2BBN) wetlands exist between 17th and 29th Avenues. Along the eastern shoreline of Little Neck Bay, the NWI has mapped E2BBN wetlands at 33rd Street, and estuarine, inter-tidal, emergent, narrow-leaved persistent, regular (E2EM5N) wetlands along Parsons Beach. South of Crocheron Park on the western shoreline of Little Neck Bay and Alley Creek and south of Parsons Beach on the eastern shoreline of the bay and creek, the NWI has mapped multiple wetland areas along both shorelines that span the waterbodies.

Listed from north to south, these wetland areas include E2EM5N, estuarine, inter-tidal, emergent, narrow-leaved persistent, irregular (E2EM5P); E2EM1P; and another area of E2EM5P; stretching from southern Little Neck Bay to the head of Alley Creek. An area of estuarine, sub-tidal, open water / unknown bottom, sub-tidal (E1OWL) wetland is mapped inland to the west of Alley Creek northwest of the Cross Island Expressway cloverleaf and south of the Long Island Railroad. The open waters of Alley Creek are mapped estuarine, inter-tidal, streambed, irregularly exposed (E2SBM) wetlands.

The NWI mapped multiple wetlands along the shorelines of Udalls Cove. The open waters of the cove are mapped as E10WL. Within the New York City study area of Udalls Cove, the western shoreline north of 28th Avenue is mapped as E2EM5N. South of 28th Avenue, both shorelines of Udalls Cove within the study area are mapped as estuarine, inter-tidal, emergent, narrow-leaved persistent / persistent, irregular (E2EM5/1P) wetlands. The NWI has mapped the waters as E2SBM where the cove's open waters narrow into a tidal river.

Aquatic and Terrestrial Communities

The DCP Plan for the Queens Waterfront (DCP, 1993) reports a diverse range of species supported by the habitat in the Alley Creek and Little Neck Bay area. Little Neck Bay is a productive area for marine finfish and shellfish. The bay serves as an important nursery and feeding area for striped bass and numerous other species. A variety of finfish species can be found in the tidal shallows and Alley Creek. Although its waters are not certified for commercial shellfishing, Little Neck Bay is a hard clam producing area. Alley Pond Park and Udalls Cove contain abundant shellfish and crustaceans. The habitats also serve as breeding areas for several species of birds, as a spring and fall stopover for several migratory species, and serve as avian wintering areas for several species. Shorebirds and wading birds use the Udalls Cove area extensively. The area also supports numerous terrestrial and amphibious wildlife species. A more detailed summary of the aquatic and terrestrial communities can be found in the June 2009 Alley Creek and Little Neck Bay WWFP.

Freshwater Systems Biological Systems

Generalized freshwater wetlands areas are shown in Figure 2-19 are described in more detail in this section. The DEC Freshwater Wetlands Maps show seven areas of freshwater wetlands in the study area. The areas are mapped in the inlet between Fort Totten and Bay Terrace extending along the Cross Island Parkway southeast of Totten Avenue; on the west shoreline of Alley Creek extending south along the Cross Island Parkway from the cloverleaf at Northern Boulevard to the creek roughly 800 feet south of Northern Boulevard; inland from the eastern shoreline of Alley Creek extending along the southern edge of the Long Island Railroad and the western edge of the Douglaston Parkway; in two discontinuous areas along both shorelines of Alley Creek from roughly 600 feet south of Northern Boulevard to the head of the creek; in Udalls Cove from Hollywood Avenue to Sandhill Road; and in Udalls Cove between Sandhill Road and the Long Island Railroad.

The NWI maps show three areas of freshwater (palustrine) wetlands in the Little Neck Bay, Alley Creek, and Udalls Cove study area, as indicated in Figure 2-20. In the inlet between Fort Totten and Bay Terrace, a palustrine, emergent, persistent, semi-permanent (PEM1F) wetland is mapped at the northeast edge of tidal wetlands, as described above. An area of palustrine, emergent, persistent, seasonal (PEM1C) is mapped inland of the eastern shore of Alley Creek adjacent to the southern edge of the Long Island Railroad, with an area of palustrine, open water/unknown bottom, intermittently exposed/permanent (POWF) wetlands adjacent to the PEM1C wetlands. In addition, an area of palustrine, open water/unknown bottom, intermittently exposed/permanent (POWZ) is mapped to the west of Udalls Cove between Sandhill Road and the Long Island Railroad.

Table 2-14. NWI Classification Codes

NWI Classification	Description
E1OWL	Estuarine, sub-tidal, open water/unknown bottom, sub-tidal
E2BBN	Estuarine, inter-tidal, beach-bar, regular
E2BBP	Estuarine, inter-tidal, beach-bar, irregular
E2EM1P	Estuarine, inter-tidal, emergent-persistent, irregular
E2EM5/1P	Estuarine, inter-tidal, emergent, narrow-leaved persistent/persistent, irregular
E2EM5N	Estuarine, inter-tidal, emergent, narrow-leaved, persistent, regular
E2EM5P	Estuarine, inter-tidal, emergent, narrow-leaved, persistent, irregular
E2FLN	Estuarine, inter-tidal, flat, regular
E2SBM	Estuarine, inter-tidal, streambed, irregularly exposed
PEM1C	Palustrine, emergent, persistent, seasonal
PEM1F	Palustrine, emergent, persistent, semi-permanent
PFO1A	Palustrine, forested, broad-leaved deciduous, temporarily flooded
POWF	Palustrine, open water/unknown bottom, intermittently exposed/permanent
POWZ	Palustrine, open water/unknown bottom, intermittently exposed/permanent
PUBF	Palustrine, unconsolidated bottom, semi-permanent
PUBHh	Palustrine, unconsolidated bottom, permanent, diked/impounded
PUBZ	Palustrine, unconsolidated bottom, intermittently exposed/permanent
PUBZh	Palustrine, unconsolidated bottom, intermittently exposed/permanent, diked/impounded

Figure 2-14. Western Shoreline of Little Neck Bay Near 27th Ave. (Looking West)

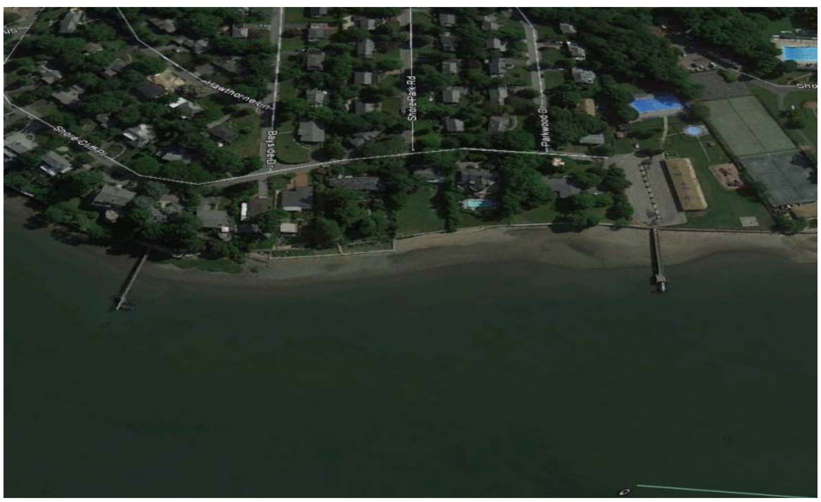


Figure 2-15. Eastern Shoreline of Little Neck Bay Near Shorecliff Place (Looking West)

Figure 2-16. Shoreline of Alley Creek (Looking North)

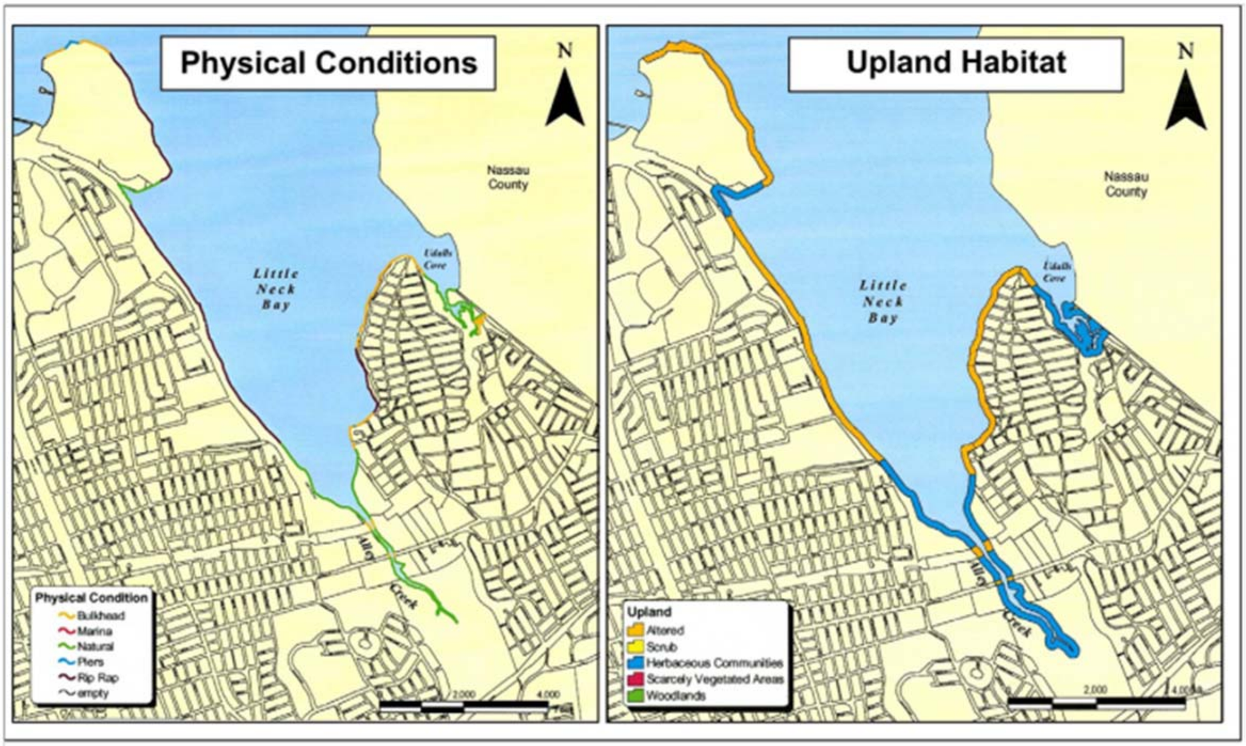


Figure 2-17. Shoreline Physical Conditions and Upland Habitat

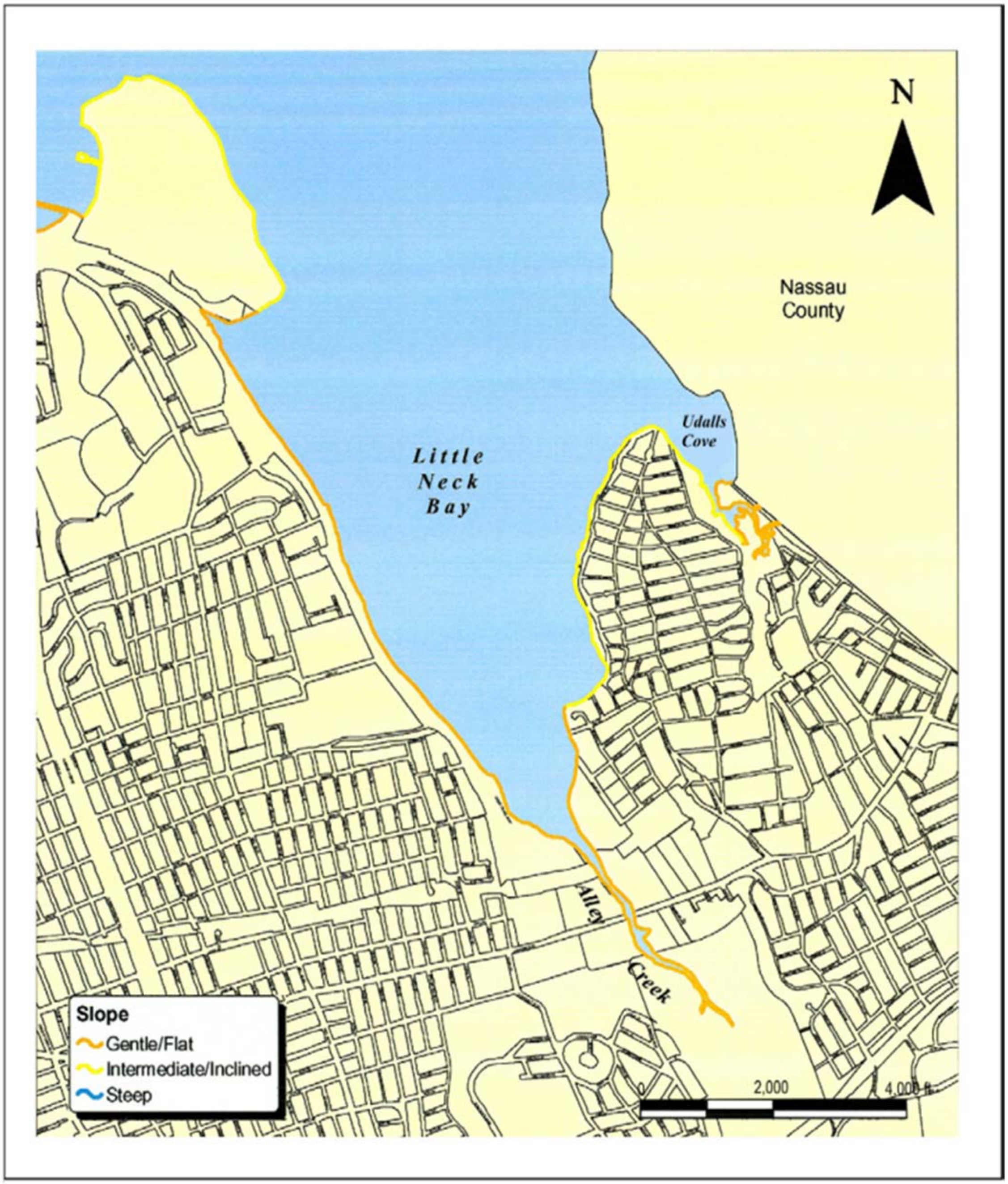


Figure 2-18. Alley Creek Existing Shoreline Slope

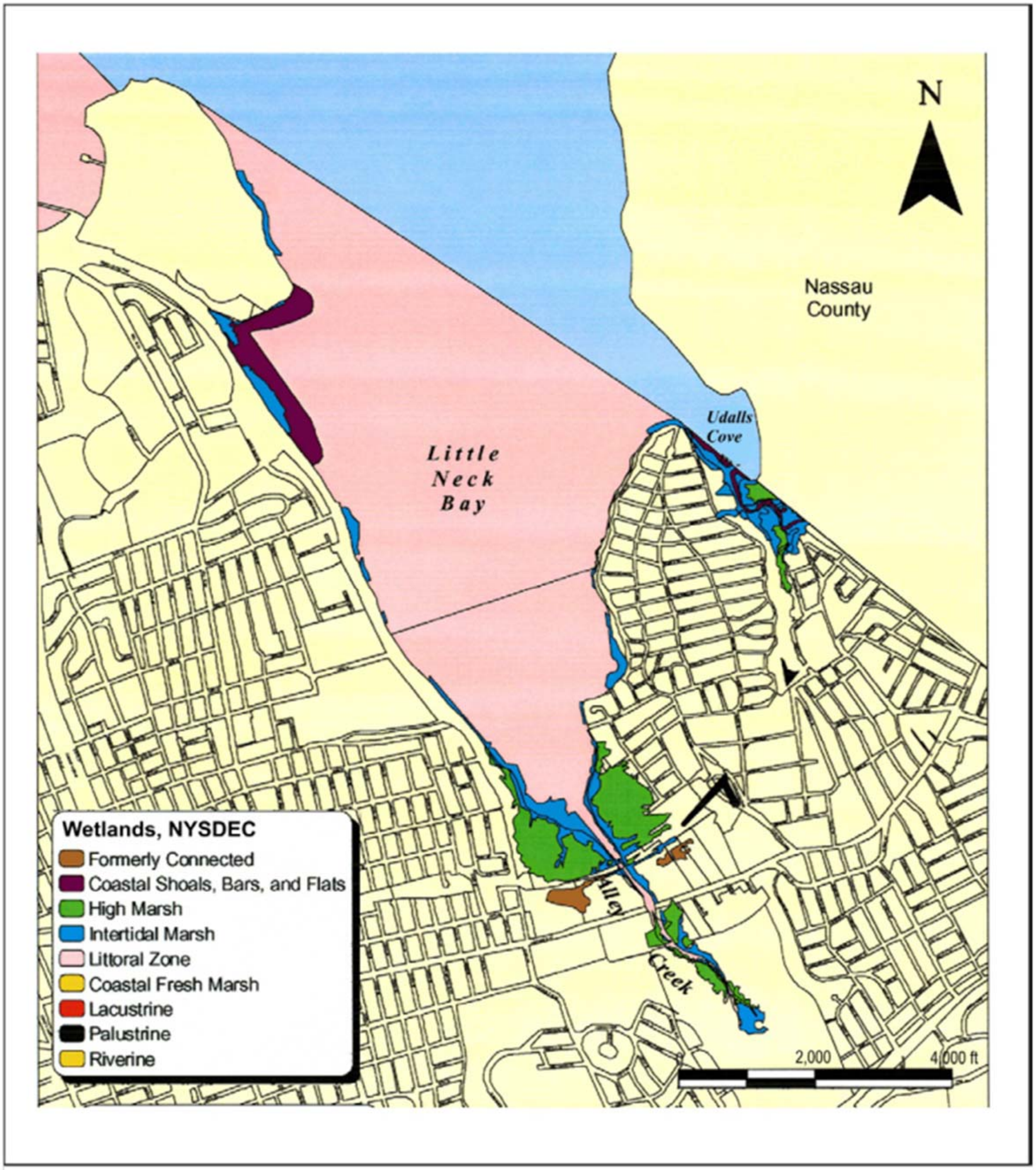


Figure 2-19. DEC Existing Mapped Wetlands. Source: WWFP, June 2009

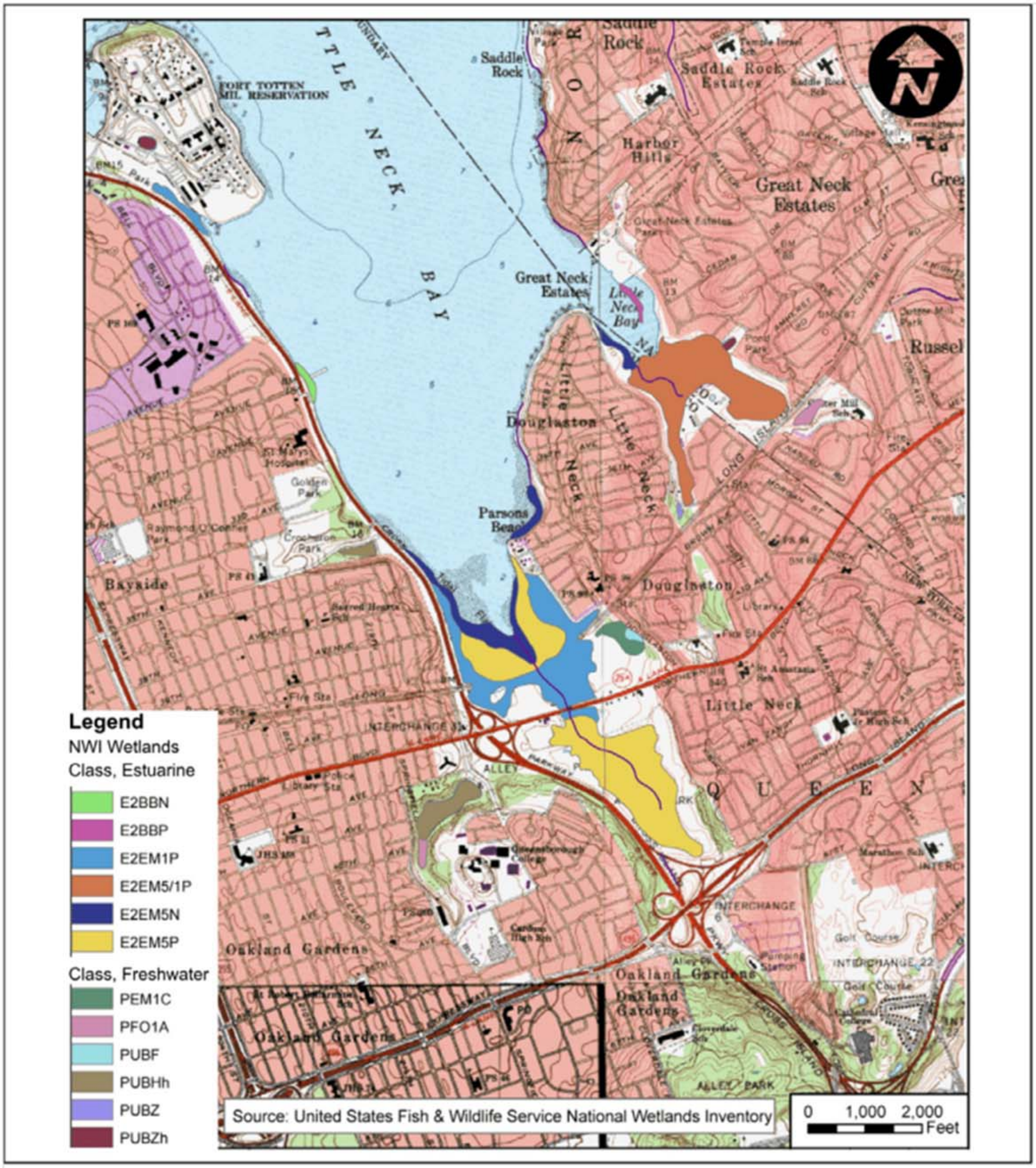


Figure 2-20. National Wetlands Inventory (NWI) Source: WWFP, June 2009

2.2.a.3 Current Public Access and Uses

Alley Creek, its shoreline, areas immediately adjacent to the water, and much of the surrounding drainage area of the creek are within Alley Pond Park. Access to Alley Creek is provided for by the park but no facilities for primary contact recreation are available. The park does not provide any regular secondary contact recreation opportunities; however, the Urban Park Rangers do run structured programs. One such program, "Alley Pond Adventure" is an overnight, summer camping program that includes supervised canoeing (secondary contact recreation use) and fishing.

The major use of Alley Creek is passive, non-contact recreation. There are hiking trails that offer views of the water. Another significant, passive use of Alley Creek is for environmental education associated with wetlands habitat. The Alley Pond Environmental Center, located near the mouth of Alley Creek offers an extensive naturalist program with outreach to schools throughout the City.

Swimming (primary contact recreation use) is an existing use in Little Neck Bay at the privately owned bathing beach located on the eastern shore of the bay at Douglas Manor. As seen in Figure 2-9, the DMA Beach is located approximately 0.7 miles north of the mouth of Alley Creek, and approximately one mile downstream from the principal CSO outfall on Alley Creek, TI-025. DOHMH beach monitoring is conducted weekly during the bathing season from May through September. In addition to the supervised bathing at the DMA Beach, bathing has been reported to occur from the boating docks along this shoreline but is not a sanctioned use.

On the western side of Little Neck Bay, access to the water is limited by the Cross Island Parkway that runs parallel to the shoreline. There is no swimming noted along this shoreline. Access to the Bay for boating (secondary contact recreation use) is provided at the public marina in Bayside, operated under a concession from the DPR. This facility is open seasonally between May 1 and October 31 and has accommodation for 150 boats. Fort Totten, located at the northeast point of Little Neck Bay, is also operated by DPR and provides public access for canoeing and kayaking. In addition, fishing is allowed from the docks for special events.

A major use of Little Neck Bay is passive recreation. There is also a hiking/bicycle path that runs between the shoreline of Little Neck Bay and the Cross Island Parkway providing viewing of the Bay. In addition, fishing occurs along this pathway. Another wetland area used for environmental education is Aurora Pond, adjacent to Udalls Cove, an eastern tributary to the Little Neck Bay. Environmental education, hiking, biking, and promenades are passive uses of the waterbodies that do not involve either primary or secondary contact with the water. Fishing in Little Neck Bay might include limited contact with the water.

These locations are further discussed in Section 8.6

2.2.a.4 Identification of Sensitive Areas

Federal CSO Policy requires that the LTCP give the highest priority to controlling overflows to sensitive areas. 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
- Water with primary contact recreation
- Waters with threatened or endangered species and their habitat
- Water with primary contact recreation
- Additional areas determined by the Permitting Authority (i.e., DEC).

General Assessment of Sensitive Areas

An analysis of the waters of the Alley Creek and Little Neck Bay with respect to the CSO Policy was conducted and is summarized in Table 2-15.

Table 2-15. Sensitive Areas Assessment

	Current Uses Classification of Waters Receiving CSO Discharges Compared to Sensitive Areas Classifications or Designations[(1)]						
CSO Discharge Receiving Water Segments	**Outstanding National Resource Water (ONRW)**	**National Marine Sanctuaries[(2)]**	**Threatened or Endangered Species and their Habitat[(3)]**	**Primary Contact Recreation**	**Public Water Supply Intake**	**Public Water Supply Protected Area**	**Shellfish Bed**
Alley Creek	None	None	Yes	No[(4)]	None[(5)]	None[(5)]	None
Little Neck Bay	None	None	No	Yes	None[(5)]	None[(5)]	None

(1) Classifications or Designations per CSO Policy
(2) As shown at http://www.sactuaries.noaa.gov/oms/omsmaplarge.html
(3) DOS Significant Coastal Fish and Wildlife Habitats website (http://nyswaterfronts.com/water-front_natural_narratives.asp)
(4) Existing uses include secondary contact recreation and fishing, Class I
(5) These waterbodies contain salt water

This analysis identified two items of potential concern:

- *Threatened or endangered species at Alley Creek.* Based on the Coastal Fish and Wildlife habitat rating form, the Northern harrier, a threatened (T) bird species over winters in Alley Pond Park.
- *Primary contact recreation in Little Neck Bay.* There is a private beach, the DMA Beach, located on the western shore of the Douglaston Peninsula.

However, the Northern harrier is a raptor whose diet consists strictly of land mammals (mice, voles and insects). The presence of the Northern harrier is due to the relatively large protected wetlands in Alley Pond Park and not the waters or aquatic life of Alley Creek. The presence of the Northern harrier (T) does not, therefore, define Alley Creek as a sensitive area for threatened species according to EPA CSO Policy. There are no threatened or endangered species present in Udalls Cove or Little Neck Bay.

Findings for Sensitive Areas

There is one sensitive area located within Little Neck Bay, the DMA Beach (see Figure 2-10), as defined by the EPA CSO Control Policy. Accordingly, the LTCP will address the Policy requirements which include: (a) prohibit new or significantly increased overflows; (b) 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 (c) provide reassessments in each permit term based on changes in technology, economics, or other circumstances for those locations not eliminated or relocated (EPA, 1995a).

2.2.a.5 Tidal Flow and Background Harbor Conditions and Water Quality

DEP has been collecting New York Harbor water quality data since 1909. These data are utilized by regulators, scientists, educators and citizens to assess impacts, trends, and improvements in the water quality of New York Harbor.

The Harbor Survey Program has been the responsibility of DEP's Marine Sciences Section (MSS) for the past 27 years. These initial surveys were performed in response to public complaints about quality of life near polluted waterways. The initial effort has grown into a Survey that consists of 72 stations distributed throughout the open waters of the Harbor and smaller tributaries within the City. The number of water quality parameters measured has also increased from five in 1909 to over 20 at present.

Harbor water quality has improved dramatically since the initial surveys. Infrastructure improvements and the capture and treatment of virtually all dry-weather sewage are the primary reasons for this improvement. During the last decade, water quality in NY Harbor has improved to the point that the waters are now utilized for recreation and commerce throughout the year. Still, impaired areas remain within the Harbor. The LTCP process has begun to focus on those areas within the Harbor that remain impacted. This project will look at 10 waterbodies and their drainage basins and will develop a comprehensive plan for each waterbody.

The 2010 Harbor Survey report focuses on the most recent water quality data collected by DEP. Fecal coliform bacteria, dissolved oxygen; chlorophyll 'a' and Secchi transparency are the water quality parameters used in Harbor Water Quality Study. Data are presented in four sections, each delineating a geographic region within the Harbor. Alley Creek and Little Neck Bay are located within the Upper East River – Western Long Island Sound (UER-WLIS) section. This area contains nine open water monitoring stations and five tributary sites as shown in Figure 2-21. Samples from Stations E11, LN1, and AC1 will give the most accurate data for Alley Creek and Little Neck Bay water quality.

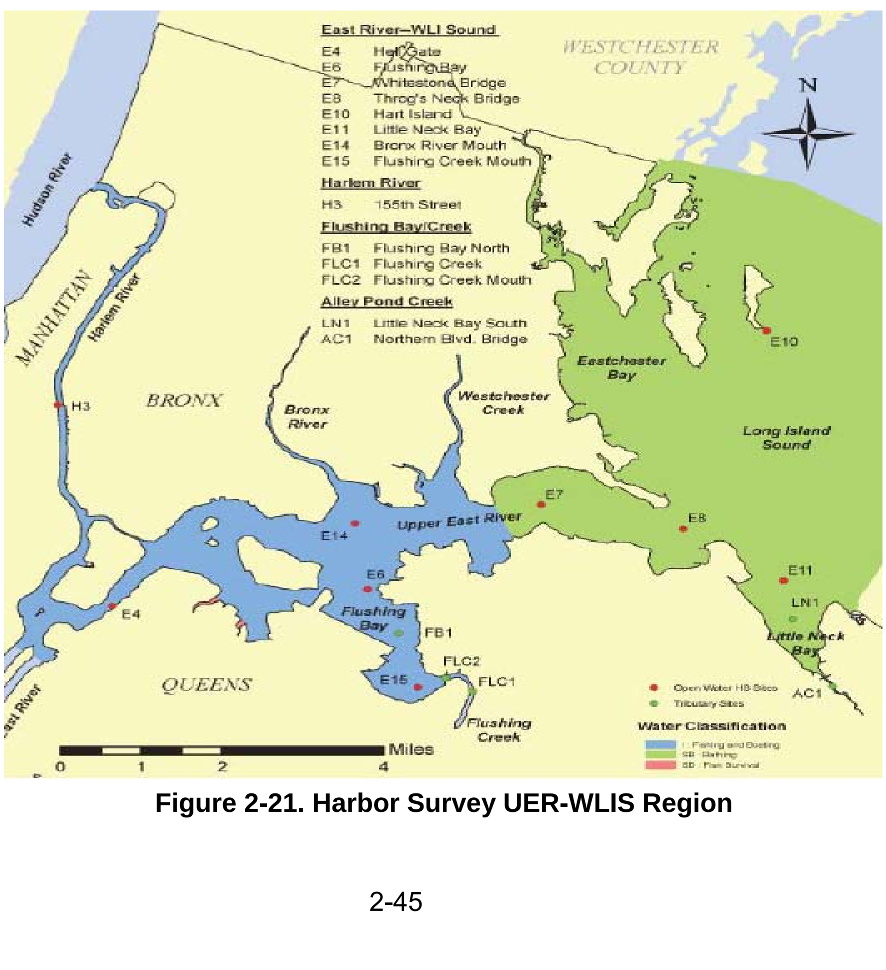


Figure 2-21. Harbor Survey UER-WLIS Region

Fecal coliform and enterococci are indicators of human waste and pathogenic bacteria. The UER-WLIS saw a rise in summer GM from 36 cells/100 mL to 43 cells/100 mL from the 2009 data. However, fecal coliform and enterococcus concentrations continued to be in compliance with their respective classification standards for Stations E11, LN1, and AC1. Fecal coliform and entercocci levels have remained below the compliance standard due to a reduction in CSOs and upgrades to the WWTP.

Dissolved oxygen is the oxygen in a water body available for aquatic life forms. Average dissolved oxygen levels have exceeded the compliance requirement of 5.0 mg/L. In 2010, the average surface was measured at 5.6 mg/L; while the average bottom was measured at 5.2 mg/L. During summer months all surface waters obtained their classification requirement, but bottom waters only met their classification for 5 out of 8 sites. The "DO never-less-than" percentage for surface and bottom waters increased to 77 percent and 72 percent in 2010, from 74 percent and 66percent in 2009. Hypoxia is another statistic associated with DO and occurs when DO levels are below 3.0 mg/L. Stations for Alley Creek and Little Neck Bay did not have any such incidents.

Chlorophyll 'a' is the green pigment in algae and plankton. The amount of chlorophyll 'a' is a gauge of primary productivity which is used to measure ecosystem quality. A concentration of 20 µg/L or above is considered eutrophic. In a state of eutrophication phytoplankton reproduction rates greatly increase causing a depletion of DO. The average reading for UER-WLIS was 9.5 µg/L in 2010. Little Neck Bay reported an average of over 20 µg/L. This is a common condition for confined bodies of water. The general trend has remained close to 10 µg/L since chlorophyll 'a' level collection started in 1986.

Secchi transparency is a measure of the clarity of surface waters. Clarity is measured as a depth when the Secchi disk blends in with the water. Clarity is most affected by the concentrations of suspended solids and plankton. Lack of clarity limits sunlight which inhibits the nutrient cycle. The average summer concentration for UER-WLIS was 4.0 feet. No stations in Alley Creek and Little Neck Bay reported a low transparency (under 3.0 feet).

2.2.a.6 Compilation and Analysis of Existing Water Quality Data

More recent data collected within Alley Creek and Little Neck Bay are available from sampling conducted by DEP Harbor Survey in 2009 and 2012 and from sampling collected in late 2012 during the development of this report. Figure 2-23 summarizes enterococci data and fecal coliform data collected at locations AC1, LN1 and E11, in Alley Creek and Little Neck Bay, respectively and at the DMA Beach. The above mentioned locations can be seen in Figure 2-24. These data represent the period of January 2009 through April 2011 prior to when the Alley Creek CSO Retention Tank came on-line. Also shown on this figure are data from May 2011 through the end of 2012, the period for which the CSO retention tank was online. Data provided show the GM of the data set over the period of record along with data ranges (minimum to maximum and 25th percentile to 75th percentile). Also shown on the figure for reference purposes are the 30-day GM water quality standard for enterococci and the 30-calendar day GM water quality standard for fecal coliform bacteria.

These data indicate that the pathogen concentrations within Alley Creek are elevated with the data period GMs for enterococci at approximately 500 org/100ml and for fecal coliform bacteria near 2,000 org/100ml. The 75th percentile excursions above these values reach nearly 2,000 org/100ml for enterococci and exceed 5,000 org/100ml for fecal coliform bacteria.

Pathogen levels within Little Neck Bay are significantly lower where period GM concentrations are less than 10 org/100ml for enterococci and are between 10 and 100ml for fecal coliform bacteria. Locally at DMA Beach, enterococci concentrations, as measured by the DOHMH, have a period GM that is very close to the maximum 30-day GM standard of 35 org/100ml. DMA Beach use is regulated by the DOHMH who sample the beach routinely between late April and mid-September to control when it can be used within the bathing season (approx. Memorial Day to Labor Day). Between 2009 and the end of 2012 the water quality was measured to be in compliance with the maximum 30-day GM enterococci standards from a low of 5 percent of the time in 2011 to a high of 67 percent of the time in 2012 as shown in Figure 2-22.

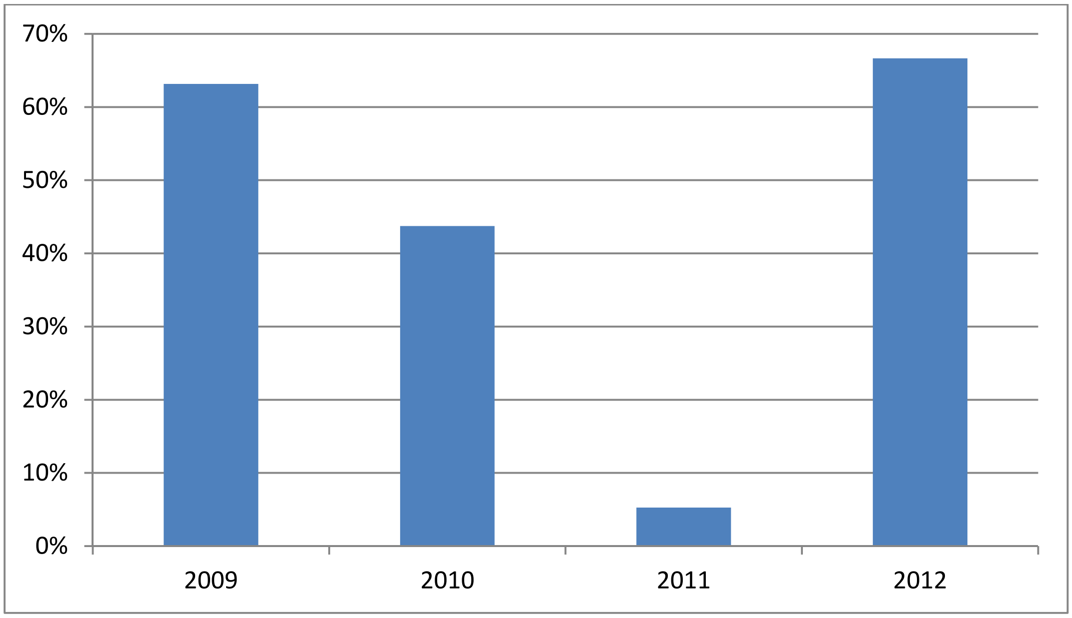


Figure 2-22. Percent of Enterococci Samples with 30-day GM<35 org/100ml

Additional targeted sampling described herein was conducted as part of developing the Alley Creek LTCP in 2012 to collect pathogen samples within Alley Creek and Little Neck Bay to further evaluate the spatial extent of the area within Little Neck Bay that experiences elevated pathogen concentrations as a result of the high concentrations of pathogens found in Alley Creek and at the DMA shoreline. This sampling was conducted in November and December at 15 locations shown in Figure 2-25.

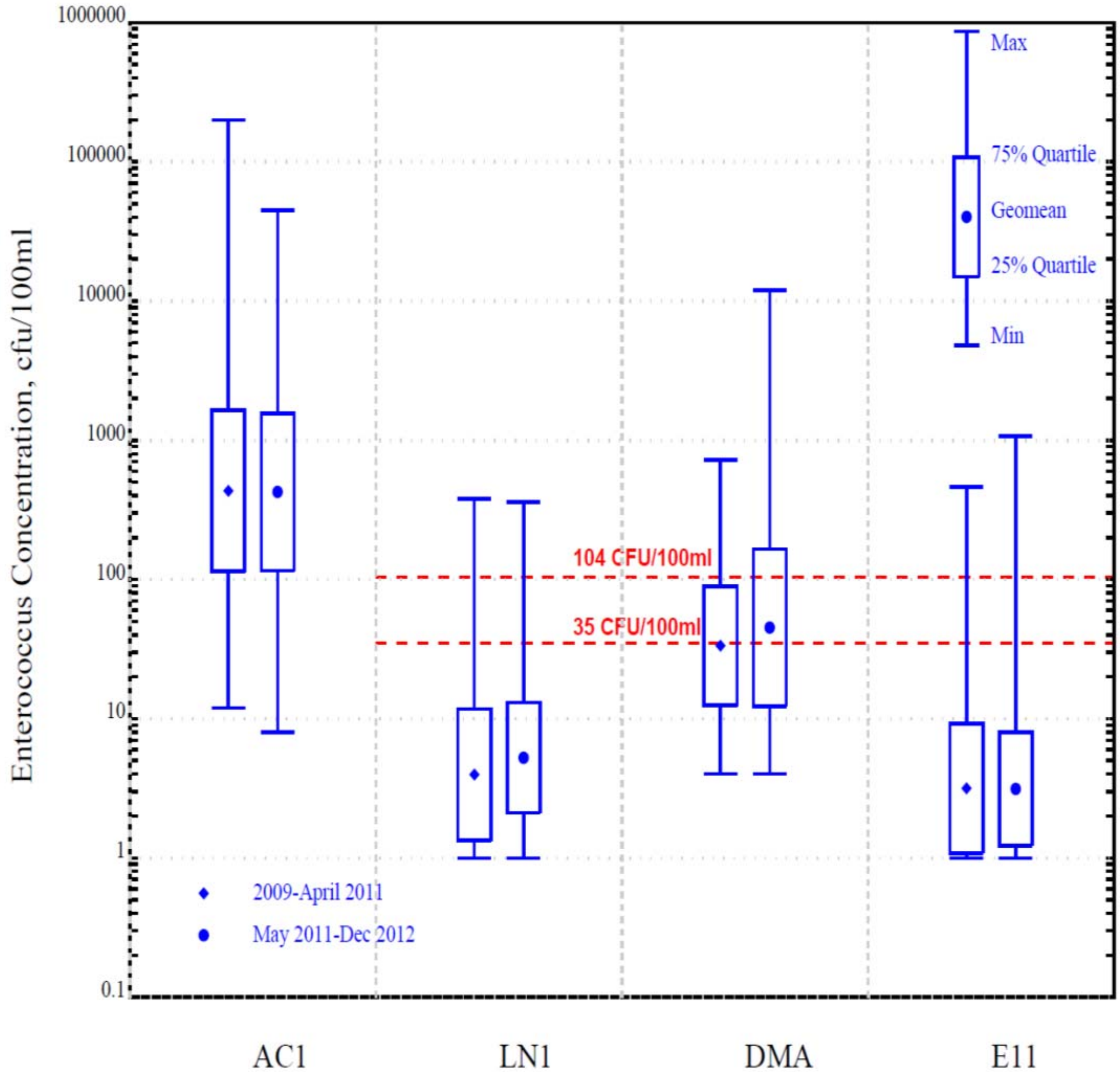


Figure 2-23. Bacterial Concentrations at Harbor Survey Monitoring Stations

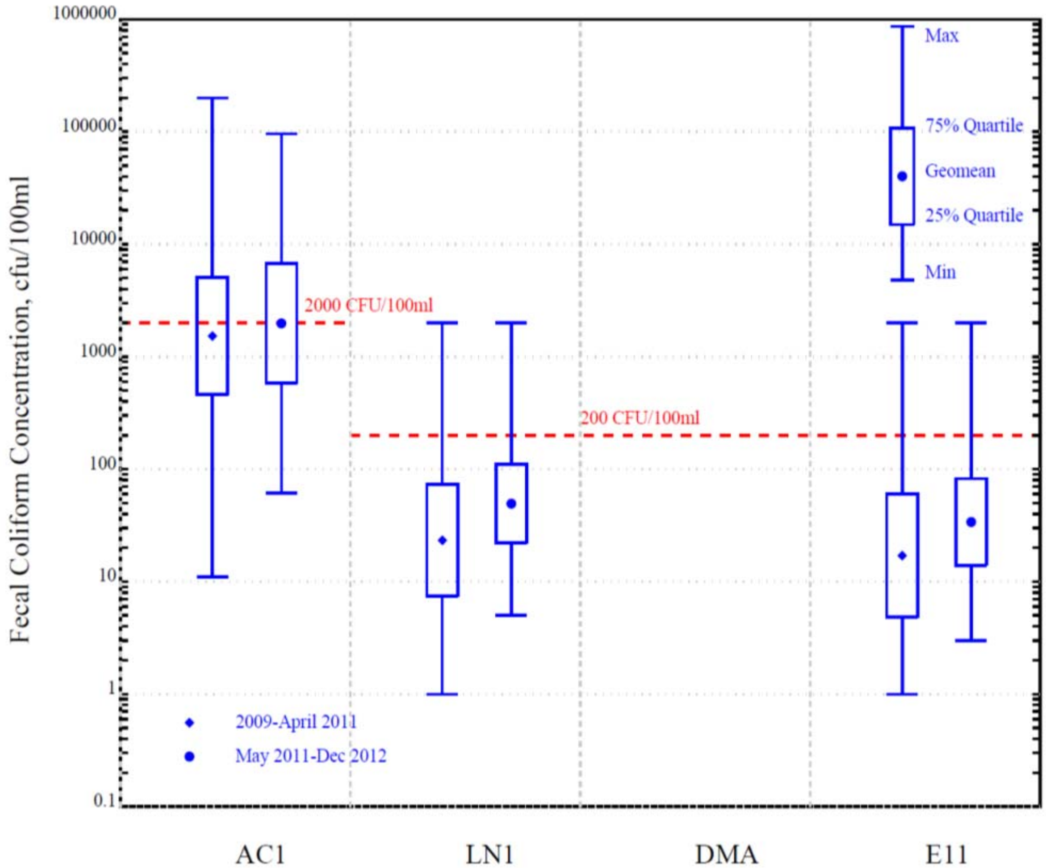


Figure 2-24. Bacterial Concentrations at Harbor Survey Monitoring Stations

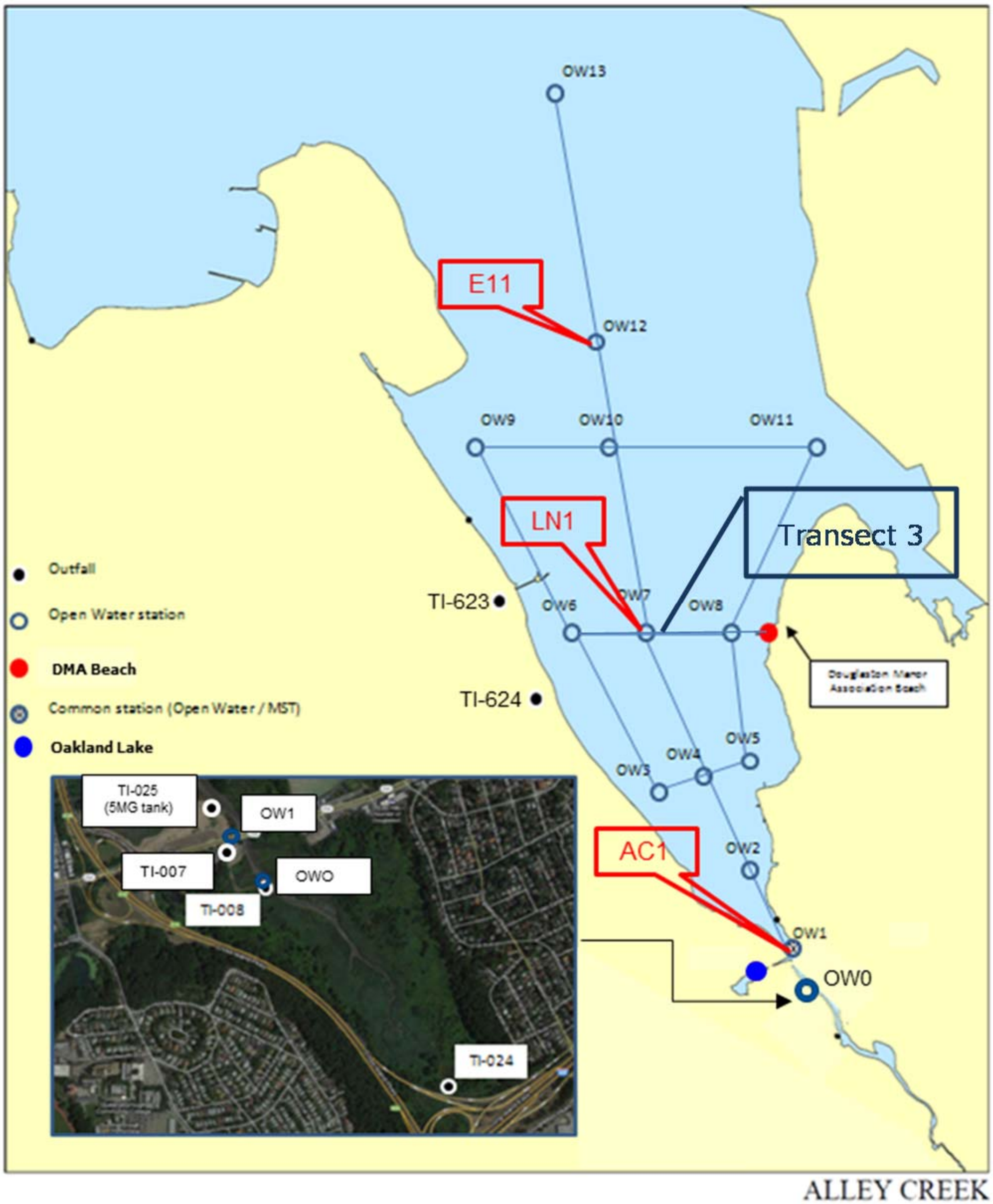


Figure 2-25. FSAP AND HSM Locations

The results of this sampling effort are provided in Figure 2-26 for enterococci for fecal coliform in wet weather and in Figure 2-27 in dry weather. As shown in Figure 2-26, there appears to be a gradient of pathogens from Alley Creek to the center portion of Little Neck Bay along the Bay centerline (Stations OW2, OW4 and OW7), along the eastern shoreline (OW2, OW5 and OW8) and along the western shoreline (OW2, OW3 and OW6). Locations further removed from Alley Creek (OW9 through OW13) appear to have pathogen concentrations that are almost equal and appear to be unrelated to gradient of elevated pathogens emanating from the Creek. Although these outer stations are elevated above dry weather concentrations (Figure 2-27), the lack of a gradient from the Creek outward indicates that these elevated concentrations above dry weather concentrations are likely associated with other sources of pathogens to the system that are impacting the greater East River and western Long Island Sound.

Similarly, the concentrations of pathogens at the DMA Beach shoreline that appear on Transect 3 (OW6, OW7, OW8 and DMA Beach) in close vicinity to Station OW8 are higher in wet weather than the Station OW8 concentrations suggesting a local source of pathogens in the DMA area.

Dissolved oxygen concentrations for the period of 2009 through April 2011 and May 2011 through the end of 2012 for Alley Creek and Little Neck Bay areas summarized in Figure 2-29. The graphic shows the surface DO concentrations in the upper panel and the bottom level DO concentrations in the lower panel. For the Alley Creek sampling locations (AC1) there is only a single DO reading taken (mid-depth), which is displayed in the upper panel. Dissolved oxygen concentrations are as shown in the graphic as the period mean, the 25^{th} percentile and 75^{th} percentile concentrations as well as the period minimum and maximum values.

Although there are some slight difference in the bay samples between the surface and bottom, it does not appear that the bay is stratified with respect to DO. The Bay also appears to be fairly uniform with respect to DO with the inner location at LN1 and the outer location E11 having very similar DO concentrations.

These data indicate that about 58 percent of the measured DO concentrations in the Bay at LN1 are greater than the Class SA chronic criteria of 4.8 mg/L and 89 percent of the measured samples have DO concentrations greater than the 3.0 mg/L acute criteria prior to May 2011. After May 2011, these values increase to 75 percent of the measurements being greater than 4.8 mg/L and 100 percent of the measurements being greater than 3.0 mg/L. Further out into the Bay at Station E11, these data indicate that about 84 percent of the measured DO concentrations are greater than the chronic criteria of 4.8 mg/L and 98 percent of the measured samples have DO concentrations greater than 3.0 mg/L prior to May 2011. After May 2011, these values change to 73 percent of the measurements being greater than 4.8 mg/L and 99 percent of the measurements being greater than 3.0 mg/L. It should be noted that the ERTM results confirmed that the low DO concentrations in Little Neck Bay are, in part, associated with the hypoxia and nutrient enrichment in western Long Island Sound and are not a result of CSO or stormwater sources.

DO concentrations at Station AC1 are more limited and prior to May 2011 all the data show concentrations that are greater than 4.0 mg/L. After May 2011, only 68 percent of the measurements were found to be greater than 4.0 mg/L.

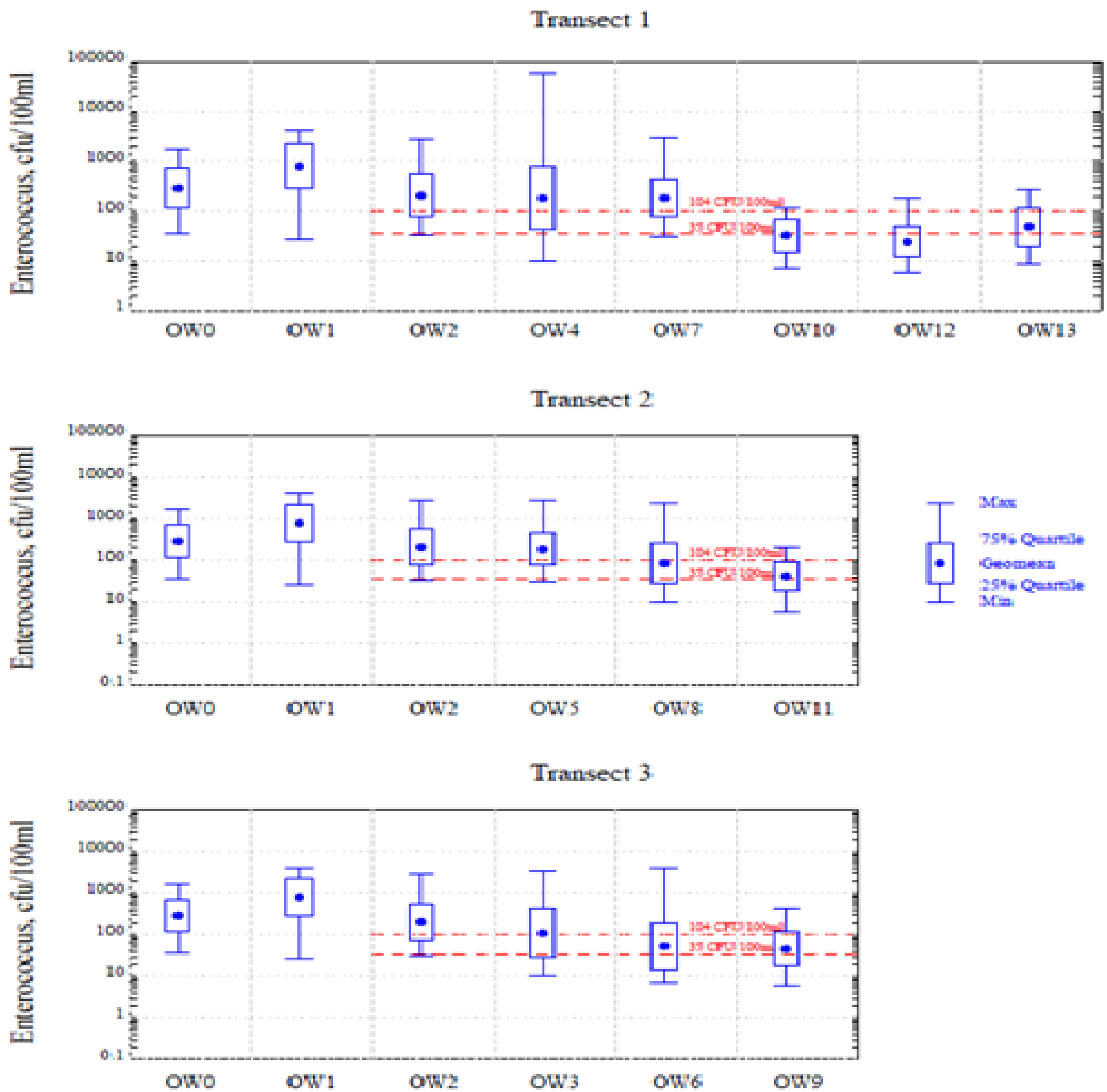


Figure 2-26. FSAP Wet Weather Bacterial Concentrations

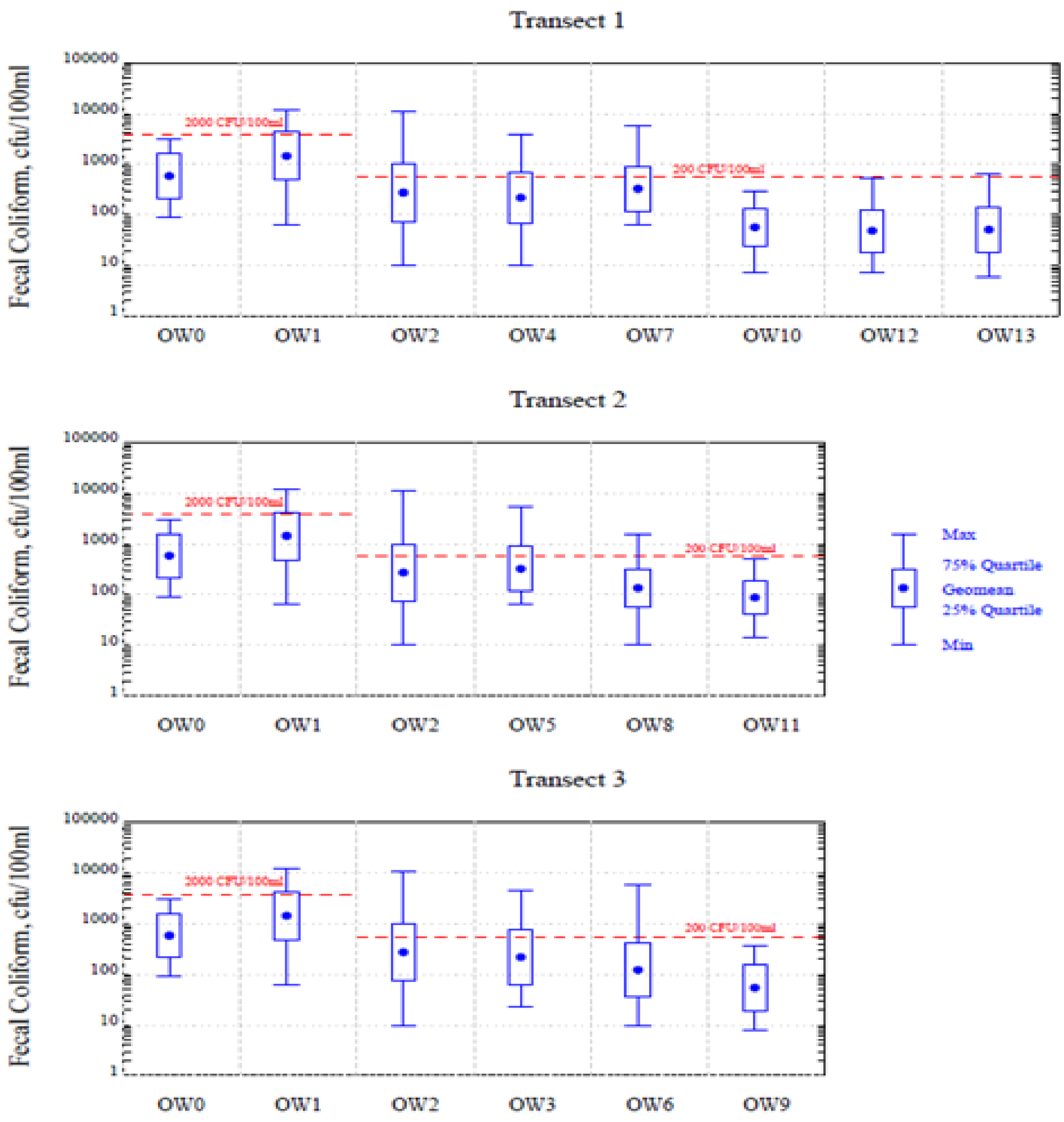


Figure 2-27. FSAP Wet Weather Bacterial Concentrations

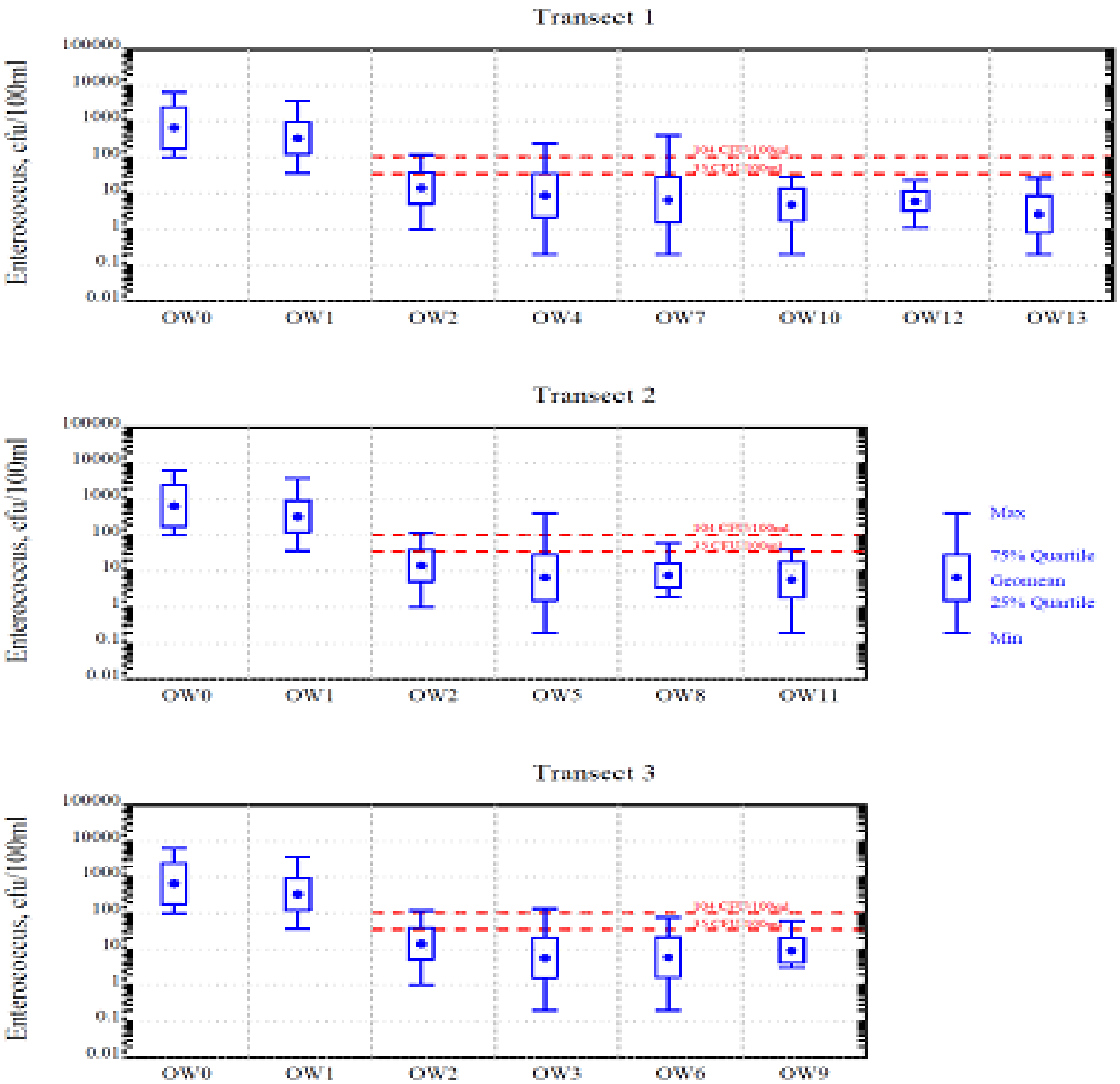


Figure 2-28. FSAP Dry Weather Bacterial Concentrations

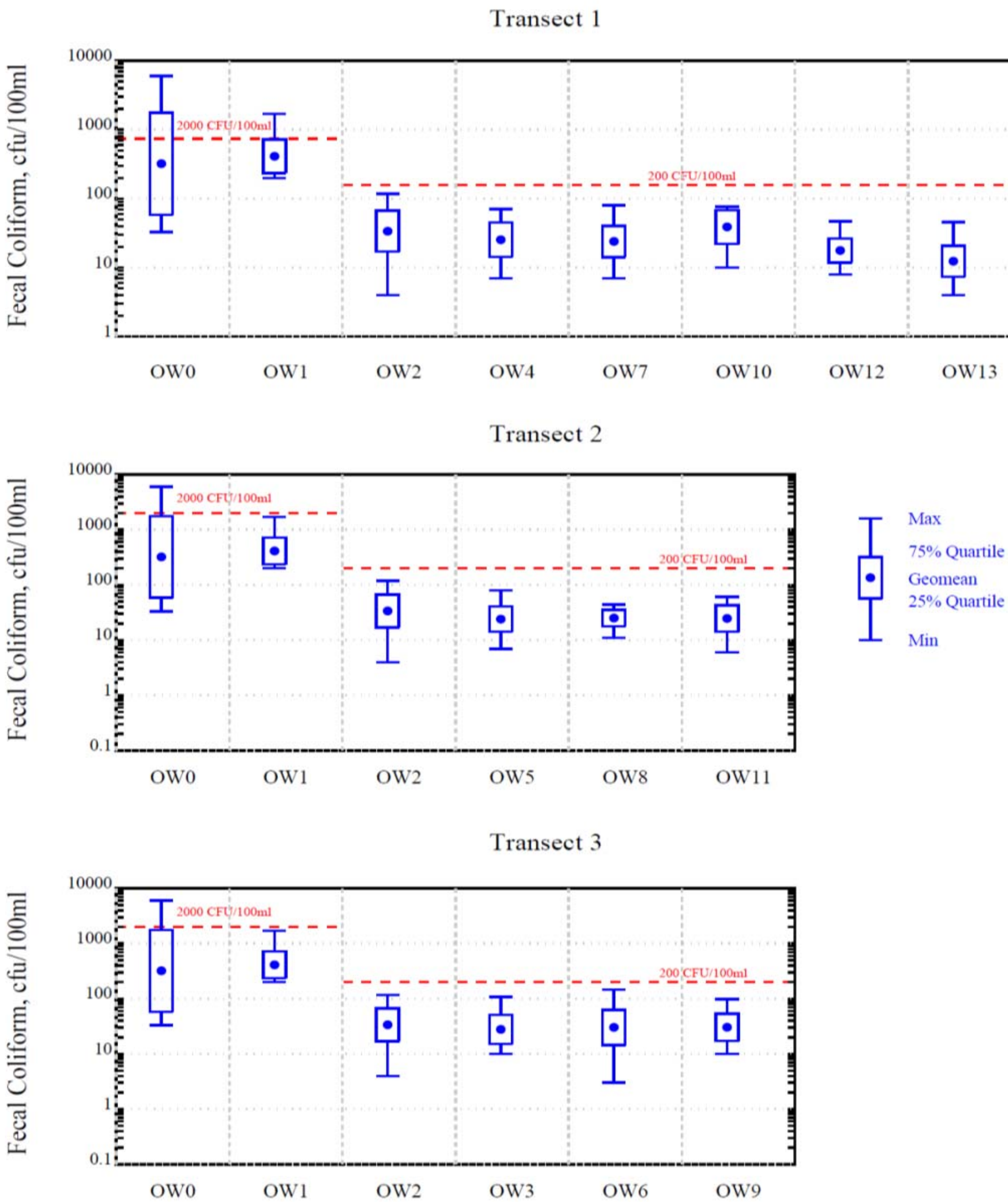


Figure 2-29. FSAP Dry Weather Bacterial Concentrations

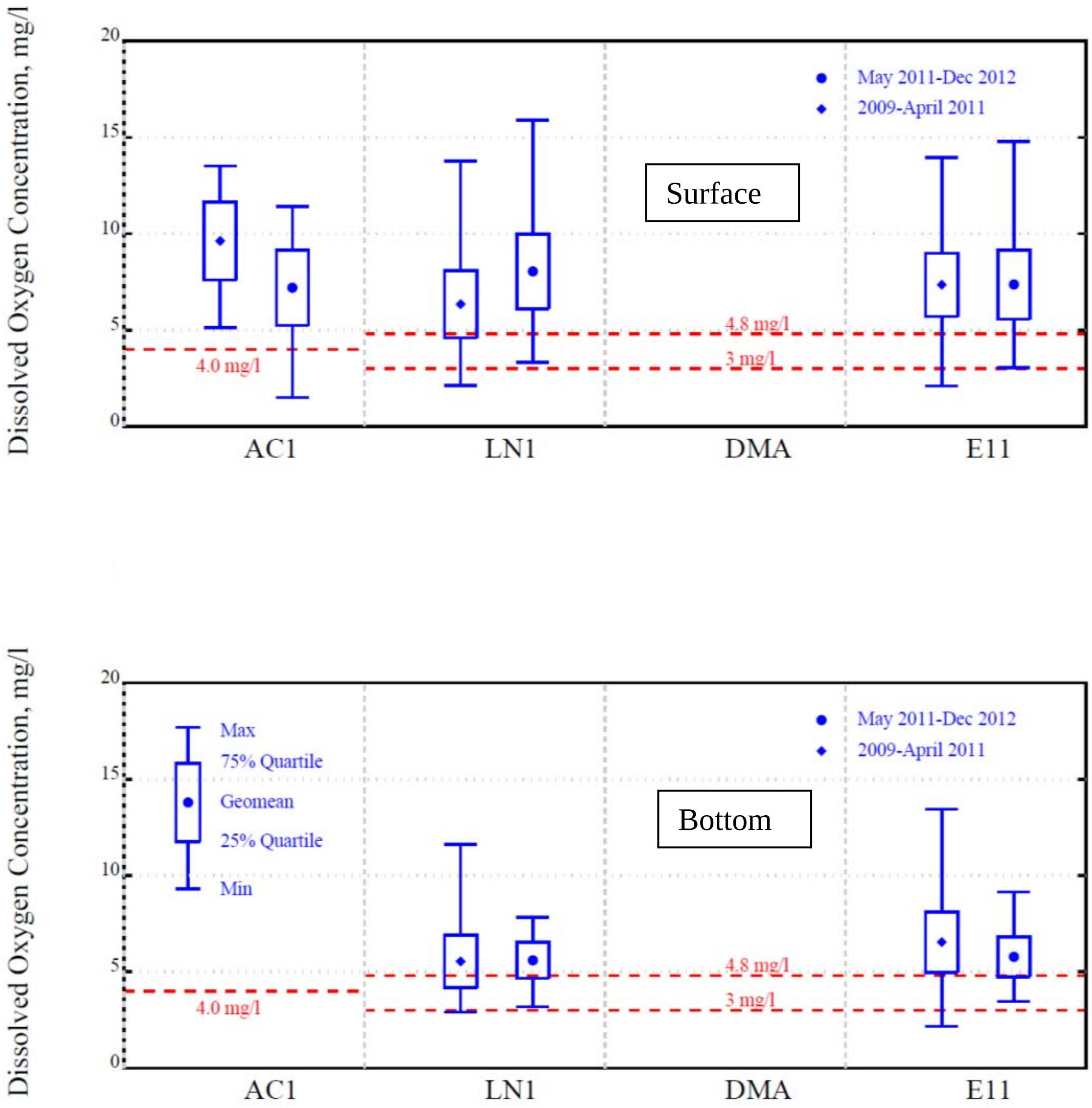


Figure 2-30. FSAP Dissolved Oxygen Concentrations

3.0 CSO BEST MANAGEMENT PRACTICES

The SPDES permits for all 14 WWTPs in New York City require DEP to report annually on the progress of the following 13 CSO BMPs:

1. CSO Maintenance and Inspection Program
2. Maximum Use of Collection Systems for Storage
3. Maximize Flow to POTW
4. Wet Weather Operating Plan
5. Prohibition of Dry Weather Overflow
6. Industrial Pretreatment
7. Control of Floatable and Settleable Solids
8. Combined Sewer Replacement
9. Combined Sewer Extension
10. Sewer Connection & Extension Prohibitions
11. Septage and Hauled Waste
12. Control of Runoff
13. Public Notification

These BMPs are equivalent to the Nine Minimum Controls (NMCs) required under the EPA National Combined Sewer Overflow Policy, which were developed by the EPA to represent BMPs 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 best available technology based controls that could be implemented within two years by permittees. EPA developed two guidance manuals that embodied the underlying intent of the NMCs for permit writers and municipalities, offering suggested language for SPDES permits and programmatic controls that may accomplish the goals of the NMCs (EPA 1995a, 1995b). A comparison of the EPA's NMCs to the 13 SPDES BMPs is as shown in Table 3-1.

This section is currently based on the practices summarized in the 2012 Best Management Practices Annual Report.

Table 3-1. EPA Nine Minimum Controls Compared to SPDES Permit BMPs

EPA NMC	SPDES BMP
NMC 1: Proper Operation and Regular Maintenance Programs for the Sewer System and the CSOs	BMP 1: CSO Maintenance and Inspection Program BMP 4: Wet Weather Operating Plan BMP 8: Combined Sewer Replacement BMP 9: Combined Sewer Extension BMP 10: Sewer Connection & Extension Prohibitions BMP 11: Septage and Hauled Waste
NMC 2: Maximum Use of the Collection System for Storage	BMP 2: Maximum Use of Collection Systems for Storage
NMC 3: Review and Modification of Pretreatment Requirements to Assure CSO Impacts are Minimized	BMP 6: Industrial Pretreatment
NMC 4: Maximization of Flow to the Publicly Owned Treatment Works for Treatment	BMP 3: Maximize Wet Flow to POTW BMP 4: Wet Weather Operating Plan
NMC 5:Prohibition of CSOs during Dry Weather	BMP 5: Prohibition of Dry Weather Overflow
NMC 6: Control of Solid and Floatable Material in CSOs	BMP 7: Control of Floatable and Settleable Solids
NMC 7: Pollution Prevention	BMP 6: Industrial Pretreatment BMP 7: Control of Floatable and Settleable Solids BMP 12: Control of Runoff
NMC 8: Public Notification	BMP 13: Public Notification
NMC 9: Monitoring to Effectively Characterize CSO Impacts and the Efficacy of CSO Controls	BMP 1: CSO Maintenance and Inspection Program BMP 5: Prohibition of Dry Weather Overflow BMP 6: Industrial Pretreatment BMP 7: Control of Floatable and Settleable Solids

This section presents 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 CSS, thereby reducing water quality impacts.

3.1 Collection System 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 events that cause discharge at outfalls during dry weather; and
- DEC review of inspection program reports.

Details of recent preventative and corrective maintenance reports can be found in the Appendices of the BMP Annual Reports.

3.2 Maximizing 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 in the BMP Annual Report, describing the status of City-wide SCADA, regulators, tide gates, interceptors, in-line storage projects, and collection system inspections and cleaning.

3.3 Maximizing Wet Weather Flow to WWTPs

This BMP addresses NMC 4 (Maximizing Flow to the Publicly Owned Treatment Works), and reiterates the WWTP operating targets established by the SPDES permits regarding the ability of the WWTP to receive and treat minimum flows during wet weather. The treatment plant shall be physically capable of: receiving a minimum of 2xDDWF through the plant headworks; a minimum of 2xDDWF through the primary treatment works (and disinfection works if applicable); and a minimum of 1.5xDDWF through the secondary treatment works during wet weather. The actual process control set points may be established by the Wet Weather Operating Plan (WWOP) required in BMP 4.

All of the City’s WWTPs are physically capable of receiving a minimum of twice their permit-rated design flow through primary treatment and disinfection or their DEC-approved Wet Weather Operating Plans. The maximum flow that can reach a particular WWTP is controlled by: (1) the regulators in the drainage area; (2) the storm intensities within different areas of the collection system; and (3) plant operators, who can restrict flow using “throttling” gates located at the WWTP entrance to protect the WWTP from flooding and process upsets. DEP’s operations engineers are trained on how to maximize pumped flows without impacting the treatment process, critical infrastructure, or public safety. For guidance, DEP’s operations engineers follow their plant’s DEC-approved WWOP, which specifies the “actual Process Control Set Points”, including average flow, as per Section VIII (3) and (4) of the SPDES permits. Analyses presented in the 2012 BMP report indicate that DEP’s facilities complied with this BMP during 2012.

3.4 Wet Weather Operating Plan

To maximize treatment during wet weather events, WWOPs were developed for each WWTP drainage area in accordance with the DEC publication entitled *Wet Weather Operations and Wet Weather Operating Plan Development for Wastewater Treatment Plants*. Components of the WWOPs include:

- 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 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 Tallman Island WWTP WWOP, which includes the Alley Creek CSO Tank WWOP, was approved by DEC in September 2011. Revisions to the Tallman Island WWOP were submitted to DEC in July 2011, with DEC approval of the revisions still pending.

3.5 Prohibition of Dry Weather Overflows

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 BMP Annual Report.

Dry weather overflows from the CSS are prohibited and DEP's goal is to reduce and/or eliminate dry weather bypasses. An examination of the data for regulators, pump stations and WWTP's revealed that there was no dry weather bypassing to Alley Creek or Little Neck Bay during 2012.

3.6 Industrial Pretreatment Program

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 CSS and permitting of direct discharges of cooling water; and
- Prioritization of industrial waste containing toxic pollutants for capture and treatment by the WWTP over residential/commercial service areas.

Since 2000, the average total industrial metals loading to NYC WWTPs has been declining. As described in the 2012 BMP Annual Report, the average total metals discharged by all regulated industries to the NYC WWTPs was 12.8 lb/day, and the total amount of metals discharged by regulated IUs remained very low. Applying the same percentage of CSO bypass (1.5 percent) from the CSO report to the current data, it appears that, on average, less than 0.2 lb/day of total metals from year 2012 regulated industries were bypasses to CSOs (DEP, 2012a). Over the years, the total amount of metals being discharged by regulated IUs has declined.

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 the following four practices to eliminate or minimize the discharge of floating solids, oil and grease, or solids of sewage origin that cause deposition in receiving waters:

- Catch Basin Repair and Maintenance: This practice includes inspection and maintenance scheduled 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, City-wide.

- 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 also established.

- Institutional, Regulatory, and Public Education: 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.

3.8 Combined Sewer 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 (DOH) and to be specified within DEP's Master Plan for Sewage and Drainage. Whenever possible, separate sanitary and storm sewers should be used to replace combined sewers. The BMP Annual Report describes the general City-wide plan, and addresses specific projects occurring in the reporting year. No projects are reported for the Tallman Island WWTP service area in the Best Management Practices 2012 Annual Report.

3.9 Combined Sewer Extension

To minimize storm water entering the CSS, this BMP requires combined sewer extensions to be accomplished using separate sewers whenever possible. If separate sewers must be extended from combined sewers, analyses must be performed to demonstrate 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 BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls); a brief status report is provided in the Best Management Practices 2012 Annual Report, although no combined sewer extension projects were completed during that year.

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 CSS downstream of the last regulator or diversion chamber are also prohibited. The 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 2012, conditions did not require DEP to prohibit additional sewer connections or sewer extensions.

3.11 Septage and Hauled Waste

The discharge or release of septage or hauled waste upstream of a CSO (e.g., 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 2008 CSO BMP

Annual Report summarizes the three scavenger waste acceptance facilities controlled by DEP and the regulations governing discharge of such material at the facilities. The facilities are located in the Hunts Point, Oakwood Beach and 26th Ward WWTP service areas. The program remained unchanged through the 2011 CSO BMP Annual report.

3.12 Control of Runoff

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.

A rule to "reduce the release rate of storm flow from new developments to 10 percent of the drainage plan allowable or 0.25 cfs, whichever is higher (for cases when the allowable storm flow is more than 0.25 cfs)," was promulgated on January 4, 2012, and became effective on July 4, 2012.

3.13 Public Notification

BMP 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).

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 DOHMH to implement and manage the notification program. Accordingly, the Wet Weather Advisories, Pollution Advisories and Closures are tabulated for all NYC public and private beaches. DMA Beach, a private beach on Little Neck Bay, was closed a total of 81 days and had Pollution Advisories posted for a further 23 days during the 2011 bathing season due to localized elevated bacteria levels.

3.14 Characterization and Monitoring

Previous studies have characterized and described the Tallman Island WWTP collection system and the water quality for Alley Creek and Little Neck Bay (see Chapters 3 and 4 of the Alley Creek and Little Neck Bay WWFP, 2009). Additional data was collected and are analyzed in this LTCP (see Section 2.2). Continuing monitoring occurs under a variety of DEP initiatives, such as floatables monitoring programs and DEP Harbor Survey, and is reported in the BMP Annual Reports under SPDES BMPs 1, 5, 6 and 7, as described above.

3.15 CSO BMP Report Summaries

In accordance with the SPDES permit requirements, annual reports summarizing the City-wide implementation of the 13 BMPs described above are submitted by April 1, 2013 to DEC. DEP has submitted ten annual reports to date, covering calendar years 2003 through 2012. Typical reports are divided into 13 sections, one for each of the BMPs in the SPDES permits. Each section of the annual reports describes ongoing DEP programs, provides statistics for initiatives occurring during the preceding calendar year, and discusses overall environmental improvements.

4.0 GREY INFRASTRUCTURE

4.1 Status of Grey Infrastructure Projects Recommended in Facility Plans

CSO Facility Planning for Alley Creek and Little Neck Bay began in 1984, predating the current LTCP program. Evaluation of the Tallman Island WWTP collection system showed that outfall TI-008 was a major source of CSO discharges to these waterbodies. To address CSO discharges, DEP developed and modified several facility plans including the 2003 Alley Creek CSO Facility Plan (URS, 2003) and the 2009 Alley Creek and Little Neck Bay WWFP. The 2003 Alley Creek CSO Facility Plan proposed to reduce discharges from TI-008 by diverting the flow through a new chamber to a new 5 MG CSO Retention Tank and its new CSO outfall TI-025, located in Alley Creek. The 2009 WWFP recommended retaining the proposed Alley Creek CSO Facilities Plan, the Alley Creek Retention Tank and outfall TI-025. A summary of the grey infrastructure elements of the WWFP are listed as follows:

- New diversion chamber (Chamber 6) to direct CSO to the new Alley Creek CSO Retention Tank and to provide tank bypass to TI-008
- New CSO Retention Tank (5 MG Alley Creek Tank)
- New 1,475 foot long multi-barrel outfall sewer extending to a new outfall on Alley Creek (TI-025)
- New CSO outfall, TI-025, for discharge from the Alley Creek Tank
- Fixed baffle at TI-025 for floatables retention, minimizing release of floatables to Alley Creek
- Upgrade of Old Douglaston Pump Station to empty tank and convey flow to Tallman Island WWTP after the end of the storm

4.1.a Completed Projects

The Alley Creek CSO Retention Tank was operational as of March 11, 2011. DEP certified construction completion of the facilities on June 27, 2011. DEC accepted DEP's certification of completion on September 25, 2012.

4.1.b Ongoing Projects

There are no additional grey infrastructure projects currently in progress.

4.1.c Planned Projects

No additional grey infrastructure projects are planned for the Alley Creek and Little Neck Bay watersheds for the reasons explained in Sections 6 and 8 of this LTCP.

4.2 Other Water Quality Improvement Measures Recommended in Facility Plans (dredging, floatables, aeration)

There are no other water quality improvement measures planned for Alley Creek and Little Neck Bay.

4.3 Post-Construction Monitoring

The Post-Construction Compliance Monitoring Program is integral to the optimization of the Alley Creek CSO Retention Tank, providing data for model validation, feedback to facility operations, and an assessment metric for the effectiveness of the facilities. Each year's data set will be compiled and evaluated to refine the understanding of the interaction between Alley Creek, Little Neck Bay, and the Alley Creek CSO Retention Tank, with the ultimate goal of fully attaining compliance with current WQS or for supporting a UAA to revise such standards. The data collection monitoring will contain three basic components:

1. The Alley Creek CSO Retention Tank WWOP as appended to Tallman Island WWTP WWOP;
2. Receiving water data collection in Alley Creek and Little Neck Bay using existing DEP Harbor Survey locations and adding stations as necessary; and
3. Modeling of the associated receiving waters to characterize water quality.

The details provided herein are limited to the Alley Creek and Little Neck Bay 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 DEC for review and approval as described in Section 9.5.

4.3.a Collection and Monitoring of Water Quality in Receiving Water

Post-construction compliance monitoring for the Alley Creek CSO Retention Tank consists of sample collection at one location in Alley Creek (Station AC1) and one location in Little Neck Bay (Station LN1). In addition, DEP collected water quality samples at two other locations in the affected water body during November and December 2012: near the mouth of Alley Creek (Stations OW0 and OW1), and in Little Neck Bay near Station LN1 (Station OW2). Figure 4-1 presents a map of these station locations.

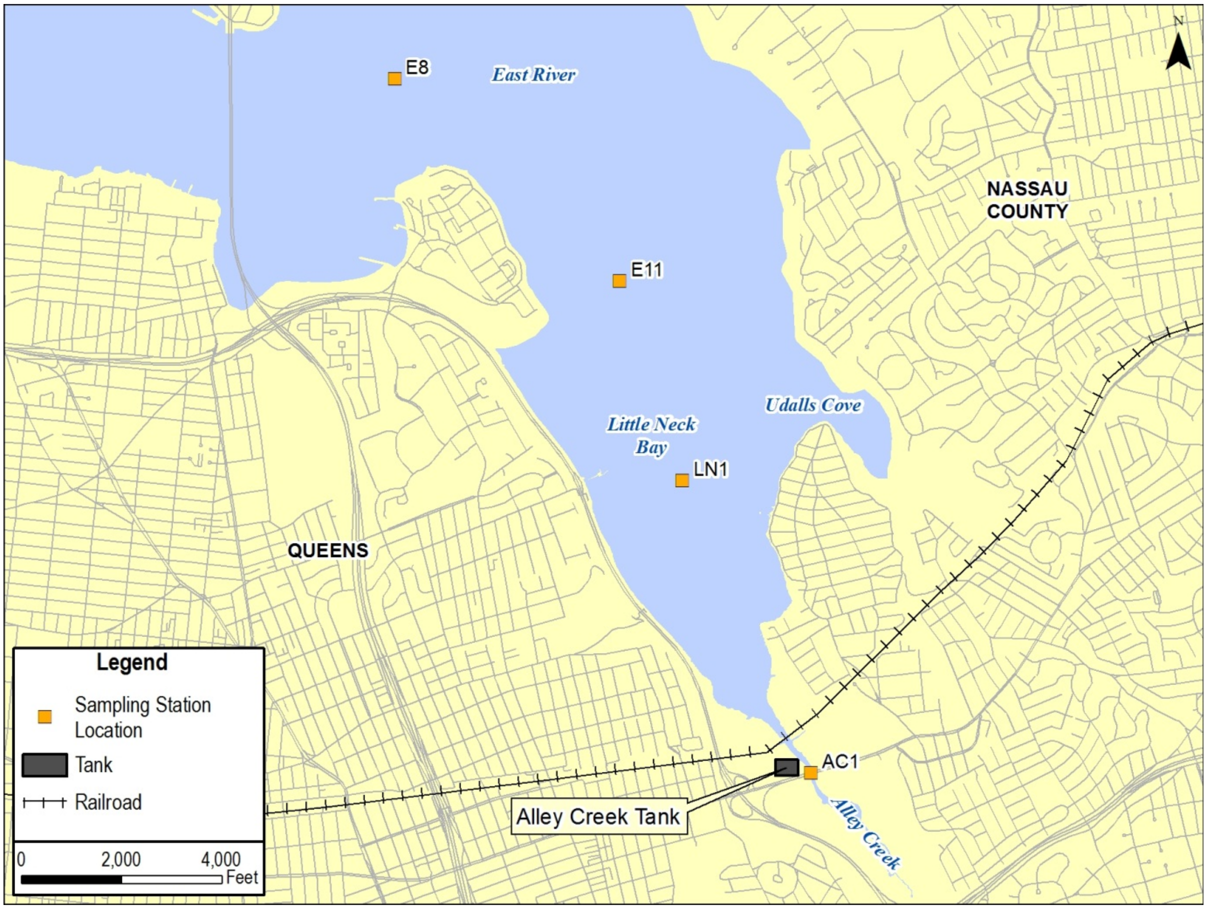


Figure 4-1. Alley Creek CSO Retention Tank
Location of Facility and Water-Quality Monitoring Stations

The Alley Creek and Little Neck Bay monitoring results are provided on Figures 4-2 through 4-5. The results are shown for DO, fecal coliform bacteria, enterococci bacteria, and TSS, respectively. The top panel of each figure shows the daily rainfall for 2012 (at LaGuardia Airport). The second presents the reported overflow volumes discharged from the Alley Creek CSO Retention Tank during the same period. The third panel shows the measured constituent concentrations for the stations in Alley Creek, and the bottom panel shows the measured constituent concentrations for the stations in Little Neck Bay. Applicable NYS WQS (Class I for Alley Creek and SB for Little Neck Bay) are also shown.

On Figure 4-2, the DO-monitoring results for Alley Creek show occasional excursions below the standard (4.0 mg/L) from July through October. In Little Neck Bay, DO values are generally above the chronic standard of 4.8 mg/L, one measurement in June and three sampling events during mid-August to early-September. All DO measurements in Little Neck Bay were above the acute standard of 3.0 mg/L.

Figure 4-3 presents the fecal coliform concentrations measured in Alley Creek and Little Neck Bay. Discrete values in Alley Creek are often above the GM standard (2,000 No./100mL), with the majority of high concentrations occurring during the summer. In Little Neck Bay, most discrete measurements are below the GM standard of 200 No./100mL. The few discrete measurements above the standard occurred during August, November and December.

As shown on Figure 4-4, enterococci levels in Alley Creek are generally elevated with many values above 1,000 No./100mL and some values above 10,000 No./100mL. In Little Neck Bay, most samples are less than 10 No./100mL but there are a number of values above 35 No./100mL during November and December.

Figure 4-5 presents the results of TSS sampling in Alley Creek and Little Neck Bay. TSS concentrations in Alley Creek are quite variable with some measurements greater than 150 mg/L. Measured TSS concentrations are generally below 25 mg/L in Little Neck Bay with a few higher values during August and September.

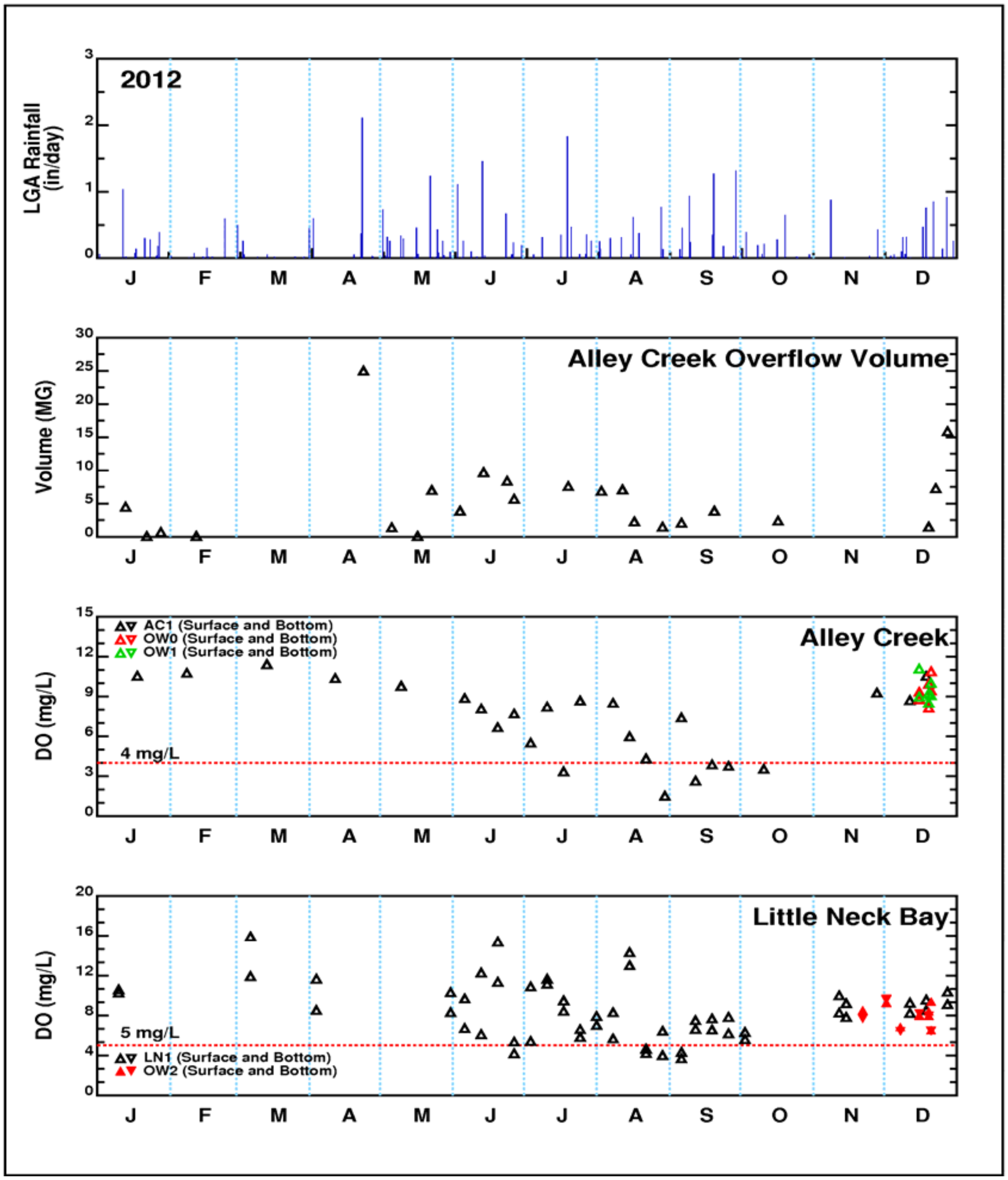


Figure 4-2. Alley Creek CSO Retention Tank Ambient Water-Quality Monitoring – Dissolved Oxygen, 2012

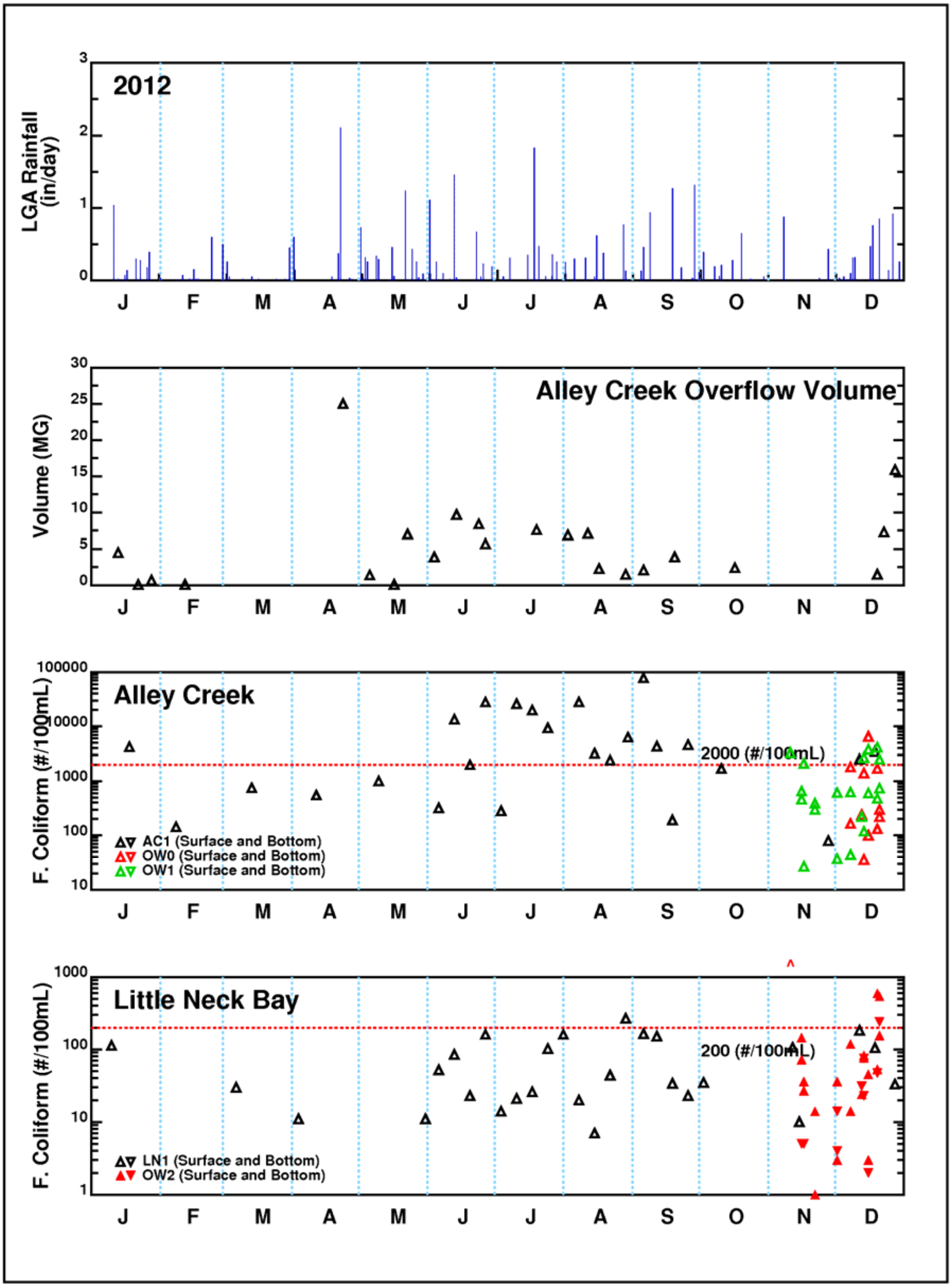


Figure 4-3. Alley Creek CSO Retention Tank
Ambient Water-Quality Monitoring – Fecal Coliform Bacteria, 2012

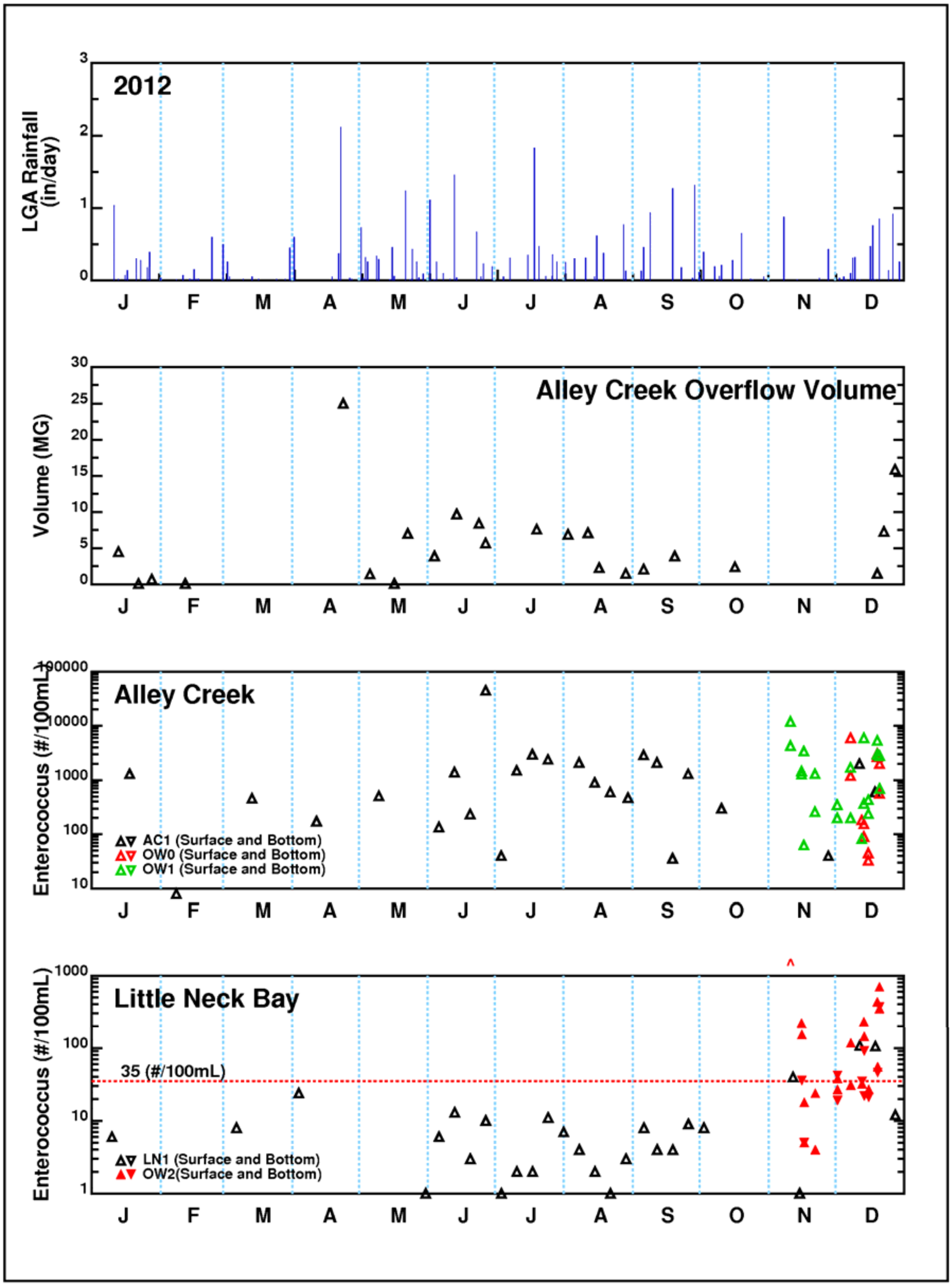


Figure 4-4. Alley Creek CSO Retention Tank
Ambient Water-Quality Monitoring – Enterococci Bacteria, 2012

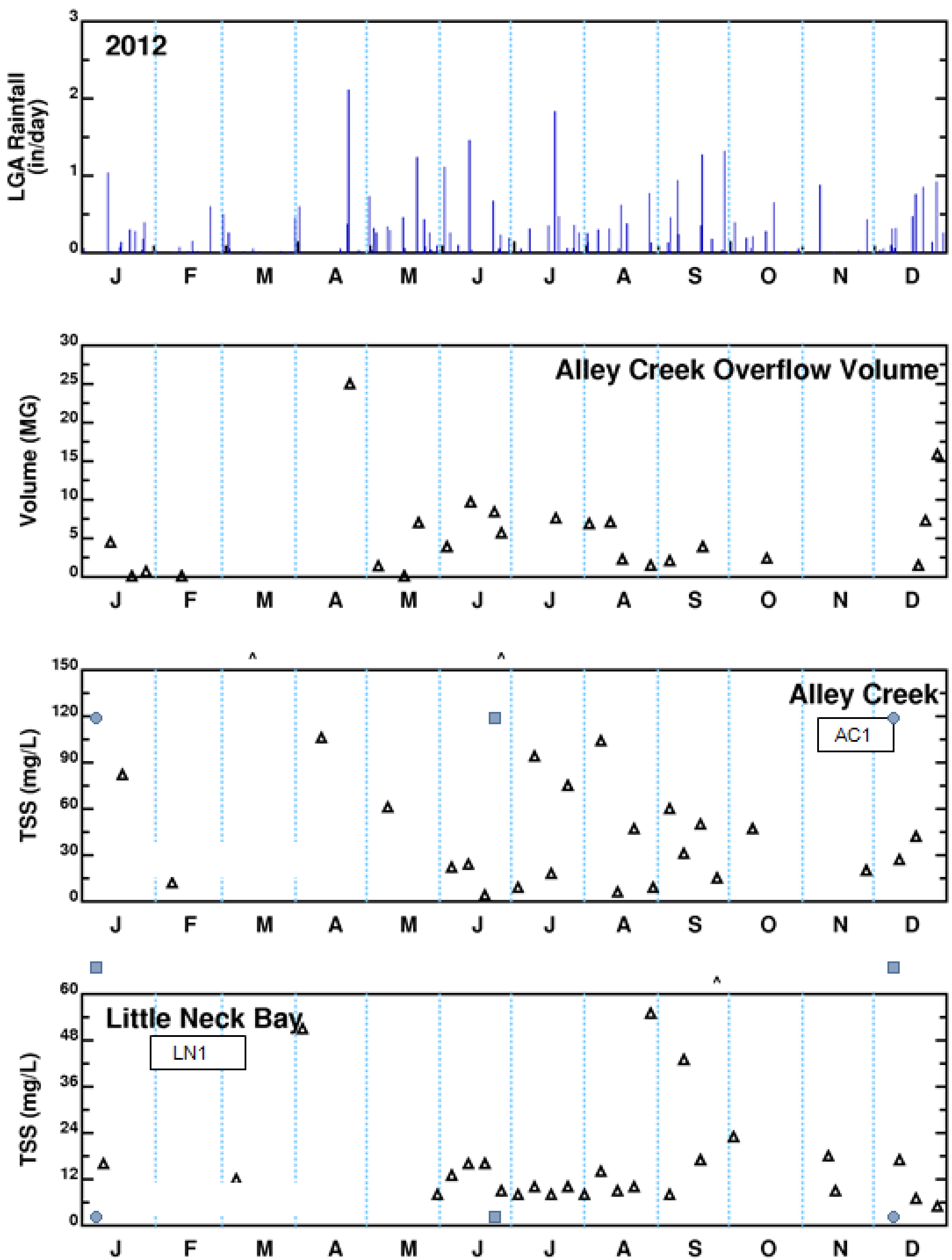


Figure 4-5. Alley Creek CSO Retention Tank
Ambient Water-Quality Monitoring – TSS, 2012

4.3.b CSO Facilities Operation – Flow Monitoring and Effluent Quality

Flow Monitoring

DEP monitors water-surface elevations and pumped volumes over time at the Alley Creek CSO Retention Tank. Based on these measurements and other information, DEP estimates daily inflow and infiltration (I/I), wet weather retained volume, pumpback volume, and overflow periods and overflow volumes. Tables 4-1 and 4-2 present a summary of the monthly and per-overflow-event estimates, respectively. Monthly monitoring data are also summarized graphically on Figure 4-6 (monthly total retained volume pumped back for treatment) and 4-7 (monthly overflow volume).

Analysis[1] of rainfall data recorded at the National Weather Service's LaGuardia Airport (LGA) gauge indicates that, with 125 storms totaling 36.18 inches, 2012 had less total rainfall and smaller storms than the long-term average in New York City. Monthly rainfall ranged from 0.91 to 5.06 inches. As summarized in Table 4-2, the Alley Creek tank overflowed during 25 storm events in 2012, meaning that the tank fully captured flow generated during the other 100 rainfall events (80 percent) in 2012. DEP reported that the tank retained a total of 256 MG of combined sewage for pumpback and treatment at the Tallman Island WWTP.

Table 4-1. Alley Creek CSO Retention Tank –
Estimated Monthly Retained Volume and Overflows, 2012

Month	Rain at LGA (in)	Monthly Information		
		Retained Volume (MG)	Overflow Events (Count)	Overflow Volume (MG)
January	2.51	16	4	5
February	1.43	10	1	0
March	0.91	11	0	0
April	3.18	14	1	25
May	4.67	34	3	9
June	4.19	27	4	28
July	3.77	23	1	8
August	2.95	32	4	18
September	5.06	29	3	6
October	1.86	18	1	2
November	1.35	15	0	0
December	4.30	26	3	25
Totals:	36.18	256	25	125

(1) From Monthly Operation Reports

[1] Analyses of rainfall statistics performed using EPA's SYNOP program using minimum inter-event time of 4 hours and minimum storm threshold of zero inches.

Table 4-2. Overflow-Event Timing and Hours Since Prior Storm, Alley Creek CSO Retention Tank, 2012

	Overflow Event at Alley Creek Tank		Rain Event at LaGuardia Airport[1]			Hours Since Prior Rain[4]
Overflow No.	Start Mo/Da Hr:Mn	End Mo/Da Hr:Mn	Start Mo/Da Hr:Mn	End Mo/Da Hr:Mn	Rainfall (inch)[2]	
1	01/11 07:25	01/11 18:44	01/11 23:00	01/12 14:00	**1.04**	241
2	01/21 12:17	01/21 22:50	01/21 04:00	01/21 14:00	0.30	83
3	01/22 11:24	01/22 16:05	[3]	[3]	0.00[3]	**21**
4	01/27 11:32	01/28 07:58	01/27 08:00	01/27 14:00	0.39	**7**
5	02/11 12:04	02/11 16:15	02/11 04:00	02/11 11:00	0.07[3]	52
6	04/22 19:04	04/23 18:00	04/22 11:00	04/23 08:00	**2.11**	**9**
7	05/04 07:00	05/04 13:52	05/04 05:00	05/04 07:00	0.26	**25**
8	05/15 16:13	05/16 01:20	05/15 11:00	05/15 16:00	**0.46**	**19**
9	05/21 10:21	05/22 05:32	05/21 09:00	05/22 07:00	**1.24**	122
10	06/02 01:32	06/02 08:58	06/02 00:00	06/02 09:00	**1.11**	73
11	06/12 23:36	06/13 13:44	06/12 12:00	06/13 04:00	**1.46**	56
12	06/22 15:26	06/23 10:58	06/22 14:00	06/23 04:00	**0.67**	217
13	06/25 17:07	06/26 01:31	06/25 16:00	06/25 19:00	0.23[3]	**6**
14	07/18 16:49	07/19 01:10	07/18 15:00	07/18 19:00	**1.83**	64
15	08/01 11:58	08/01 21:17	08/01 13:00	08/01 16:00	0.14	**4**
16	08/10 13:00	08/10 21:57	08/10 12:00	08/10 14:00	0.31[3]	104
17	08/15 14:12	08/16 04:23	08/15 13:00	08/15 21:00	**0.62**	**24**
18	08/27 13:25	08/27 20:06	08/27 12:00	08/27 14:00	**0.77**	218
19	09/04 12:14	09/04 20:35	09/04 11:00	09/04 22:00	0.13	**9**
20	09/05 11:42	09/05 20:44	09/05 09:00	09/05 13:00	**0.46**	**6**
21	09/18 22:58	09/19 05:12	09/18 19:00	09/18 23:00	**1.27**	**8**
22	10/15 19:07	10/16 02:28	10/15 17:00	10/15 20:00	0.28[3]	128
23	12/18 01:47	12/19 00:17	12/17 22:00	12/18 06:00	**0.76**	**14**
24	12/21 07:04	12/22 01:06	12/21 00:00	12/21 11:00	**0.85**	54
25	12/26 22:09	12/28 07:14	12/26 17:00	12/27 11:00	**0.92**	**34**

(1) Statistics generated using EPA SYNOP program with 4-hr inter-event time and zero minimum rain threshold.
(2) Bold rain events are 0.46 inch or more and are therefore expected to fill or exceed the tank capacity.
(3) Radar shows the facility drainage area received up to: 0.75 inches on 1/21; 0.20 inches on 2/11; 1.50 inches on 6/25; 0.75 inches on 8/10; and 0.50 inches on 10/15.
(4) Bold values reflect less than the 36 hours required to dewater the tank, subject to available capacity in the collection system and at Tallman Island WWTP. (Date and time of prior rain not shown in this table.)

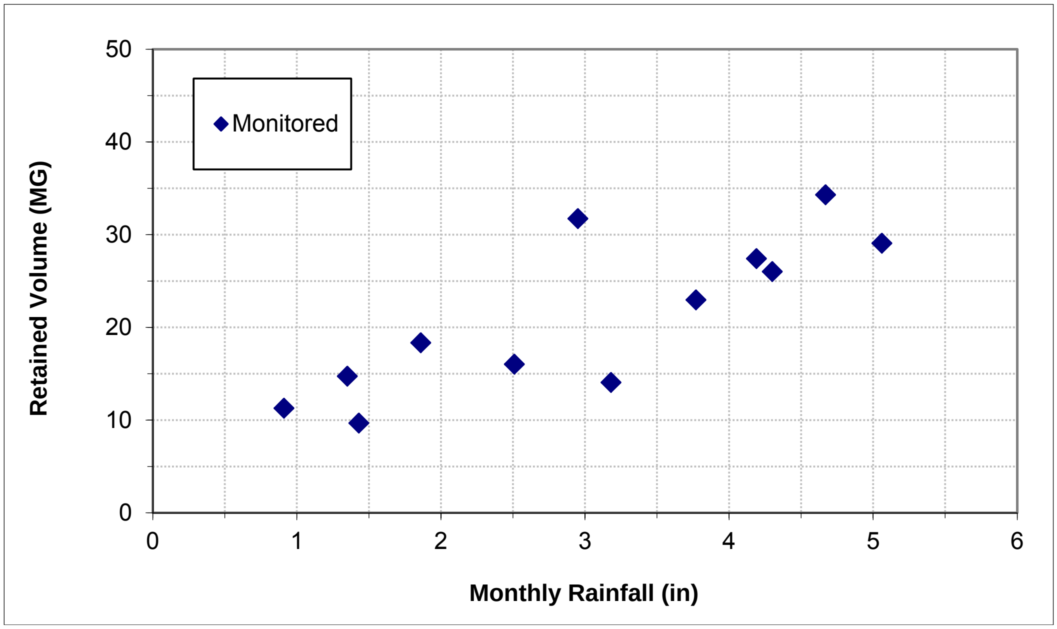


Figure 4-6. Monthly Retained Volume vs. Rainfall, Alley Creek CSO Retention Tank, 2012

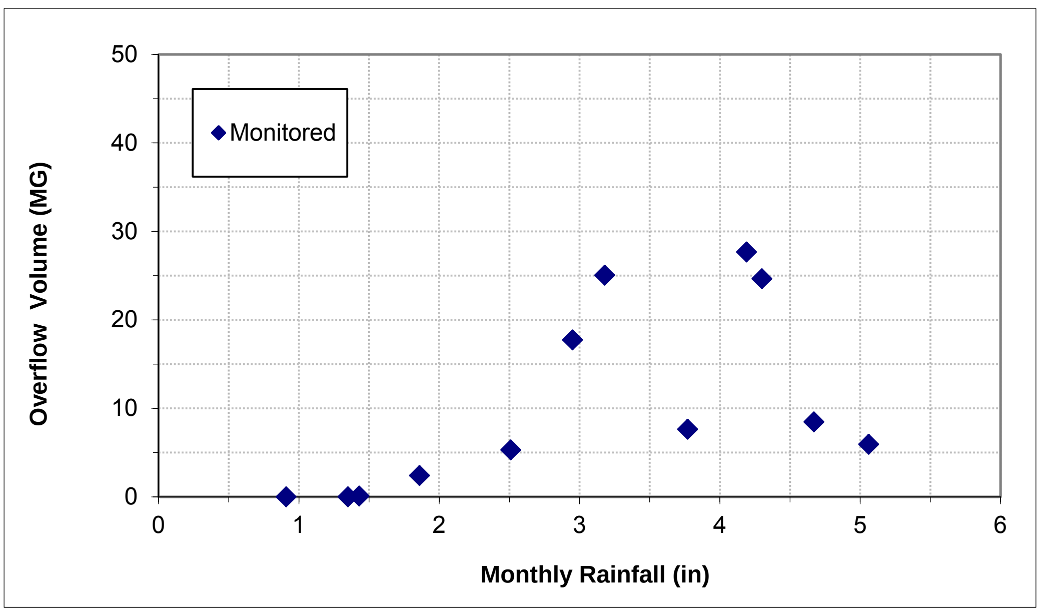


Figure 4-7. Monthly Overflow Volume vs. Rainfall, Alley Creek CSO Retention Tank, 2012

Even during dry weather, the Alley Creek Retention Tank collects a combination of I/I from the influent sewers and seepage. To quantify the I/I, DEP tracks the water-surface elevations in the tank cells and estimates[2] the overall I/I on a daily and monthly basis. The I/I estimates are summarized in the facility monthly operating reports. In 2012, the average I/I rate was 0.55 MGD, with monthly average values ranging from 0.00 to 0.91 MGD and a highest daily estimate of 4.4 MGD (following a large storm event). The Alley Creek tank is operated such that I/I volumes are pumped back to the WWTP prior to anticipated wet weather events to minimize the impact on wet weather capture of combined sewage at the facility.

Effluent Quality

Overflow effluent quality was not measured at the Alley Creek CSO Retention Tank during any overflow events in 2012 as there is no requirement in the SPDES permits to monitor overflow quality nor is the facility manned. Contained volumes are collected from the tank during dewatering and all flows and associated pollutants after leaving the tank are pumped through the Old Douglaston Pump Station into the interceptor and on to the Tallman Island WWTP.

Effluent quality was, however, sampled as part of the development of the LTCP. Two CSO Retention Tank overflows were sampled on December 18, 2012, and January 31, 2013. Inadequate laboratorial dilutions applied did not allow a complete count; therefore, results for the samples collected on December 18, 2012, are not representative of the typical bacterial densities of CSOs.

Bacterial concentrations of Enterococci and Fecal Coliform were obtained from Outfall TI-025 during the January 31, 2013, tank overflow event. The bacterial densities obtained and computed GMs are shown in Table 4-3.

Table 4-3.TI-025 Alley Creek Retention Tank Overflow Bacterial Concentrations.

Alley Creek Tank Overflow (TI-025)			cfu/100 ml
01-31-13 Wet Weather event	7:45 A.M.	Enterococci	57,273
		Fecal coliform	390,000
	8:15 A.M.	Enterococci	580,000
		Fecal coliform	480,000
	8:45 A.M.	Enterococci	570,000
		Fecal coliform	440,000
	9:15 A.M.	Enterococci	420,000
		Fecal coliform	560,000
	9:45 A.M.	Enterococci	430,000
		Fecal coliform	510,000
	GM	Enterococci	**321,214**
		Fecal coliform	**472,393**

1) GM do not include results reported as the upper detection limit of the laboratorial analysis.

[2] For the Alley Creek facility, DEP's monthly reporting indicates that "Estimated I&I Volume on dry weather days= pump back volume + change in the total retained volume (7:00 a.m.-7:00 a.m.)".

4.3.c Assessment of Performance Criteria

The 2003 CSO Abatement Facilities Plan for Alley Creek set forth the basis of design for the Alley Creek CSO Retention Tank. Specifically, the design objectives were to meet, to the extent feasible and practical, DEC Class I water-quality criteria for dissolved oxygen and for total and fecal coliforms in Alley Creek by reducing the volume of CSOs discharged to Alley Creek. The Facility Plan states that dissolved oxygen represents the primary parameter of concern, as CSO control alone is not cost effective to meet the bacteria criteria. The Facility Plan also lists as a secondary objective, independent of CSO abatement, the alleviation of surcharging and street flooding in the area upstream of outfall TI-008. This report focuses on the first objective.

The Facility Plan stated that the Alley Creek CSO Retention Tank will, through its 5 MG storage capacity, capture 100 percent of combined sewage generated by storms up to about 0.46 inches total precipitation. This storage capacity was expected to fully capture combined sewage generated in the facility drainage area from 70 percent of the storms that occur on an annual basis, and to reduce discharges by about 54 percent in terms of annual average CSO volume, 70 percent in terms of TSS loading, and 66 percent in terms of BOD loading, as well as reductions in floatables and pathogens. Under facility planning conditions (the modeling period of June through September 1990), modeling analyses indicate that the minimum DO concentrations in the creek will increase by about 1.17 mg/L, to 3.46 mg/L from 2.29 mg/L, and that average DO concentrations in the creek will increase by about 0.33 mg/L, to 5.97 mg/L from 5.64 mg/L.

CSO Storage

Analysis[3] of the 2012 rainfall records at LGA indicates that there were 125 rainfall events, of which 25 had more than 0.46 inches of rain (the approximate design storm for the Alley Creek CSO Retention Tank). Based on this information and the operational records in the monthly operating reports, the Alley Creek CSO Retention Tank fully captured combined sewage generated in 100 of the 125 storms, or 80 percent of all storms in 2012.

Table 4-2 lists the start and end times of each of the 25 overflow events in 2012, along with the corresponding rainfall characteristics as measured at LGA. Rainfall at LGA exceeded the 0.46-inch design capacity of the facility during 15 of these overflow events, and inspection of radar information indicates that 0.46 inches or more likely occurred over the service area during another 4 overflow events (January 21, February 11, August 10, and October 15). Another 6 overflow events occurred during storms that began within 36 hours of prior rainfall so that there was insufficient time for the tank to fully dewater. As a result, the facility met the CSO-storage metric for 124 of the 125 storms in 2012.

IW modeling performed for the 2012 period indicates that, compared to the pre-tank condition, operation of the Alley Creek CSO Retention Tank reduced the number of CSO events 73 percent, which is just above the annual-average target of 70 percent. In terms of CSO volume, operation of the tank is calculated to have reduced discharge volume by 73 percent, which exceeds the annual-average volume reduction target of 54 percent.

CSO Pollutant-Load Reduction

Based upon the IW modeling analyses, the operation of the Alley Creek CSO Retention Tank reduced 2012 pollutant loadings of both TSS and BOD by 85 percent, versus the pre-tank condition, thereby exceeding the annual-average target reductions of 70 and 66 percent, respectively.

[3] Statistic developed using EPA's SYNOP program with 4-hour inter-event time and 0 inch minimum storm threshold.

As noted above, the Alley Creek CSO Retention Tank fully captured combined sewage and associated floatables for 100 of the 125 rainfall events in 2012. During the 25 events in 2012 when the tank did overflow, floatables removal at the facility was enhanced by means of an underflow baffle. Retained floatables are removed either at trash racks at the Old Douglaston PS or the influent screens at the Tallman Island WWTP. Overall, the facility satisfied this performance criterion through substantially reducing the discharge of floatables to Alley Creek.

5.0 GREEN INFRASTRUCTURE

Recent studies around the country have shown that integrating GI into CSO LTCPs can be an effective way of capturing stormwater runoff and controlling CSO discharges into receiving waterbodies. Such an approach has been taken by the City of New York and has been incorporated into the 2012 Order on Consent with DEC.

The 2012 Order on Consent requires DEP to manage one inch of rainfall from 10 percent of impervious surfaces in combined sewer areas citywide by 2030. In the near term, DEP is to implement sufficient GI to attain an initial application rate of 1.5 percent or encumber $187M toward implementation by December 31, 2015. If this 1.5 percent goal is not met, DEP must submit a contingency plan to DEC by June 20, 2016. As part of each LTCP, DEP will refine watershed-specific application rates and anticipated CSO volume reduction benefits based on the results of modeled initial application rates. DEP will also demonstrate that watershed-specific GI implementation, combined with adaptive management, will achieve citywide targets in the Citywide LTCP due in 2017. Described below are the current GI program and planned GI implementation in NYC and the Alley Creek and Little Neck Bay watershed.

5.1 NYC Green Infrastructure Plan (GI Plan)

In September 2010, New York City published the *NYC Green Infrastructure Plan*, effectively presenting an alternative approach to improving water quality through additional CSO volume reductions by outlining strategies to implement decentralized stormwater source controls. DEP estimated that a hybrid green/grey infrastructure approach will reduce CSO volume by an additional 3.8 billion gallons per year (BGY), or approximately 2 BGY more than implementing an all-grey strategy. In addition to its primary objective, enhancing water quality in NYC, the Plan will yield co-benefits such as more open space, improved air quality, reduced energy use, increased shade, sustained pollination, beautification and increased property values.

In January 2011, DEP created the Office of Green Infrastructure (OGI) to implement the goals of the GI Plan and budgeted $187M of its capital budget plus an additional $5M in Environmental Benefits Project (EBP) funds through FY 2015 to do so.[1] Together with other bureaus within DEP and other City agencies, OGI has developed several approaches for designing and constructing GI practices that divert stormwater away from the sewers and instead directing it to areas where it can be infiltrated, evapotranspired, stored, or detained. OGI has developed standardized designs for right-of-way bioswales (ROWBs) and detailed plans to construct other GI technologies including pervious pavement, rain gardens, and green and blue roofs. The diverse strategies and activities initiated by OGI to implement these designs and plans and achieve the milestones in the 2012 Order on Consent are described in more detail below.

5.2 Citywide Coordination and Implementation

5.2.a Community Engagement

Stakeholder participation is a critical success factor for the effective implementation of decentralized GI projects. To this end, DEP engages and educates local neighborhoods, community groups, and other environmental and urban planning stakeholders about their role in the management of stormwater. DEP's outreach efforts involve presentations and coordination with elected officials, community boards,

[1] EBP projects are 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.

stormwater advocacy organizations, green job non-profits, environmental justice organizations, schools and universities, Citizens Advisory Committees (CACs), civic organizations and other City agencies.

In February 2011, DEP held the first Citywide Green Infrastructure Citizens Group meeting, providing an opportunity for the general public to learn about the Plan's implementation since its inception. In this forum, the public asked questions and made recommendations on the implementation of the Plan. Other issues discussed at the meetings included the Green Infrastructure Grant Program, programmatic updates, and DEP's agreement with DEC to improve New York Harbor water quality by using GI as an integral component of the 2012 Order on Consent. Citizens Group members received periodic updates from DEP and will meet once a year; the first annual meeting of the Citizens Group was held in November 2011. Future meetings will be scheduled to coincide with the release of the Green Infrastructure Annual Report due to DEC in April of each year to provide the public with regular updates on GI planning, construction, and monitoring.

DEP convened the Green Infrastructure Steering Committee comprised of a cross-section of stakeholders ranging from environmental justice and economic development organizations, to architecture, design, green jobs training organizations, and other experts in stormwater management issues. The Steering Committee meets quarterly and serves as a liaison between the Citizens Group and DEP in order to represent respective ideas and concerns. In 2012, the Steering Committee organized itself into three separate Working Groups structured around specific concentrations of DEP's GI implementation strategy: Green Jobs, Education & Engagement, and Technical Advice & Research.

Throughout the implementation of the Green Infrastructure Program, DEP has conducted additional community engagement activities such as a Rain Barrel Giveaway Program distributing free rain barrels for stormwater detention at private sites, and has created educational and informational materials that are available on the DEP website. DEP has also participated in several workshops such as Grow Our Grassroots with MillionTreesNYC and the Mayor's Office of Long-term Planning and Sustainability, and Green Infrastructure; its beauty and function with the NYC ReLeaf Committee. Furthermore, DEP notifies the public of upcoming construction by sending informational postcards to all mailing addresses within an average three-block radius of project sites, informing communities of right-of-way bioswale GI build-out for every project area and by coordinating with the Bureau of Engineering Design & Construction on construction project newsletters.

5.2.b Interagency Coordination

In 2011, the City created an interagency Green Infrastructure Task Force to identify opportunities to add GI to existing and planned capital projects across NYC. Since the creation of the OGI, DEP has established a schedule of standing Green Infrastructure Task Force meetings with representatives of DOB, DCP, City-wide Administrative Services, Cultural Affairs, Design and Construction, Education, DOT, DPR, Sanitation, Housing & Preservation Development, NYC Economic Development Corporation, NYC Law Department, NYC Housing Authority, NYC Office of Management and Budget, Mayor's Office of Long Term Planning and Sustainability and the NYC Health and Hospitals Corporation.

In 2011 DEP, DOT, and DPR signed an agreement that stipulates DPR will use Greenstreets crews to maintain vegetated GI in the right-of-way through June 2015. The agreement clearly defines roles and responsibilities for right-of-way GI installations, establishing that DEP will provide funding to DPR for maintenance of plants, trees, and landscaped areas; DOT will maintain to the extent practicable the existing grades during milling and resurfacing operations when working around GI sites; and DEP will continue to maintain catch basins and other existing roadway drainage elements.

5.3 Completed Green Infrastructure Projects to Reduce CSOs (Citywide and Watershed-Specific)

5.3.a Green Infrastructure Demonstration and Pilot Projects

The GI program applies an adaptive management approach based on pilot monitoring results and information collected and assessed for demonstration projects. In particular, this information will be used to develop a GI performance metrics report by 2016, relating the benefits of CSO reduction with the amount of constructed GI.

Pilot Monitoring Program: DEP initiated site selection and design of its Pilot Monitoring Program in 2009. The program has provided DEP opportunities to test different designs and monitoring techniques in order to determine the most cost-effective, adaptable and efficient GI strategies that can be implemented citywide. Specifically, the pilot monitoring has aimed to assess the effectiveness of each of the evaluated source controls at reducing the volume and/or rate of stormwater runoff from the drainage area through measuring quantitative aspects like source control inflow and outflow rates, as well as qualitative issues like maintenance requirements, appearance and community perception. Data collection began in 2010 and 2011 as construction for each of the 25 monitoring sites was completed. Pilot Monitoring Program results are currently used to improve GI designs and validate modeling methods and parameters. Results are further discussed in Section 5.3.e.

Neighborhood Demonstration Area Projects: The 2012 Order on Consent contains milestones related to the construction of three Neighborhood Demonstration Area Projects. DEP will build and monitor GI on 63 acres across the Newtown Creek, Hutchinson River and Jamaica Bay watersheds to study the benefits of GI application on a neighborhood scale. The development of these Demonstration Projects will culminate in the submission of a Phasing Post Construction Monitoring Report in August 2014, and will be incorporated into the 2016 performance metrics report.

Construction of ROWBs as part of the Hutchinson River Green Infrastructure Demonstration Project (Demo Area 1) started in September 2012. Demo Area 1 is comprised of 24 acres of GI and will cost approximately $300,000. The Jamaica Bay Green Infrastructure Demonstration Project in 26th Ward Sewershed (Demo Area 2) encompasses 23 acres, and will dedicate $705,800 to the construction of ROWBs. As is the case with the Hutchinson River Demonstration Project, construction work and performance monitoring initiated in Demo Area 2 in 2012. Finally, the Newtown Creek Demonstration Project (Demo Area 3) will include ROWBs over a 16-acre area and will cost $508,150. DEP has committed to spend a minimum of $2M worth of EBP funds to construct the neighborhood scale GI demonstration projects.

While DEP's Pilot Monitoring Program provides performance data for individual GI installations, the Neighborhood Demonstration Area Projects will provide standardized methods and information for calculating, tracking and reporting derived CSO volume reductions and other benefits associated with multiple installations within a concentrated area and with common connections to the sewer system. The data collected from each of the three demonstration areas will enhance DEP's understanding of the benefits of GI relative to runoff control and CSO reduction. The results will then be extrapolated for calculating and modeling water quality and cost-benefit information on a citywide and waterbody basis.

5.3.b Public Projects

DEP has identified and selected seventeen Priority CSO Tributary Areas for GI implementation based on CSO volume, frequency, and receiving waterbody quality. Additional criteria were considered to identify specific outfall subcatchments for GI implementation, including proximity to public access locations and WWFP improvement projects already constructed or to be constructed. When added together, the priority CSO tributary areas total 18,705 acres and spread across the Bronx, Queens, and Brooklyn (Figure 5-1).

DEP will utilize area-wide contracts for designing and constructing decentralized GI systems, primarily right-of-way bioswales over entire CSO tributary areas. Area-wide GI contracts have been awarded to three DEP consultants covering seven Priority CSO Tributary Areas. Moreover, additional Priority Areas have been assigned to agency partners including the Bureau of Engineering Design and Construction, Parks and Recreation and the NYC Economic Development Corporation. By the end of 2012, the first 45 ROWBs had been built using the NYC Green Infrastructure Standards for ROWBs established by DEP earlier in the year. DEP projects the implementation of approximately 6,000 ROWBs by 2015, contributing to the 1.5 percent citywide GI application rate.

DEP has partnered with the Green Infrastructure Task Force to initiate GI retrofits on public properties within Priority CSO Tributary Areas. As of December 2012, DEP had initiated designs with the NYC Housing Authority at three developments, one in the Bronx and two in Brooklyn. In addition, DEP has committed to work with the Trust for Public Land, in coordination with the NYC School Construction Authority and the Department of Education, to construct up to ten GI projects in schoolyards per fiscal year. DEP will also work with the NYC Health and Hospitals Corporation, DPR, the Department of Cultural Affairs, and other City agencies to site and build GI projects to contribute to the 1.5 percent citywide GI application rate by 2015. Because of the factors noted earlier in the section, there are no GI public projects – on-site or in the right-of-way – currently being implemented or have been completed in the Alley Creek and Little Neck Bay watershed.

5.3.c Performance Standard for New Development

On July 4, 2012, DEP's stormwater performance standard came into effect as an amendment to Chapter 31, Title 15 of the Rules of the City of New York. The standard modifies the flow rate of stormwater to the City's CSS for new and existing development, as part of sewer availability and connection approvals. The rule applies to development lots where new buildings or horizontal alterations of existing buildings that would result in an expansion of building footprint or impervious surfaces are proposed.

DEP developed the rule in coordination with other City agencies and utilized prototypical development, overlay of potential site conditions and sewer system design. The purpose of the rule amendment is to more stringently control the flow of stormwater runoff from development lots to the City's sewer system in an effort to improve the performance of the system and increase its capacity, while ensuring that the system is protected from uncontrolled or pressurized flow.

The stormwater performance standard applies to all development lots regardless of size and extends to all stormwater recycling systems. For infiltration practices, the cap was removed for proposed volume reductions as demonstrated by soil borings and in-situ permeability tests. The rule specifies overall site runoff coefficient reductions for different surface types including open space, green roofs and permeable pavement.

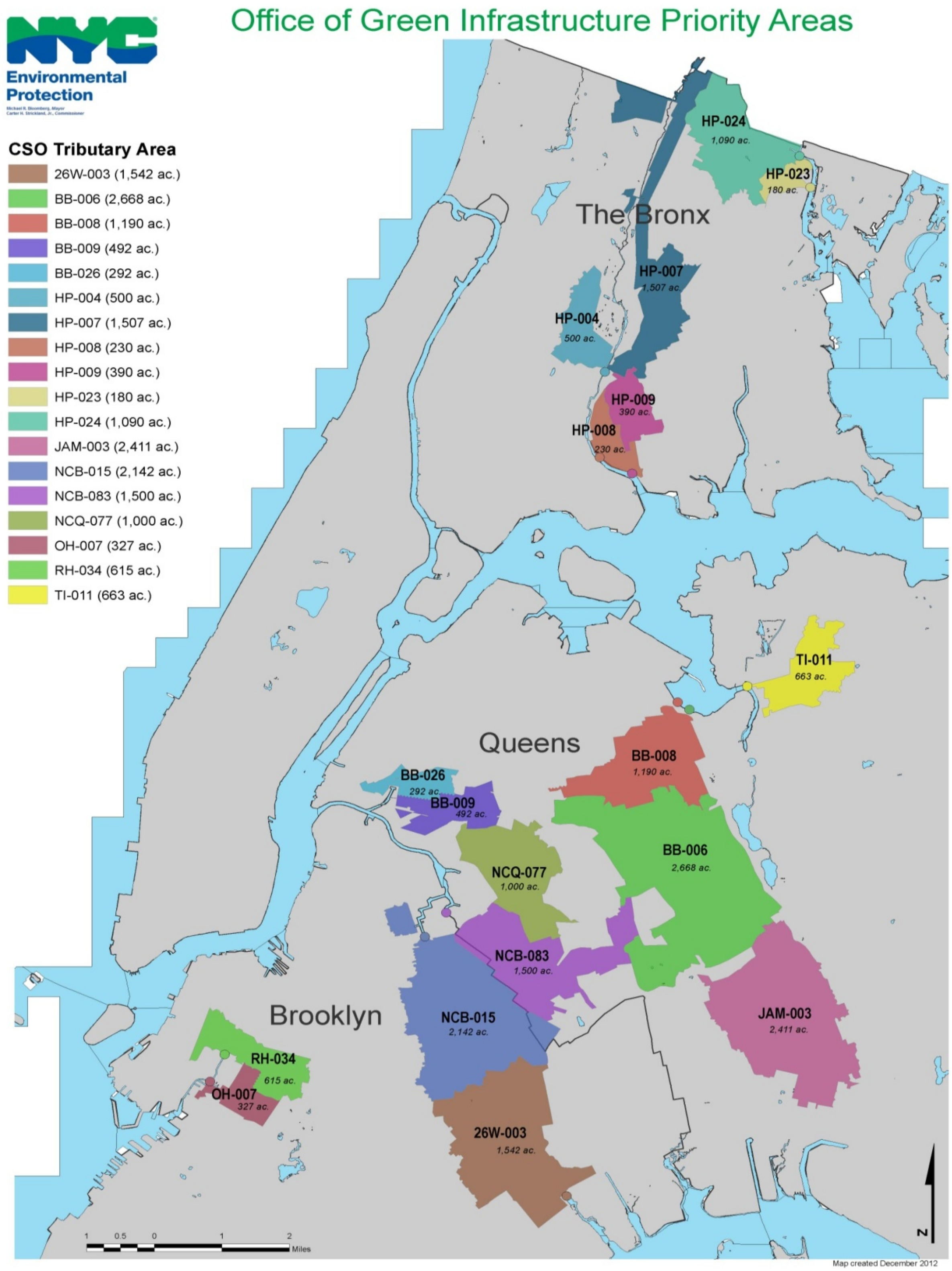


Figure 5-1. Priority CSO Tributary Areas for Green Infrastructure Implementation

Costs for compliance as part of new developments and alterations are expected to be less than 1.5 percent of total development costs. Moreover, the new rule allows for a phased approach toward attaining future and potentially more stringent federal and State stormwater requirements, and also provides substantial flexibility for applicants to comply with stricter release requirements based on the availability of different technologies and site specific conditions.

Parallel to the enactment of the new stormwater performance standard, DEP published a set of "Guidelines for the Design and Construction of Stormwater Management Systems", to assist New York City's development community and licensed professionals in the selection, planning, design and construction of onsite source controls that comply with the new rule. The guidelines feature guidance on siting, design and construction considerations for various stormwater control systems, as well as operation and maintenance recommendations.

5.3.d Other Private Projects (Grant Program)

Application in Private Property

The Green Infrastructure Grant Program has awarded approximately $7M to private property owners to build GI projects in the combined sewer areas of NYC. Since its introduction in 2011, the Grant Program has sought to strengthen public-private partnerships and public engagement in regard to the design, construction and maintenance of GI.

For the 2011 grant cycle, $3.4M was awarded among 12 projects across four boroughs and three watersheds. Projects included rooftop farms, permeable pavement, rain gardens, as well as green and blue roofs. Notably, the first completed Green Infrastructure Grant projects were the rooftop farm at Brooklyn Navy Yard and the rain garden-permeable pavement at Queens College, which were completed in summer 2012.

The Grant Program awarded $3.6M to nine proposals for the 2012 cycle. Projects are also spread across four boroughs and three watersheds, and included green roofs, rain gardens, porous pavement and bioinfiltration. During the 2012 grant cycle, DEP created an online application to standardize and streamline processes, and make the overall Program substantially more efficient. DEP hosts workshops throughout the City to equip applicants with the tools necessary to submit successful applications and works to improve the Program each cycle by sending surveys to all applicants. DEP has expanded the Grant Program by announcing $6M for 2013; adding to the previously awarded $7M. Currently, no GI projects under the Grant Program are being implemented or have been completed in the Alley Creek and Little Neck Bay watershed.

In addition, the 2012 Order on Consent requires the extension of DEP's current Grant Program and a commitment to use a minimum of $3M of Environmental Benefit Project funds by 2015 to expand available grant funding for applicants. By the end of 2012, three grant projects were being implemented using Environmental Benefit Project funds.

The NYC Green Roof Tax Abatement (GRTA) has provided a fiscal incentive to install green roofs in private property since 2008. DEP has worked with the Mayor's Office of Long Term Planning and Sustainability (OLTPS), DOB, the Department of Finance (DOF) and the Office of Management and Budget (OMB), as well as environmental advocates and green roof designers to modify and extend the GRTA through 2018. DEP has met with stakeholders and incorporated much of their feedback to improve the next version and help increase the number of green roofs in the City. Proposed changes include an increase in the abatement value to account for 2012 construction costs, a doubling of the abatement cap to encourage rooftop farms, text allowing native species and agricultural plants, and allowing more time to meet plant coverage requirements. Likewise, DEP will fund an outreach position to educate applicants and assist them through the abatement process to help facilitate application approval and respond to issues that may arise.

5.3.e Projected vs. Monitoring Results

Pilot Monitoring Program: Data collection for DEP's Pilot Monitoring Program began in 2010 and 2011 as construction for each of the 25 monitoring sites was completed; subsequent quantitative monitoring parameters included:

- Water quantity: inflow, outflow, infiltration, soil moisture and stage.
- Weather: evaporation, rainfall, wind, relative humidity and solar radiation.
- Water/soil quality: diesel/gas, nutrients, TSS, TOC, salts, metals, soil sampling and infiltrated water sampling.

Quantitative monitoring was conducted primarily through remote monitoring equipment, such as pressure transducer water level loggers in conjunction with weirs or flumes to measure flows, monitoring aspects of source control performance at a 5-minute interval. On-site testing and calibration efforts included infiltration tests and metered discharges to calibrate flow monitoring equipment and assess the validity of assumptions used in pilot performance analysis.

The *Preliminary Pilot Monitoring Report* has provided useful information that has influenced siting procedures and the designs of GI systems. Preliminary observations indicate that all GI applications are providing stormwater management benefits, and that bioretention source controls appear to come close to fully managing the 1-inch rainfall. Though initial results are encouraging, further data analysis and refinement of metrics will provide greater insight into the relationship between CSO volume reductions and GI planning, as well as the development of future CSO LTCPs and the adjustment of GI application rates for specific watersheds.

Neighborhood Demonstration Area Projects: As previously discussed, the objective of DEP's Neighborhood Demonstration Area Projects is to design them to maximize management of stormwater runoff near where it is generated and then monitor the reduction of combined sewage originating from the drainage sub-basins. The development of these demonstration projects will culminate in the submission of a PCM Report in August 2014, and ultimately in a 2016 performance metrics report. The 2016 report will relate the benefits of CSO reduction associated with the amount of GI constructed and detail methods by which DEP will use to calculate the CSO reduction benefits in the future.

The three Neighborhood Demonstration Areas where DEP will test the effectiveness of GI implementation were selected because the existing CSSs were suitable for monitoring flow in a single sewer pipe of a certain size and are not influenced by surcharging hydraulic conditions. In each of the Demonstration Areas, DEP has identified GI opportunities such as bioswales and stormwater Greenstreets in the right-of-way, and on-site detention and retention opportunities on City-owned property.

The combined sewer flow reductions achieved by GI implementation will be monitored through the collection of high quality flow monitoring data at the point at which the combined sewers exit Demonstration Area catchments. Monitoring activities consist of recording flow and depth using meters placed within key outlet sewers. Data acquisition will be continuous with measurements recorded at 15 minute intervals.

Data analysis will include a review of changes in pervious and impervious surface coverage between pre- and post-construction conditions, and consist of several elements including statistical analyses and modeling refinements. The statistical analyses will enable DEP to:

- Determine the overall amount of CSO reduction associated with GI implementation

- Determine rules of thumb (gallons per acre controlled) for use in scaled-up GI planning and implementation in other (non-demo) areas of the City

- Determine a representative permeability range for ROWBs infiltration

- Utilize monitoring data to inform future ROWB designs

Project data collected will be used to calibrate the IW computer model to the monitored flows for both pre- and post-construction conditions. Post-construction performance data will be used to ensure retention modeling techniques adequately account for the degree of flow reduction within subcatchments with planned GI and equivalent CSO volume reductions.

It is beneficial to understand the performance of individual source controls in addition to the cumulative effect of GI on total flows from a sewershed. Right-of-way GI sizing and effectiveness is dictated in large part upon the storage capacity within the source control and the ability of the system to infiltrate water. The source control scale monitoring approach proposed as part of the Demonstration Areas is intended to provide a better understanding of these elements, informing future designs. Individual bioswale monitoring will consist of surface water level measurements, subsurface water level measurements and soil moisture readings at three specified depths.

5.4 Future Green Infrastructure in the Watershed

5.4.a Relationship Between Stormwater Capture and CSO Reduction

CSO reduction and pollutant load reduction through additional stormwater capture in the Alley Creek and Little Neck Bay watersheds can be evaluated using the landside model, developed in IW modeling software, based on the extent of retention and detention practices in combined sewer areas. The extent of retention and detention is configured in terms of a percent of impervious cover where one inch of stormwater is managed through different types of source controls. Retention at different source controls is lumped on a sub-basin or subcatchment level in the landside model, due to their distributed locations within a watershed and also due to the fact that the landside model does not include small combined sewers to be able to model them in a distributed manner. Retention is modeled with the applicable storage and/or infiltration elements. Similarly, the distributed detention locations within a watershed are represented as lumped detention tank with the applicable storage volume and constricted outlet configured based on allowable peak flows from their respective drainage areas. Modeling methods designed during the development of DEP's GI plan have been refined over time to better characterize the retention and detention functions.

As reviewed in the existing system configuration, CSO volumes in Alley Creek are essentially discharged from the outfall TI-025, which is the bypass for Alley Creek CSO Retention Tank. Discharges to this outfall include both CSO and stormwater discharges being conveyed together through the old outfall, TI-008, and getting diverted to the tank through Chamber 6 weir. Therefore, the future GI opportunities will be evaluated in both combined and separate areas draining to the tank, in order to assess the associated reductions in CSOs at TI-025. As reviewed in Section 8, two future GI scenarios (10 and 50 percent retention GI) will be evaluated and discussed in terms of CSO volume reduction as well as pollutant load reductions.

A large volume of stormwater is discharged into Alley Creek and Little Neck Bay from separately sewered drainage areas or direct drainage areas (wetlands, open areas, and parklands). Therefore, GI application in combined/separate areas draining to TI-025 alone will not result in appreciable improvements in water quality of Alley Creek and Little Neck Bay. The 10 percent retention GI application reflects the citywide goal of managing the equivalent of stormwater generated by one inch of precipitation from 10 percent of impervious surfaces in combined sewer areas by 2030, per the 2012 Order on Consent. It is important to note, however, that a 50 percent application rate would require constructing GI projects on both public onsite properties as well as private property; given that right-of-way opportunities comprise, on average, 30 percent of gross impervious area throughout the City (based on the experience gained by the OGI in the exploration of opportunities for right-of-way bioswales). Thus, a 50 percent application rate would be highly difficult to achieve.

5.4.b Opportunities for Cost-Effective CSO Reduction Analysis

Concurrent with the Alley Creek and Little Neck Bay LTCP, DPR's Natural Resources Group (NRG) is preparing the Alley Creek Watershed Plan ("Watershed Plan"), focusing on ecological restoration and stormwater management for the Alley Creek watershed and receiving water bodies of Little Neck Bay. The development of the Watershed Plan is funded by a New York State Department of State (DOS) grant with matching funds from New York City. By articulating a vision for the watershed, categorizing impacts and threats to habitat and water quality, and identifying opportunities for restoration, the plan is intended to provide a road map for managing and improving ecological resources and maximizing ecological values.

As a first step in developing the Watershed Plan, NRG has begun characterizing the historic and current land use, ecological communities, and physical and hydrologic conditions of the Alley Creek watershed by collating existing data and professional and community knowledge, and collecting information from rapid assessments in the field. These field assessments will include reconnaissance of the salt marshes, the ephemeral, perennial and tidal stream reaches, and invasive plant extent in the upland forested areas. Issues such as dumping, invasive plants and erosion, identified during the field assessment, will provide an inventory of potential opportunities for restoration.

As required by DOS, NRG established a Watershed Advisory Committee (WAC), consisting of governmental and non-governmental stakeholders from the watershed, to guide and review the development of the Watershed Plan. Broader community input solicited during a series of public meetings will also be incorporated during Plan development. Finally, plan development is being coordinated with other watershed planning efforts such as the DEP's Alley Creek and Little Neck Bay LTCP and other regional plans, such as the Long Island Sound and the NY-NJ Harbor and Estuary Comprehensive Restoration Plans, in order to leverage and build upon ongoing regional coastal zone restoration efforts.

In the built landscape of the watershed, a significant component of the Watershed Plan focuses on identifying stormwater management opportunities on DPR's opens spaces, park edges and larger right-of-way opportunities particularly in separately sewered (non-CSO) areas. The goal is to identify several feasible projects for which conceptual designs and costs will be developed, with the ultimate aim of seeking additional funding to support construction. Numeric models will be utilized to assess the potential performance of identified GI opportunities.

In the parkland sections of the watershed, restoration opportunities will focus on protecting, enhancing and restoring ecological communities and their functions, from forested upland to salt marshes along Little Neck Bay. NRG has reviewed the extent and results of past restoration efforts in the watershed and identified a range of opportunities from stream channel and riparian corridor vegetation restoration near the headwaters (e.g. along Douglaston Parkway) to vernal pool restoration opportunities in the adjacent upland closer to the mouth of Alley Creek. Additional opportunities for vegetation community restoration and for eliminating inadvertent point source discharges have been flagged in Udall's Cove Park.

Broader ecosystem restoration opportunities will also focus on the management of invasive species and their deleterious effects, such as suppression of natural recruitment of diverse native woody species that help stabilize stream banks. In conjunction with Mayor Bloomberg's PlaNYC, invasive removal and habitat restoration along the eastern shore of Alley Creek between Northern Boulevard and the Long Island Expressway is currently underway. Approximately 20 acres of aggressive invasive plant species, such as phragmites, autumn olive and porcelainberry, are in the process of being controlled and removed. The first phase of replanting with coastal maritime forest species began with a large volunteer event on April 27, 2013, as part of the MillionTreesNYC spring planting day. Contract work will continue in this area until fall of 2015.

5.4.c Watershed Planning to Determine 20-year Penetration Rate for Inclusion in Baseline Performance

In order to meet the 1.5, 4, 7 and 10 percent citywide GI application rates by 2015, 2020, 2025 and 2030, respectively, DEP has developed a watershed prioritization system based on watershed-specific needs. This approach has provided an opportunity to build upon existing data and make informed estimates available; it has also provided DEP a footprint for ongoing GI implementation.

Watershed-specific implementation rates for GI are estimated based on the best available information from modeling efforts. Specific waterbody/watershed facility plans, the Sustainable Stormwater Management Plan, the Green Infrastructure Plan, CSO outfall tiers data and historic building permit information are all reviewed to better assess waterbody-specific GI application rates.

The following criteria were applied to compare and prioritize watersheds in order to determine watershed-specific GI application rates:

- WQS
  - Fecal Coliform
  - Total Coliform
  - Dissolved Oxygen
- Cost effective grey investments
  - Planned/constructed grey investments
  - Projected CSO volume reductions
  - Remaining CSO volumes
  - Total capital costs
- The ratio of separate stormwater discharges to CSO discharges
- Preliminary watershed sensitivity to GI in terms of cost per gallon of CSO reduced
- Additional considerations:
  - Background water quality conditions
  - Public concerns and demand for higher uses
  - Site specific limitations (i.e., groundwater, bedrock, soil types, etc.)
  - Presence of high frequency outfalls
  - Eliminated or deferred CSO storage facilities
  - Additional planned CSO controls not captured in WWFPs or 2012 Order on Consent (i.e., high level storm sewers, HLSS)

The overall goal for this prioritization is to distribute GI implementation rates among different priority watersheds such that the total managed impervious acres will still be achieved in accordance with the 2010 Green Infrastructure plan, except for the East River and Open Waters.

Green Infrastructure Baseline Application Rate – Alley Creek and Little Neck Bay

Alley Creek and Little Neck Bay's characterization, based on the above criteria, ultimately determined the watershed's individual GI application rate. This particular watershed has one of the smallest total combined sewer impervious areas among the list of managed watersheds, totaling 1,490 acres. This area is significantly controlled by existing CSO facilities and sewer enhancements. Therefore, DEP assumes no investment in GI implementation in the right-of-way or onsite public properties, taking into account water quality with WWFP improvements in place, and the potentially more effective allocation of GI resources in other watersheds that can provide more water quality benefits for the same level of implementation.

DEP, however, does expect 45 acres of implemented GI to be managed in onsite private properties in Alley Creek and Little Neck Bay by 2030. This acreage would represent 3 percent of the total combined sewer impervious area in the watershed, and assumes new development based on DOB building permit data from 2000 to 2011. The data has been projected for the 2012-2030 period to account for compliance with the stormwater performance standard.

In summary, DEP expects stormwater to be managed through onsite private GI implementation in 3 percent of the total combined sewer impervious areas in Alley Creek and Little Neck Bay by 2030. Furthermore, as LTCPs are developed, baseline GI application rates for specific watersheds may be adjusted based on the adaptive management approach and GI requirements set forth in the 2012 Order on Consent.

6.0 Baseline Conditions and Performance Gap

Key to development of the LTCP for Alley Creek and Little Neck Bay is the assessment of water quality within each waterbody. Water quality is assessed herein using the ERTM water quality model as it was recalibrated using the synoptic water quality data collected in 2012. The water quality model was used to calculate ambient pathogen concentrations within the waterbodies for a set of baseline conditions as described below. The IW CS sewer system model was used to provide flows and loads from intermittent wet weather sources to the water quality model.

Two types of continuous water quality simulations were performed to evaluate the gap between the calculated pathogen levels and the WQS. A one-year (2008 rainfall) simulation was performed for dissolved oxygen and pathogens. This shorter term continuous simulation served as a basis for evaluation of grey and green infrastructure control alternatives. Control alternatives were screened for their ability to improve water quality with this one year continuous simulation. A longer term 10-year simulation was performed for pathogens. This longer term simulation was used to assess the baseline conditions, evaluate the performance gap and assess the impacts of the final selected control plan. The 10-year simulation provided a way to assess the performance of planned CSO controls when subjected to larger variations in environmental conditions (rainfall, tides, river flows, etc.).

This section of the report describes the baseline conditions and the pathogen concentrations calculated by the water quality model. It further describes the gap between calculated baseline pathogen concentrations and the WQS, when the calculated concentrations exceed the standards.

6.1 Define Baseline Conditions

Establishing baseline conditions is an important step in the LTCP process as the baseline conditions will be used to compare and contrast the effectiveness of CSO controls and to predict whether water quality goals would be attained after the implementation of the recommended LTCP. Baseline conditions for this LTCP were established in accordance with guidance established by DEC to represent future conditions. Specifically the design year was established as 2040; Tallman Island WWTP will receive peak flows at 2xDDWF; grey infrastructure would be limited to that which was recommended in the 2009 WWFPs; and waterbody specific GI application rates would be based on the best available information. Mathematical modeling tools were used to calculate the CSO volume and pollutants loads and their impacts on water quality. The performance gap between calculated WQS was assessed herein through the evaluation of additional CSO control alternatives.

The IW model was used to develop stormwater flows, conveyance system flows and CSO overflows for a set of future conditions (Baseline Conditions). For Alley Creek and Little Neck Bay LTCP, the baseline conditions were developed in a manner that was consistent with the earlier 2009 Alley Creek and Little Neck Bay WWTP approved by DEC. However, based on the public comments received on the WWFP, it was recognized that some of the baseline condition model input data needed to be updated. Updated input values reflect more recent meteorological conditions, updated operating characteristics of various collection and conveyance system components. Further the mathematical models applied herein were also updated from their configurations and level of calibration developed and documented during development of the WWFP. IW model alterations reflected a better understanding of dry and wet weather sources, catchment areas and new or upgraded physical components of the system. Water quality model updates included more refined model segmentation. Model input changes that have resulted from physical changes in the system are described in Section 2.1. The new IW model network was then used to establish the baseline conditions and was used as a tool to evaluate the impact of alternative operating strategies and physical changes to the system.

Following are the baseline modeling conditions primarily related to DWF rates, wet weather capacity for the Tallman Island WWTP, sewer conditions, precipitation conditions, and tidal boundary conditions. Each of these is briefly discussed in the section below:

- Wet Weather Capacity: The rated wet weather capacity at the Tallman Island WWTP is 160 MGD 2xDDWF and projects are underway to ensure that the system could convey and treat this wet weather flow including ongoing TI-3 stabilization project, programmatic interceptor inspection and cleaning program, and construction of a new parallel interceptor.

- Sewer conditions: The IW model was developed to represent the sewer system on a macro scale that included including all conveyance elements greater than 48" in equivalent diameter along with all regulator structures and CSO outfall pipes. Post cleaning levels of sediments were also included for the interceptors in the collection system to better reflect actual conveyance capacities to the WWTPs.

6.1.a Hydrological Conditions

Previous evaluations of the Alley Creek watershed used the 1988 precipitation characteristics as the representative typical precipitation year. However, for this LTCP, the precipitation characteristics for 2008 were used for the baseline condition as well as alternative evaluations. In addition to the 2008 precipitation pattern, the observed tide conditions that existed in 2008 were also applied in the models as the tidal boundary conditions at the CSO Outfalls that discharge to tidally influenced waterbodies.

6.1.b Flow Conservation

Dry Weather Flow: Consistent with all of the previous studies, the dry weather sanitary sewage flows used in the baseline modeling were escalated to reflect anticipated growth in the City. In the past, flow estimates were based on the 2000 census, and growth rates were estimated by the Mayor's Office and DCP to arrive at projected 2045 sanitary flow rates that were then applied to the model that were conservative and did not account for flow conservation measures. The updated analyses uses the 2010 census data to reassign population values to the watersheds in the model and also reflects water conservation measures that have already significantly reduced flows to the WWTPs and freed up capacity in the conveyance system.

6.1.c BMP Findings and Optimization

A list of BMPs, along with brief summaries of each and their respective relationships to the EPA NMCs, were reported in detail as they pertain to Alley Creek CSOs in Section 3. 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 CSS, thereby improving water quality conditions.

The following provides an overview of the specific elements of various DEP, SPDES and BMP activities as they relate to development of the baseline conditions, specifically in setting up and using the IW models to simulate CSO discharges and in establishing non-CSO discharges that impact water quality in Alley Creek and Little Neck Bay:

- Sentinel Monitoring – In accordance with BMPs #1 and #5, DEP collects quarterly samples pathogen water quality at the mouth of Alley Creek in dry weather to assess whether dry weather sewage overflows occur. In 2011 and 2012, DEP used their in-house personnel to trace and remove dry weather sewer connections from eleven homes that were improperly connected to storm sewers that discharge through Outfall TI-024. Dye testing and inspections of homes continues to identify and remediate any remaining illegal connections on an as needed basis. Although, localized sources of pollution were included in the water quality model calibration exercises to accurately simulate the observed ambient pathogen concentrations, these sources were excluded from the baseline conditions to be reflective of future conditions.

- Interceptor Sediments – DEP inspected and performed cleaning of the Flushing and Whitestone interceptors in 2011. Sewer sediment levels determined through the post-cleaning inspections are included in the IW model.

- Combined Sewer Sediments – The IW models assume no sediment in upstream combined trunk sewers in accordance with BMP #2.

- WWTP Flow Maximization - In accordance with BMP #3, DEP treats wet weather flows up to 2xDDWF that are conveyed to the Tallman Island WWTP. DEP follows this wet weather plan and received and treated 2xDDWF for a few hours in 2011 and 2012; cleaning of the interceptor sediments has increased the ability of the system to bring 2xDDWF to the treatment plant. With the installation of the Whitestone interceptor extension, the WWTP will be receiving 2xDDWF more frequently. The baseline IW model is setup to simulate CSO discharges with the WWTP accepting and treating 2xDDWF and with the Whitestone interceptor extension, which is currently being constructed.

- Wet Weather Operation Plans (WWOP) - The Alley Creek CSO Retention Tank WWOP (BMP #4) is contained within the Tallman Island WWTP WWOP. This plan sets out procedures for pumping down the retention tank after wet weather events to make room for the next event. The IW models were setup to simulate operating conditions and pumping rates/methods consistent with the WWOP.

- DEP follows and reports annually on all of its CSO BMPs, however, the five noted above are of particular importance in determining the amount of CSO overflows generated by the Alley Creek CSS under the baseline condition. As such, DEP does not believe that any further adjustments to the BMPs can help reduce the gap between calculated baseline water quality conditions and the WQS.

6.1.d Elements of Facility Plan and GI Plan

Alley Creek and Little Neck Bay LTCP included the following grey projects recommended in the 2009 WWFP. Construction of this grey infrastructure was completed in early 2011 and Alley Creek CSO Retention Tank became operational on March 11, 2011.

- A new 1,475-foot long multi-barrel outfall sewer extending to a new outfall on Alley Creek (TI-025)

- A new 5 MG Alley Creek CSO Retention Tank:

    - New diversion chamber (Chamber 6) to direct CSO to the new Alley Creek CSO Retention Tank and to provide tank bypass to TI-008

    - Weir set within Chamber 6 to pass all flows up to the DEP 5-year design flow into the tank

    - New CSO outfall, TI-025, for discharge from the tank

    - Fixed baffle at TI-025 for floatables retention, minimizing release of floatables to Alley Creek

- o Upgrade of Old Douglaston PS to empty tank and convey flow to Tallman Island WWTP after the end of the storm

As discussed in section 5, the Alley Creek and Little Neck Bay watershed has one of the smallest total CSS impervious areas. DEP estimated that 3 percent of the combined sewer impervious area in the watershed (approximately 45 acres) will have new development based on the projections and will apply an on-site GI control. This level of GI implementation has been assumed in the baseline model.

6.1.e Non CSO Discharges

In several sections of the Tallman Island WWTP drainage area, stormwater drains directly to receiving waters without entering the combined system. These areas are depicted as “Direct Drainage” or “Local Sources” in Figure 2-8 and were delineated based on topography and the direction of stormwater runoff flow in those areas. In general, shoreline areas adjacent to waterbodies comprise the direct drainage category. Significant “direct drainage” areas include Fort Totten, Douglas Manor, and Alley Pond Park, all of which are tributary to Alley Creek and Little Neck Bay. In addition, the northern portion of Douglaston Peninsula, as indicated in Figure 2-8, is currently unsewered. This area appears to contribute pollutants to adjacent Little Neck Bay waters during dry and wet weather.

“Other” areas are largely comprised of parkland, such as portions of Flushing Meadows, Corona Park, Kissena, Cunningham and Clearview Parks, and Mt. Hebron and Flushing Cemeteries. These areas were depicted as “other” drainage areas in Figure 2-8. The “other” category also includes special cases, such as the former Flushing Airport in College Point (now a commercial distribution center), where sanitary flow is conveyed to the WWTP and stormwater is most likely conveyed through storm water collection systems to receiving waters. The named areas above are generally outside the Alley Creek and Little Neck Bay watershed. The “other” areas that are attributed to drain to Alley Creek are Oakland Lake and an area in the headwaters of Alley Creek.

Overall the “direct drainage” and “other” areas cover roughly 3,654 acres of the Tallman Island WWTP, 1,484 and 2,170 acres, respectively. In Alley Creek and Little Neck Bay, the “direct drainage” and “other” areas are 828 acres and 192 acres, respectively, totaling 1,020 acres.

6.2 Baseline Conditions – Projected CSO Volumes and Loadings after the Facility Plan and GI Plan

The IW model was used to develop CSO annual average overflow volumes (AAOVs) for the baseline conditions and included the Alley Creek CSO Retention Tank, which is operational, and assumed the implementation of 3 percent onsite GI. Using these overflow volumes, pollutant loadings from the CSOs were generated using the enterococci, fecal coliform and BOD concentrations that were used in the recalibration of the Alley Creek portion of the ERTM water quality model (Table 6-1). In addition to CSO pollutant loadings, storm sewer discharges, and other continuous sources of flow impact water quality in Alley Creek and Little Neck Bay.

Continuous flows and loadings from Oakland Lake and the upstream Alley Creek area were assumed to be the same for the baseline condition as they were in the 2011 and 2012 existing conditions, for which the pathogen water quality model was calibrated, with the following exceptions:

- Little Neck Bay DMA area – Localized sources of non-CSO contamination are assumed to be mitigated, outside the LTCP program.

- Upper Alley Creek watershed - Source of possible contaminated stormwater into Oakland Lake, and other tributaries, will be tracked down and eliminated as part of ongoing monitoring programs and possible future programs required under the new MS4 permit.

- During the 2011 and 2012 pathogen model calibrations, stormwater runoff from DMA was assigned higher than normal stormwater pathogen concentrations, which represented the impact of localized sources. Based on the assumption that improvements will be undertaken to address these localized sources, the additional pathogen loading from the stormwater runoff has been eliminated from the future condition baseline evaluations. As such, in the baseline condition, stormwater runoff from the DMA area is assigned the same pathogen concentrations used for other portions of the system that have stormwater discharges within the Alley Creek and Little Neck Bay watershed.

The pollutant concentration assigned to the various sources of pollution to Alley Creek and Little Neck Bay is summarized in Table 6-1.

Table 6-1. Pollutant Concentration for Various Sources in Alley Creek

Pollutant Source	Enterococci (org./100mL)	Fecal Coliform (org./100mL)	BOD_5 (mg/L)
Stormwater	15,000	35,000	15
Sanitary Sewage	1,000,000	4,000,000	140
Direct Drainage	15,000	35,000	15
Oakland Lake DW	120	120	15
Duck Pond DW	70	30	0

Annual average baseline volumes of CSO, stormwater, direct drainage and localized dry weather sources of pollution to Alley Creek are summarized in Table 6-2. Tables 6-3 and 6-4 provide summaries of enterococci and fecal coliform annual loadings. Table 6-5 summarizes annual BOD loadings expressed as 5-day values, the information in these tables is provided for the 2008 rainfall condition.

Table 6-2. Annual CSO, Stormwater, Direct Drainage, Local Sources Baseline Volumes (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Alley Creek	TI-007	ODPS Bypass	0.1
Alley Creek	TI-008	R07	0.0
Alley Creek	TI-025	R29, R30	**132.0**
Little Neck Bay	TI-009		0.0
		Total CSO	**132.1**

Stormwater Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Alley Creek	TI-008	Oakland Lake	36.4
Alley Creek	TI-024	NA	122.4
Alley Creek	TI-654	NA	59.8
Alley Creek	TI-655	NA	38.6
Alley Creek	TI-659	NA	24.3
Alley Creek	TI-629	NA	4.1
Alley Creek	TI-630	NA	9.8

Waterbody	Outfall	Regulator	Total Discharge (MG/Yr)
Direct Drainage	NA	NA	47.6
Little Neck Bay	TI-006	NA	174.2
Little Neck Bay	TI-543	NA	13.0
Little Neck Bay	TI-623	NA	2.7
Little Neck Bay	TI-625	NA	114.8
Little Neck Bay	TI-628	NA	29.4
Little Neck Bay	TI-633	NA	33.2
Little Neck Bay	TI-658	NA	43.0
Little Neck Bay	TI-656	NA	12.3
Little Neck Bay	TI-660	NA	51.1
Little Neck Bay	TI-668	NA	44.6
		Total Stormwater	**861.3**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Alley Creek	TI-008	Oakland Lake	755.6
Alley Creek	Upstream Pond		547.5
		Total Dry Weather	1,303.1

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Alley Creek			1,778.1
Little Neck Bay			518.4

Totals by Source			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
CSO			132.1
Stormwater			861.3
Local Sources			1,303.1

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Regulator Percent**	**Total Discharge (MG/Yr)**
Alley Creek			
	CSO	7	132.1
	Stormwater	19	342.9
	Local Sources	73	1,303.1
		Total	**1,778.1**
Little Neck Bay			
	CSO	0	0
	Stormwater	100	518.4
	Local Sources	0	0
		Total	**518.4**

Table 6-3. Annual CSO, Stormwater, Direct Drainage, Local Sources Enterococci Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-007	ODPS Bypass	0.1
Alley Creek	TI-008	R07	0.0
Alley Creek	TI-025	R29, R30	145.8
Little Neck Bay	TI-009		0.0
		Total CSO	**145.9**

Stormwater Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-008	Oakland Lake	20.7
Alley Creek	TI-024	NA	69.5
Alley Creek	TI-654	NA	34.0
Alley Creek	TI-655	NA	21.9
Alley Creek	TI-659	NA	12.8
Alley Creek	TI-629	NA	2.3
Alley Creek	TI-630	NA	5.6
Direct Drainage	NA	NA	27.0
Little Neck Bay	TI-006	NA	98.9
Little Neck Bay	TI-543	NA	7.4
Little Neck Bay	TI-623	NA	1.5
Little Neck Bay	TI-625	NA	65.2

Waterbody	Outfall	Regulator	Total Org.x10^12
Little Neck Bay	TI-628	NA	16.7
Little Neck Bay	TI-633	NA	18.8
Little Neck Bay	TI-656	NA	7.0
Little Neck Bay	TI-658	NA	24.4
Little Neck Bay	TI-660	NA	29.0
Little Neck Bay	TI-668	NA	25.3
		Total Stormwater	**488.0**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-008	Oakland Lake	3.4
Alley Creek	Upstream Pond		1.5
		Total Dry Weather	**4.9**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek			344.6
Little Neck Bay			294.2

Totals by Source			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
CSO			145.9
Stormwater			488.0
Local Sources			4.9

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Regulator Percent**	**Total Org.x10^12**
Alley Creek			
	CSO	42	145.9
	Stormwater	56	193.8
	Local Sources	1	4.9
		Total	**344.6**

Waterbody	Outfall	Regulator Percent	Total Org.x10^12
Little Neck Bay			
	CSO	0	0
	Stormwater	100	294.2
	Local Sources	0	0
		Total	**294.2**

Table 6-4. Annual CSO, Stormwater, Direct Drainage, Local Sources Fecal Coli Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-007	ODPS Bypass	0.1
Alley Creek	TI-008	R07	0.0
Alley Creek	TI-025	R29, R30	460.0
Little Neck Bay	TI-009		0.0
		Total CSO	**460.1**

Stormwater Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-008	Oakland Lake	48.2
Alley Creek	TI-024	NA	162.2
Alley Creek	TI-654	NA	79.2
Alley Creek	TI-655	NA	51.2
Alley Creek	TI-659	NA	32.1
Alley Creek	TI-629	NA	5.4
Alley Creek	TI-630	NA	13.0
Direct Drainage	NA	NA	63.0
Little Neck Bay	TI-006	NA	230.8
Little Neck Bay	TI-543	NA	17.3
Little Neck Bay	TI-623	NA	3.6
Little Neck Bay	TI-625	NA	152.0
Little Neck Bay	TI-628	NA	39.0
Little Neck Bay	TI-633	NA	43.9
Little Neck Bay	TI-656	NA	16.3
Little Neck Bay	TI-658	NA	57.0
Little Neck Bay	TI-660	NA	67.0
Little Neck Bay	TI-668	NA	59.1
		Total Stormwater	**1,140.3**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek	TI-008	Oakland Lake	3.4
Alley Creek	Upstream Pond		0.6
		Total Dry Weather	**4**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
Alley Creek			918.4
Little Neck Bay			686.0

Totals by Source			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^12**
CSO			460.1
Stormwater			1,140.3
Local Sources			4

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Regulator Percent**	**Total Org.x10^12**
Alley Creek			
	CSO	50	460.1
	Stormwater	49	454.3
	Local Sources	0	4.0
		Total	**918.4**
Little Neck Bay			
	CSO	0	0
	Stormwater	100	686.0
	Local Sources	0	0
		Total	**686.0**

Table 6-5. Annual CSO, Stormwater, Direct Drainage, Local Sources BOD_5 Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Alley Creek	TI-007	ODPS Bypass	13
Alley Creek	TI-008	R07	0
Alley Creek	TI-025	R29, R30	18,494
Little Neck Bay	TI-009		0
		Total CSO	**18,507**

Stormwater Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Alley Creek	TI-008	Oakland Lake	4,555
Alley Creek	TI-024	NA	15,313
Alley Creek	TI-654	NA	7,481
Alley Creek	TI-655	NA	4,834
Alley Creek	TI-659	NA	3,035
Alley Creek	TI-629	NA	513
Alley Creek	TI-630	NA	1,230
Direct Drainage	NA	NA	5,912
Little Neck Bay	TI-006	NA	21,796
Little Neck Bay	TI-543	NA	1,629
Little Neck Bay	TI-623	NA	341
Little Neck Bay	TI-625	NA	14,358
Little Neck Bay	TI-628	NA	3,681
Little Neck Bay	TI-633	NA	4,150
Little Neck Bay	TI-656	NA	1,539
Little Neck Bay	TI-658	NA	5,382
Little Neck Bay	TI-660	NA	6,397
Little Neck Bay	TI-668	NA	5,582
		Total Stormwater	**107,728**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Alley Creek	TI-008	Oakland Lake	0
Alley Creek	Upstream Pond		0
		Total Dry Weather	**0**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Alley Creek			61,380
Little Neck Bay			64,855

Totals by Source			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
CSO			18,507
Stormwater			107,728
Local Sources			0

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Regulator Percent**	**Total Lbs**
Alley Creek			
	CSO	30.2	18,507
	Stormwater	69.8	42,873
	Local Sources	0.0	0
		Total	**61,380**
Little Neck Bay			
	CSO	0.0	0
	Stormwater	100.0	64,855
	Local Sources	0.0	0
		Total	**64,855**

6.3 Performance Gap

Concentrations of pathogens in Alley Creek and Little Neck Bay are controlled by a number of factors including the volumes of all sources of pollutants into the waterbodies and the concentrations of the respective pollutants. Since a large amount of the flow and pollutant loads discharged into these waterbodies are caused by rainfall events, the frequency, duration and amounts of rainfall will also strongly influence water quality in these waterbodies. The Alley Creek portion of the ERTM model was used to simulate pathogen and dissolved oxygen concentrations in Alley Creek for the baseline conditions.

Water quality model simulations were performed for the baseline condition using 2008 rainfall, and hourly model calculations were saved for post-processing and for comparison to the existing and/or swimmable/fishable WQS. The performance gap was then developed as the difference between the model calculated baseline waterbody DO and pathogen concentrations and the applicable numerical WQS.

This performance gap analysis is based on the current WQS. As discussed in Section 2, the EPA released RWQC recommendations in December 2012 that are intended as guidance to states, territories, and authorized tribes in developing or updating WQS to protect swimmers from exposure to pathogens found in water with fecal contamination. As noted previously, DEC has not yet adopted this guidance or proposed specific criteria for Alley Creek and Little Neck Bay. As such, all assessments of the current and future anticipated system performance are based on the current WQS.

2008 Rainfall Annual Simulation

Typical model results and post-processed results are shown in Figures 6-1 and 6-2, for Alley Creek and Little Neck Bay at DMA Beach, respectively. The following information is shown on these graphics:

- Upper Panels – The black lines in the upper panels show the calculated enterococci concentrations for each hour of the of the one-year simulation period (2008 rainfall condition). The dashed green line represents the 30-day GM SB water quality standard of 35 org/100mL. The solid green line is the post processed hourly model output into backward looking 30-day moving averages for comparison to the required GM of 35 org/100mL. It should be noted that Alley Creek is currently classified as a Class I waterbody so this criteria does not apply at this time.
- Lower Panels – The lower panels in each graphic show the Class I fecal coliform criteria of 2,000 org/100mL (dashed red line) and Class SB fecal coliform criteria of 200 org/100mL (dashed green line). The post processed monthly GM water quality output lines are shown as solid green lines.

From these graphics, the modeling results indicate that at Alley Creek location AC1 (Figure 6-1), fecal coliform concentrations are calculated to be in full compliance with the existing water quality criteria of a monthly GM of 2,000 org/100mL. The model calculations also show that the DMA Beach location (Figure 6-2) fecal coliform concentrations are in compliance with the criteria. In general, the enterococci concentrations are also in compliance with the bathing standards during the warm weather bathing season (June 1 through Sept 1) but some limited wet periods outside the summer season were calculated to have 30-day GMs greater than 35 org/100mL.

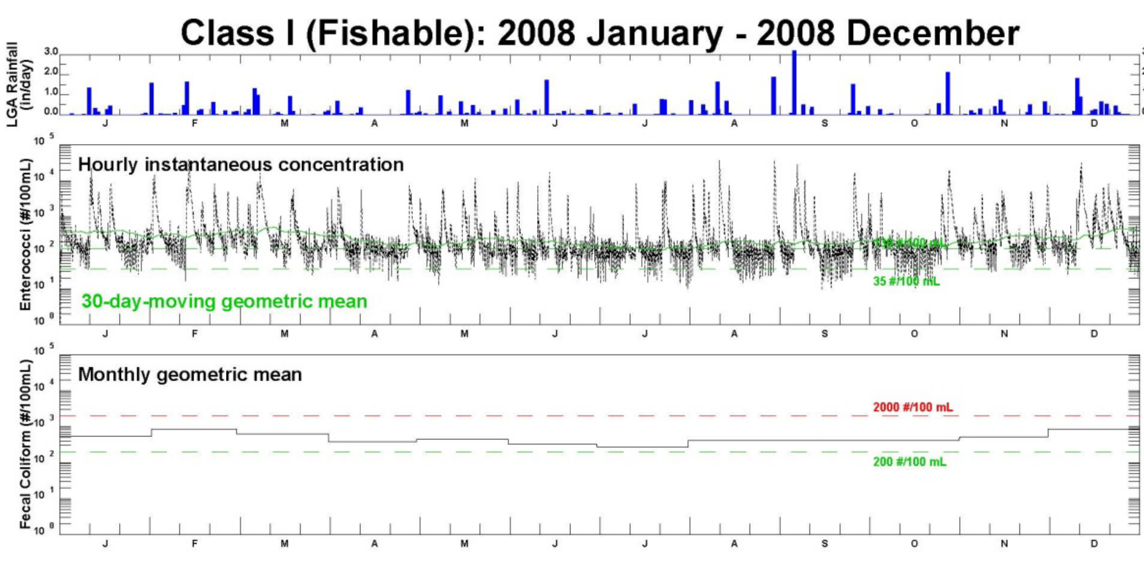


Figure 6-1 - Calculated Baseline AC1 Pathogen Concentrations (2008 Rainfall)

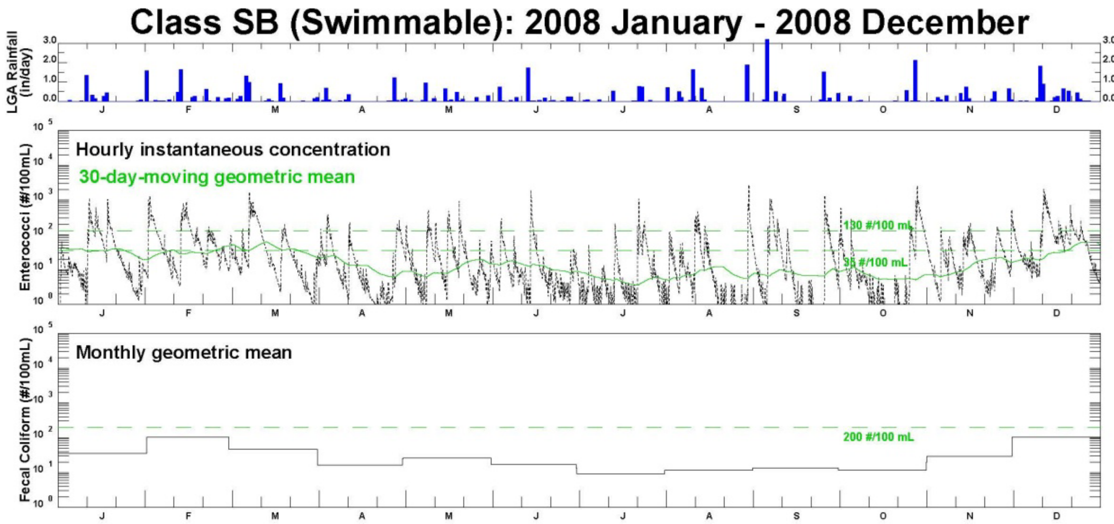


Figure 6-1. Calculated Baseline DMA Pathogen Concentrations (2008 Rainfall)

10-Year Long-Term Simulation

A 10-year baseline simulation of pathogen water quality was also performed for the baseline loading conditions to assess year-to-year variations in water quality. The results of these simulations are summarized in Figures 6-3 and 6-4 and in Table 6-6.

These graphics show that the 10-year long term annual enterococci concentrations calculated for the baseline within Little Neck Bay are divided into areas that are in compliance with the enterococci standards a high percentage of the time (outer Little Neck Bay) and a transition zone (inner Little Neck Bay) where compliance with the standards ranges from a low of 68 to a high of 92 percent. The DMA Beach area of the Bay was calculated to be in compliance with the enterococci standard of a monthly GM of 35 No./100mL approximately 92 percent of the time. This picture changes dramatically when the examination is focused on bathing season (Figure 6-4). During the 10-year period, the majority of the Bay is in compliance greater than 96 percent of the time. The tidal mixing area or transition zone in the inner Little Neck Bay still exists as a small area of the Bay immediately adjacent to the mouth of Alley Creek but the compliance level is estimated to be between 84 and 92 percent of the time. During the bathing season the DMA Beach is calculated to comply with the SB enterococci standards 100 percent of the time per model predictions. Values were not assessed for Alley Creek proper because its current Class I designation does not include enterococci standards.

Table 6-6 provides further insight into the baseline pathogen concentrations. As noted in the table, fecal coliform concentrations are calculated to be in compliance 100 percent of the time at all locations for each of the 10 years within the simulation period, with the exception of 2009 for Station OW2 within the transition zone. Enterococci compliance varies by year with the variations between annual compliance being calculated to be generally within 10 percent with the exception of the transition zone area where annual compliance is show to vary widely between a low of 71 percent to a high of 100 percent of the time.

Table 6-6. Calculated 10-Year Baseline Pathogen Compliance

Station	Parameter	Projection YEAR										
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Cumul.
AC1	Fecal Coli, Geometric Mean, %months	100	100	100	100	100	100	100	100	100	100	100.00
	Enterococci, Moving average,% <35#/100ml	23	17	9	36	18	18	16	13	36	8	19.40
OW2	Fecal Coli, Geometric Mean, %months	100	100	100	100	100	100	100	92	100	100	99.20
	Enterococci, Moving average,% <35#/100ml	95	71	88	79	74	74	73	79	83	73	78.90
LN1	Fecal Coli, Geometric Mean, %months	100	100	100	100	100	100	100	100	100	100	100.00
	Enterococci,Moving average,% <35#/100ml	100	98	98	93	88	93	91	94	91	89	93.50
DMA	Fecal Coli, Geometric Mean, %months	100	100	100	100	100	100	100	100	100	100	100.00
	Enterococci,Moving average,% <35#/100ml	100	98	97	93	88	92	91	94	91	90	93.40
E11	Fecal Coli, Geometric Mean, %months	100	100	100	100	100	100	100	100	100	100	100.00
	Enterococci,Moving average,% <35#/100ml	100	100	100	100	100	98	99	99	93	96	98.50

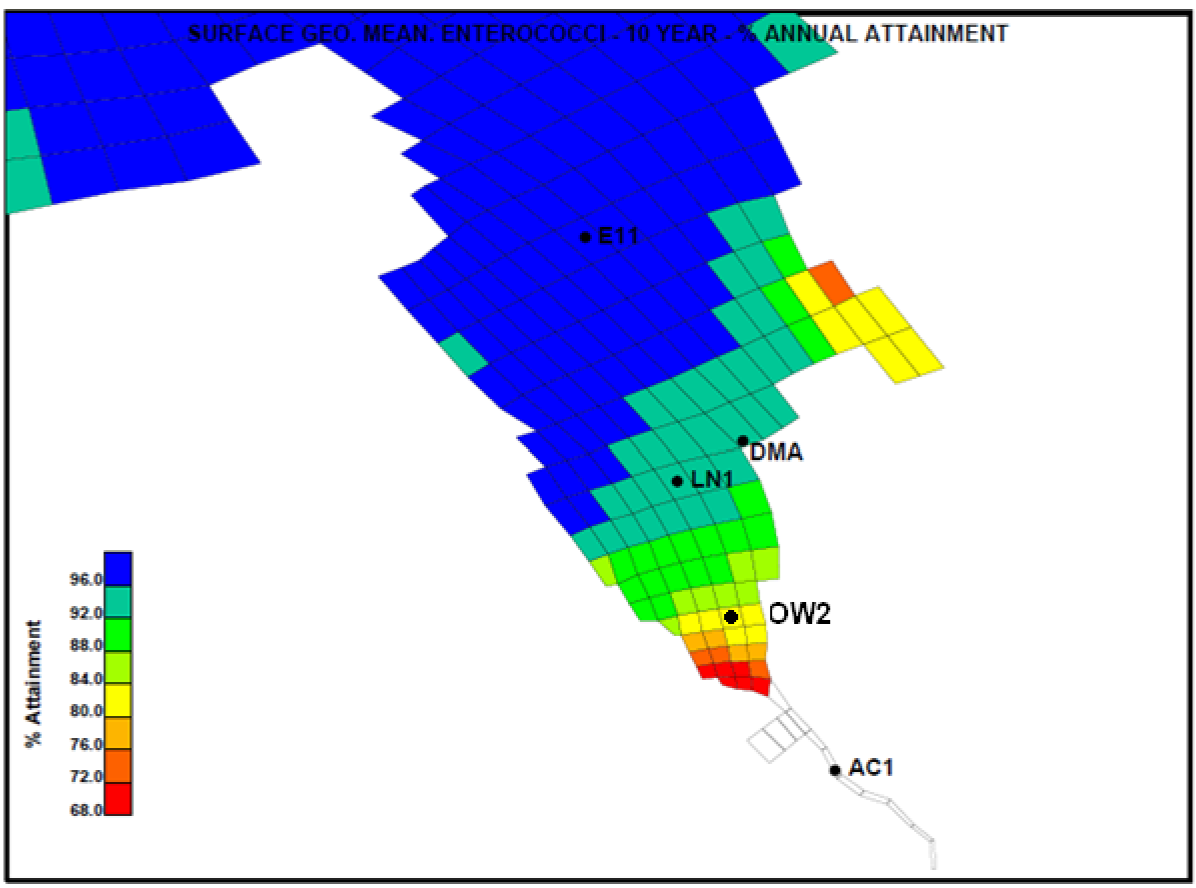


Figure 6-2. Enterococci Annual Attainment (10-Yr Simulation)

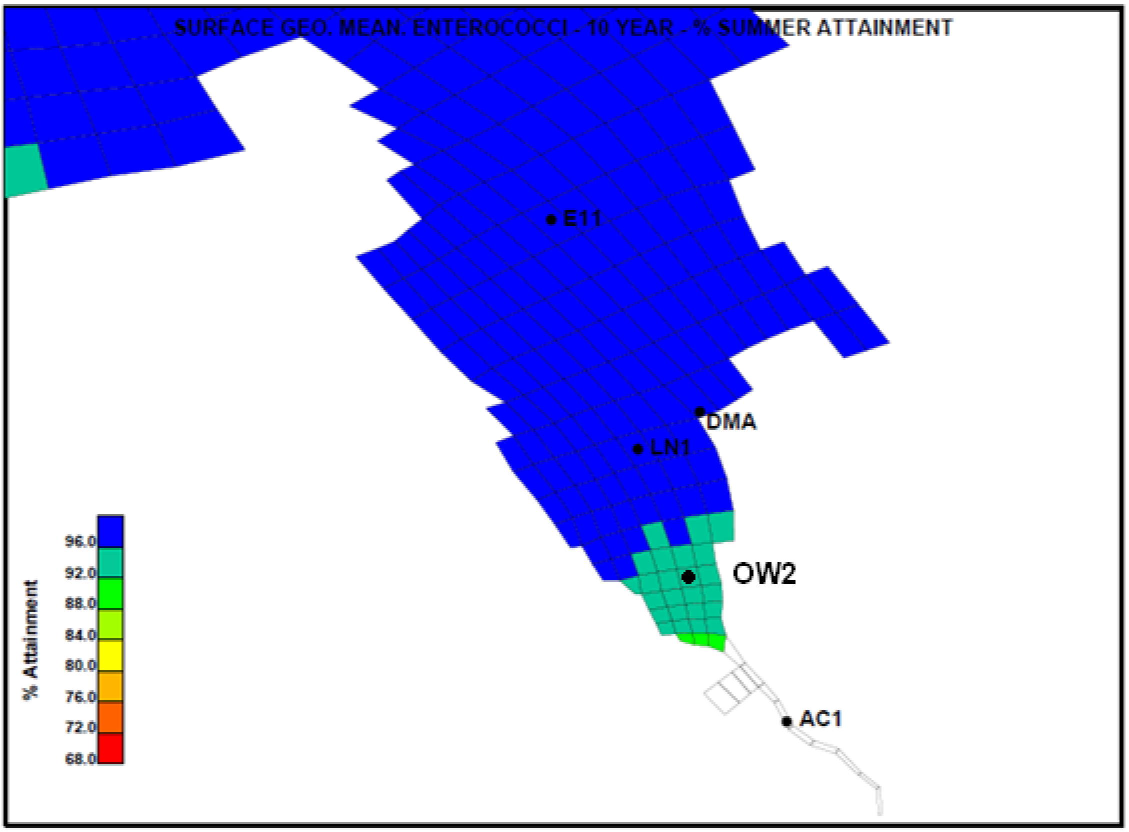


Figure 6-3. Enterococci Summer Season Attainment (10-Yr Simulation)

To put the compliance analysis into some perspective the table below provides an equivalency between the percent of time the areas of the waterbody are out of compliance with the WQS and the approximate time in days.

Table 6-6. Annual and Recreational Season Attainment

Percent Time Not in Compliance	Days Not in Compliance (annual)	Days Not in Compliance (recreational season)
2	7	2
5	18	4.5
10	36	9

Based on these analyses, the majority of Little Neck Bay is calculated for the baseline condition to be in compliance with enterococci standards all but 3 or 4 days within the recreational bathing season and the transition zone in compliance with enterococci standards all but about 7 days.

2008 Rainfall Annual Simulation – Dissolved Oxygen

Water quality model simulation of dissolved oxygen concentrations and measures of compliance with the numerical WQS are presented in Table 6-7. Water quality calculations indicate that the minimum DO concentrations in Alley Creek (Stations AC1 & Tanks Discharge Location) will be below 2 mg/L during

July but the overall attainment with the Class I standard of 4 mg/L more than 89 percent for this month and 98 percent for the year. Under the baseline conditions the calculated dissolved oxygen concentrations tend to be somewhat higher in Little Neck Bay. In July however, DO concentrations are calculated to be below 4.8 mg/L for 66 percent of the time at Station LN1 and 80 percent of the time at Station E11 with a minimum projected DO of 2.8 mg/L and 3.5 mg/L, respectively. Even though there are excursions below the DO standards in a few summer months, DO concentrations are calculated to be in compliance with the WQS a high percent of the time. As noted in Table 6-7, annual DO compliance is 96 and 99 percent depending on the area of the Bay.

Table 6-7. Dissolved Oxygen Concentrations and Measures of Compliance

Station: AC1

Month in 2008	Model-Calculated Monthly Average DO (mg/L) Baseline	Model-Calculated Monthly Minimum DO (mg/L) Baseline	Model-Calculated Percent of Time DO>4.0 mg/L Baseline
Jan	11.0	7.3	100
Feb	12.0	8.7	100
Mar	11.0	6.4	100
Apr	8.9	5.1	100
May	6.5	3.2	99
Jun	5.1	2.1	89
Jul	6.6	3.1	95
Aug	6.8	3.5	99
Sep	5.6	1.2	91
Oct	8.0	4.4	100
Nov	8.6	4.4	100
Dec	9.7	6.2	100
Year	8.3		98

Station: Tank Discharging Location

Month in 2008	Model-Calculated Monthly Average DO (mg/L) Baseline	Model-Calculated Monthly Minimum DO (mg/L) Baseline	Model-Calculated Percent of Time DO>4.0 mg/L Baseline
Jan	11.2	8.3	100
Feb	12.1	9.2	100
Mar	11.1	7.4	100
Apr	9.1	5.6	100
May	6.7	3.2	100
Jun	5.3	2.9	93

Month in 2008	Model-Calculated Monthly Average DO (mg/L) Baseline	Model-Calculated Monthly Minimum DO (mg/L) Baseline	Model-Calculated Percent of Time DO>4.0 mg/L Baseline
Jul	6.8	2.6	96
Aug	7.1	4.0	100
Sep	5.8	1.7	93
Oct	8.1	4.4	100
Nov	8.7	6.0	100
Dec	9.8	6.5	100
YEAR	8.4		99

Station: LN1

Month in 2008	Model-Calculated Monthly Average DO (mg/L) Baseline	Model-Calculated Monthly Minimum DO (mg/L) Baseline	Model-Calculated Percent of Time DO>4.8 mg/L Baseline
Jan	11.7	10.1	100
Feb	12.9	11.3	100
Mar	12.2	10.8	100
Apr	10.3	9.1	100
May	8.1	6.6	100
Jun	5.9	4.5	98
Jul	5.6	2.8	66
Aug	7.0	3.2	95
Sep	7.4	5.8	100
Oct	9.1	6.6	100
Nov	9.1	7.8	100
Dec	10.3	8.9	100
YEAR	9.1		96

Station: E11			
Month in 2008	Model-Calculated Monthly Average DO (mg/L) Baseline	Model-Calculated Monthly Minimum DO (mg/L) Baseline	Model-Calculated Percent of Time DO>4.8 mg/L Baseline
Jan	10.8	9.5	100
Feb	12.1	10.9	100
Mar	11.9	10.5	100
Apr	10.1	8.8	100
May	8.0	6.3	100
Jun	6.0	4.9	99
Jul	6.0	3.5	80
Aug	6.1	4.2	90
Sep	6.6	5.1	100
Oct	8.0	6.0	100
Nov	8.4	7.3	100
Dec	9.6	8.3	100
YEAR	8.5		97.4

6.3.a CSO Volumes and Loadings Needed to Attain Current Water Quality Standards

The water quality modeling assessment made herein indicates that the Bay is not calculated to fully comply with the enterococci WQS during baseline conditions when subjected to the 2008 rainfall conditions or when subjected to the 10-year rainfalls, although there is compliance a high portion of the time. As noted in Figure 6-3, although Little Neck Bay is in compliance with the standards a high percent of the time, there is a transition zone where compliance with the standards is reduced because of the proximity to Alley Creek, which has a lower water quality use classification. This changes somewhat when bathing season (June 1 through August 31) compliance is examined as presented in Figure 6-4. There however remains a portion of the time that Little Neck Bay is calculated for the baseline conditions to exceed the pathogen standards. Figure 6-5 provides a summary of the hourly concentrations of enterococci that exceed the 30-day GM concentration of 35 No./100mL for the period during the 10-year simulation when the maximum or highest 30-day GM enterococci concentration is calculated. This graphic shows the following:

- The maximum 10-year 30-day GM concentrations in the outer portions of Little Neck Bay near location E1 equal or are less than 10 No./100mL above the standard of 35.
- Near DMA, the calculated maximum concentrations are between 20 and 30 No./100 mL above the standard.
- In the inner portion of the Bay near the mouth of Alley Creek, the calculated maximum concentrations exceed the standard by about 70 No./100mL.

Figure 6-6 provides a summary of the maximum 30-day GM mean concentrations above the GM standard of 35 for the 10-year simulation period for the baseline case with the addition of 100 percent CSO removal. The graphic clearly shows that all areas of the Bay still have enterococci concentrations that are above the GM standard of 35.

This analysis indicates the following.

- The maximum 10-year 30-day GM concentrations in the outer portions of Little Neck Bay near location E1 remain equal or are less than 10 No/100mL above the standard of 35.
- Near DMA, the calculated maximum concentrations are between 10 and 20 No./100 mL above the standard.
- In the inner portion of the Bay near the mouth of Alley Creek, the calculated maximum concentrations are reduced from the baseline (Figure 6-5) but still exceed the standard by about as much 70 No./100mL. The exceedance is less at the outer portion of the transition zone where it is about 40 No./100 mL above the standard of 35.

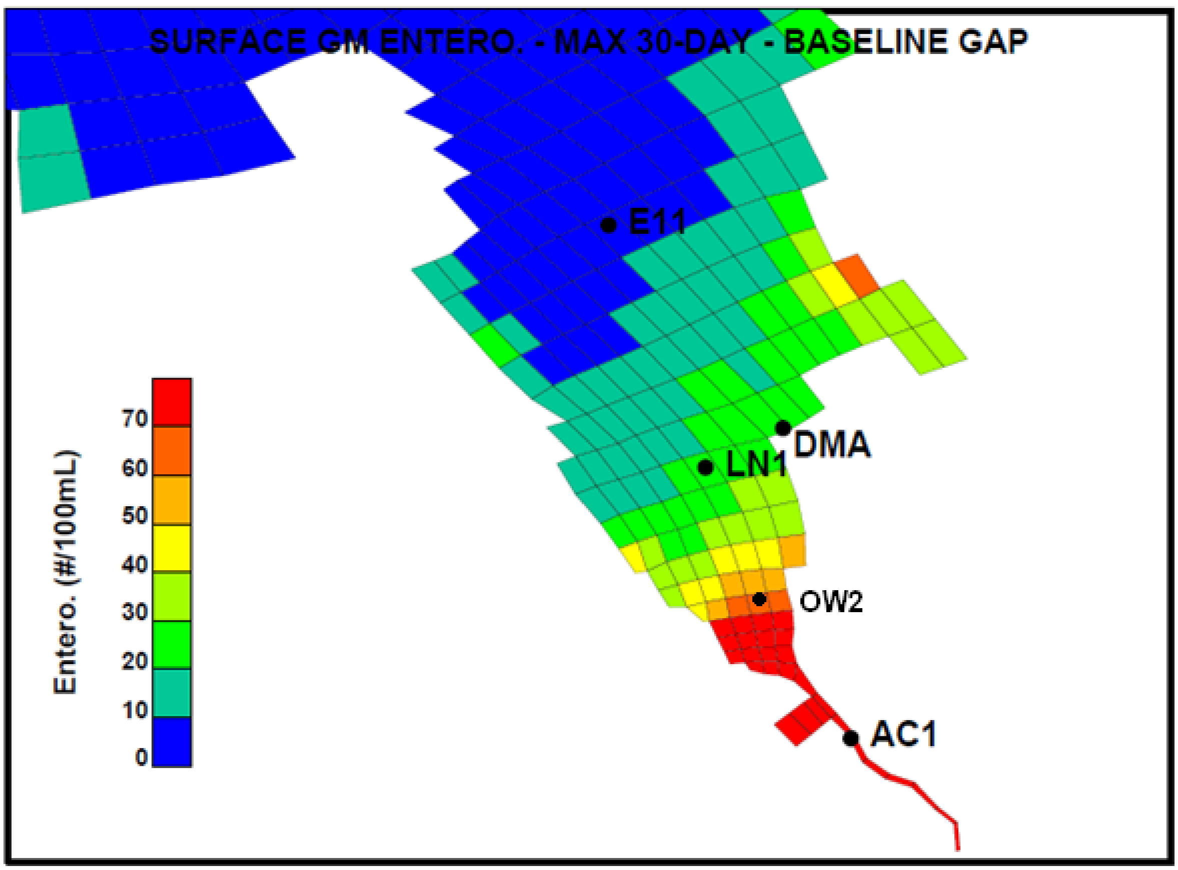


Figure 6-4. Max. 30-Day Enterococci Concentration Gap (10-Yr Simulation)

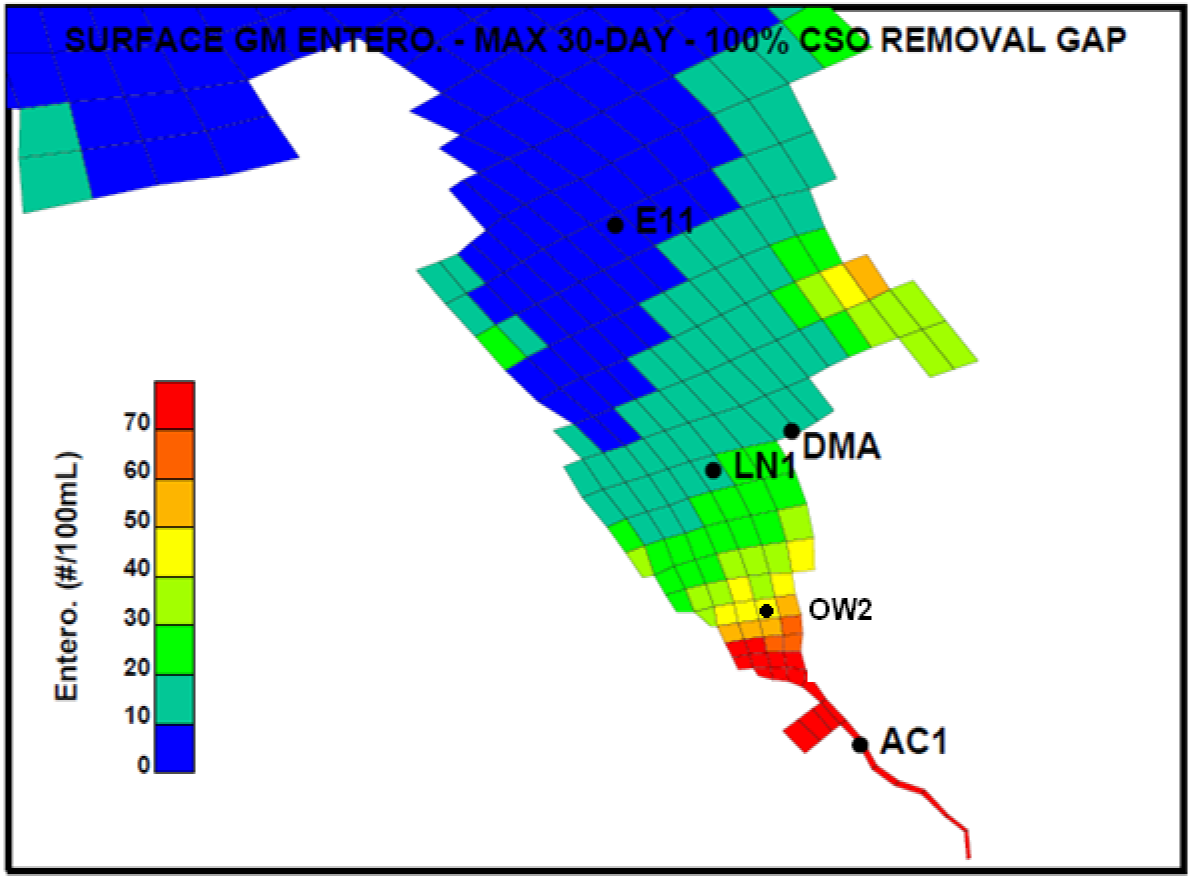


Figure 6-5. Max. 30-Day Enterococci Concentration Gap (10-Yr Simulation) with 100 Percent CSO Removal

These analyses indicate that complete removal of CSOs alone will not close the gap between the predicted baseline enterococci concentrations and the GM standard of 35 No./100mL to achieve 100 percent compliance with the standard. Additional water quality modeling analyses were performed to assess the extent to which CSO and non-CSO sources impact enterococci concentrations at key locations in Alley Creek and Little Neck Bay. A load source component analysis was conducted for the 2008 baseline year to provide a better understanding of how each source type contributes to enterococci concentrations in Alley Creek and Little Neck Bay. The source types include the East River at the mouth of Little Neck Bay, dry-weather inputs (Oakland Lake and a local pond), Nassau County stormwater, New York City stormwater, and CSOs. The analysis was completed at water quality Stations AC1, OW2, LN1, E11 and DMA using the ERTM model. The analysis included the calculation of GM and 90th percentile concentrations for the summer period (June-August), on an annual basis, and the 30-day period with the maximum GM. The GMs from each source can be added to determine the total GM. The 90th percentile concentrations are not necessarily additive, but are presented for illustrative purposes. The results of the component analysis are presented in Table 6-7.

For the summer period, only Station AC1 has a GM higher than 35 org/100mL; however, Alley Creek is not a Class SB waterbody, so the standard is not applicable at this location. Local sources, NYC stormwater and CSOs all contribute to the high enterococci GM concentration. Both Stations AC1 and OW2 had summer recreational period 90th percentile concentrations greater than 130 org/100mL. For the

90th percentile concentrations, NYC stormwater and CSOs are the primary contributors. The remaining locations analyzed had enterococci levels less than the proposed standards for the summer period.

On an annual basis, station AC1 remains the only location with a GM enterococci concentration greater than 35 org/100 mL. Stations LN1 and DMA are added to the list of stations with a 90th percentile greater than 130 org/100 mL, although they do not exceed this concentration by much with 140 org/100 mL and 145 org/100 mL, respectively. At stations LN1 and DMA, Nassau County stormwater becomes a larger portion of the calculated enterococci concentrations.

During the maximum 30-day period, all locations were calculated to have GM concentrations greater than 35 org/100 mL. During this period, even the East River boundary contributes a large portion of the enterococci concentrations. As CSO LTCPs are implemented in other sewersheds, East River enterococci concentrations should decline. The 90th percentile enterococci concentrations during the maximum 30-day period are well above 130 org/100 mL. The high concentrations are primarily a result of stormwater and CSO, but the East River can also be a significant contributor.

For the maximum 30-day period the calculations indicated that 100 percent of either NYC CSOs or NYC stormwater would not result in full attainment. To obtain full attainment during the maximum 30-day period, depending on location, 100 percent CSO removal along with reductions to other sources would be needed to reduce the calculated enterococci concentrations to below the GM standard of 35 No./100mL.

Table 6-8. Calculated Baseline Enterococci Concentrations from Various Loading Sources

Source	Station	Enterococcus Contribution, # /100mL					
		Geomean			90th Percentile		
		Summer	Year	Max 30-day	Summer	Year	Max 30-day
East River	AC1	1	1	3	1	4	30
Local Sources	AC1	9	12	17	15	18	15
Nassau County Stormwater	AC1	1	2	5	1	7	15
NYC Stormwater	AC1	16	32	129	218	549	1,405
CSO	AC1	9	19	130	371	782	2,986
Total	AC1	36	66	284	606	1,360	4,451
East River	OW2	1	2	5	2	7	51
Local Sources	OW2	1	1	4	2	4	2
Nassau County Stormwater	OW2	1	3	9	5	19	38
NYC Stormwater	OW2	4	8	51	89	148	333
CSO	OW2	2	5	55	72	129	679
Total	OW2	9	19	124	170	307	1,103
East River	LN1	1	2	8	4	12	63
Local Sources	LN1	0	0	1	0	0	8
Nassau County Stormwater	LN1	2	4	14	15	42	83
NYC Stormwater	LN1	1	3	20	30	45	95
CSO	LN1	1	2	15	24	41	164
Total	LN1	5	11	58	73	140	413
East River	E11	2	4	19	21	43	176
Local Sources	E11	0	0	0	0	0	0
Nassau County Stormwater	E11	2	3	14	23	27	53

Source	Station	Enterococcus Contribution, # /100mL					
		Geomean			90th Percentile		
		Summer	Year	Max 30-day	Summer	Year	Max 30-day
NYC Stormwater	E11	0	1	5	6	10	13
CSO	E11	0	0	4	9	11	51
Total	E11	4	8	42	59	91	293
East River	DMA	1	2	9	5	14	76
Local Sources	DMA	0	0	1	0	0	0
Nassau County Stormwater	DMA	2	5	18	21	56	117
NYC Stormwater	DMA	1	2	18	23	39	70
CSO	DMA	1	2	12	22	36	133
Total	DMA	5	11	58	71	145	396

*NYC Storm Water not Total Storm Water

2008 Rainfall Annual Simulation – Dissolved Oxygen

The water quality modeling assessment made herein indicates that the Bay is not in compliance with the dissolved oxygen WQS 100 percent of the time during baseline conditions when subjected to the 2008 rainfall conditions. Table 6-9 provides a summary of the impact on compliance with the 4 mg/L DO standard in Alley Creek and a higher minimum of 4.8 mg/L in Little Neck Bay. As noted in this table, although DO concentrations and compliance with standards slightly increase with complete removal of CSOs, complete attainment of these numerical limits is not possible with CSO removal alone.

Table 6-9. 2008 Rainfall Annual Simulation – Dissolved Oxygen

Station: AC1						
Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.0 mg/L	
	Baseline	100 Percent removal	Baseline	100 Percent removal	Baseline	100 Percent removal
Jan	11.0	11.1	7.3	7.5	100	100
Feb	12.0	12.0	8.7	8.9	100	100
Mar	11.0	11.1	6.4	6.7	100	100
Apr	8.9	9.0	5.1	5.2	100	100
May	6.5	6.6	3.2	3.4	99	100
Jun	5.1	5.2	2.1	2.2	89	91
Jul	6.6	6.7	3.1	3.2	95	97
Aug	6.8	7.1	3.5	3.6	99	100
Sep	5.6	5.9	1.2	1.3	91	93
Oct	8.0	8.1	4.4	4.6	100	100
Nov	8.6	8.6	4.4	4.6	100	100
Dec	9.7	9.8	6.2	6.6	100	100

Station: AC1						
Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.0 mg/L	
	Baseline	100 Percent	Baseline	100 Percent	Baseline	100 Percent
Year					98	98

Station: Tank Discharging Location						
Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.0 mg/L	
	Baseline	100 Percent removal	Baseline	100 Percent removal	Baseline	100 Percent removal
Jan	11.2	11.2	8.3	8.4	100	100
Feb	12.1	12.2	9.2	9.3	100	100
Mar	11.1	11.3	7.4	7.5	100	100
Apr	9.1	9.2	5.6	6.0	100	100
May	6.7	6.9	3.2	3.4	100	100
Jun	5.3	5.5	2.9	3.1	93	94
Jul	6.8	6.9	2.6	3.2	96	98
Aug	7.1	7.3	4.0	4.2	100	100
Sep	5.8	6.1	1.7	1.9	93	97
Oct	8.1	8.2	4.4	4.6	100	100
Nov	8.7	8.7	6.0	6.2	100	100
Dec	9.8	9.9	6.5	6.1	100	100
YEAR					99	99

Station: LN1						
Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.8 mg/L	
	Baseline	100 Percent removal	Baseline	100 Percent removal	Baseline	100 Percent removal
Jan	11.7	11.7	10.1	10.1	100	100
Feb	12.9	12.9	11.3	11.3	100	100
Mar	12.2	12.2	10.8	10.8	100	100
Apr	10.3	10.3	9.1	9.1	100	100
May	8.1	8.1	6.6	6.6	100	100

Station: LN1

Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.8 mg/L	
	Baseline	100 Percent	Baseline	100 Percent	Baseline	100 Percent
Jun	5.9	5.9	4.5	4.5	98	98
Jul	5.6	5.6	2.8	2.9	66	66
Aug	7.0	7.0	3.2	3.2	95	95
Sep	7.4	7.4	5.8	5.8	100	100
Oct	9.1	9.1	6.6	6.6	100	100
Nov	9.1	9.2	7.8	7.8	100	100
Dec	10.3	10.3	8.9	8.9	100	100
YEAR					96	97

Station: E11

Month in 2008	Model-Calculated Monthly Average DO (mg/L)		Model-Calculated Monthly Minimum DO (mg/L)		Model-Calculated Percent of Time DO>4.8 mg/L	
	Baseline	100 Percent removal	Baseline	100 Percent removal	Baseline	100 Percent removal
Jan	10.8	10.8	9.5	9.5	100	100
Feb	12.1	12.1	10.9	10.9	100	100
Mar	11.9	11.9	10.5	10.5	100	100
Apr	10.1	10.1	8.8	8.8	100	100
May	8.0	8.0	6.3	6.3	100	100
Jun	6.0	6.0	4.9	4.9	99	99
Jul	6.0	6.0	3.5	3.5	80	80
Aug	6.1	6.1	4.2	4.2	90	90
Sep	6.6	6.6	5.1	5.1	100	100
Oct	8.0	8.1	6.0	6.0	100	100
Nov	8.4	8.4	7.3	7.3	100	100
Dec	9.6	9.6	8.3	8.3	100	100
YEAR					97	97

6.3.b CSO Volumes and Loadings That Would be Needed to Support the Next Highest Use or Swimmable/ Fishable Uses

Alley Creek is currently classified as Class I, which does not have enterococci limits but does require an upper fecal coliform limit of 2,000 org/100mL on a monthly GM basis. Water quality modeling calculations at location AC1 in Alley Creek shows that this standard would be met under the baseline conditions. Upgrading the Class I standard to Class SB (swimmable/fishable) would impose an enterococci 30-day

GM maximum of 35 org/100mL and would reduce the fecal coliform criterion from 2,000 org/100mL to 200 org/100mL.

As shown in Figures 6-5 and 6-6, both enterococci and fecal coliform concentrations are calculated to exceed the Class SB levels. The calculated 30-day maximum GM enterococci concentration at AC1 is over 500 org/100mL (Figure 6-5) and the calculated monthly GM fecal coliform concentration is about 1,000 org/100mL. The enterococci sources would have to be reduced by 93 percent (1-35/500) while fecal coliform sources would have to be reduced by 80 percent (1-200/1000) to bring the 30-day enterococci GM and the monthly fecal coliform GM to equal the Class SB swimmable standard. As the Alley Creek CSO Retention Tank only overflows 5 percent of the hours within the period during which the maximum 30-day GM enterococci concentrations are computed and stormwater overflows occur during 26 percent of those hours, CSO control alone will not bring the waterbody into full compliance with upgraded Alley Creek water quality (SB) standards.

With respect to DO concentrations, Alley Creek has a very high level of attainment of the never less than 4 mg/L Class I standards. As noted above however, 100 percent CSO control does not result in complete compliance. Consequently, compliance with the higher never less than 4.8 mg/L SB standards is not possible through CSO removals alone.

7.0 PUBLIC PARTICIPATION AND AGENCY COORDINATION

As part of the City-wide LTCP program, DEP is committed to implementing a proactive and robust public participation program to inform the development of watershed-specific and City-wide LTCPs. Public outreach and public participation are important aspects of plans designed to reduce CSO-related impacts to achieve waterbody-specific WQS, consistent with the federal CSO Policy and the water quality goals of the CWA, and in accordance with EPA and DEC mandates.

DEP's public participation plan was released to the public on June 26, 2012, and describes the tools and activities DEP will use to inform and involve and engage a diverse group of stakeholders and the broader public throughout the LTCP process. The purpose of the public participation plan is to create a framework for communicating with and soliciting input from interested stakeholders and the broader public on water quality and the challenges and opportunities for CSO controls. As described in the plan, DEP will strategically and systematically implement activities that meet the information needs of a variety of stakeholders in an effort to meet critical milestones in the overall LTCP schedule as outlined in the 2012 Order on Consent signed by DEC and DEP on March 8, 2012.

As part of the CSO Quarterly Reports, DEP will report to DEC on public participation activities outlined in the public participation plan. Updates to the Public Participation Plan implemented as a result of public comments received and the quarterly summary of public participation activities reported to DEC will be posted annually to DEP's website.

7.1 Local Stakeholder Team

DEP began the public participation process for the Alley Creek and Little Neck Bay LTCP by reaching out to the Queens Borough President's Office and Community Board 11 to identify the stakeholders who would be instrumental to the development of this LTCP. Stakeholders identified included both City-wide and regional groups, including: environmental organizations such as APEC, Natural Resources Defense Council, Metropolitan Waterfront Alliance, IEC and Udalls Cove Preservation Society; community planning organizations such as Douglaston Historical Society, DMA, Bayside Marina; design and economic organizations such as Queens Chamber of Commerce and Auburndale Improvement Association; academic and research organizations such as Queens College and Polytechnic University of New York; and City government agencies such as DCP, DOHMH and DOH.

Given the proximity of the study area to an existing park, DEP also worked closely with DPR. In addition to engaging DPR as a stakeholder in the LTCP process, DEP and DPR are already working closely to coordinate data collection and identification of stormwater management strategies included as part of DPR's Alley Creek Watershed Planning and Habitat Restoration Study. This two-year study endeavors to identify ways DPR can shift from an opportunistic pursuit of restoration actions to intentional watershed-based restoration planning. As part of this process DPR identified stakeholders and is in the process of forming a WAC to help formulate resource management goals for the study; map watershed resource uses and future uses; identify and prioritize opportunities, and help develop a strategy for implementation. DEP plans to continue to meet with DPR and the WAC to coordinate planning efforts and leverage opportunities for plan implementation.

In addition, DEP will continue to coordinate with the DOH and DOHMH regarding fish advisory promotion information and outreach strategies. DEP ensures this information is available to local and regional stakeholders on the LTCP website and at public meetings.

7.2 Summaries of Stakeholder Meetings

DEP has held public meetings and several stakeholder group meetings to aid in the development and execution of the LTCP. The objective of the public meetings and a summary of the discussion are presented below:

Public Meetings

- Public Meeting #1: Alley Creek LTCP Kickoff Meeting (October 24, 2012)

  Objectives: Provide overview of LTCP process, public participation schedule, watershed characteristics and improvement projects; solicit input on waterbody uses.

  DEP and DEC co-hosted a Public Kickoff Meeting to initiate the water quality planning process for long term control of CSOs in the Alley Creek and Little Neck Bay Waterbody. The two-hour event, held at APEC in Queens served to provide overview information about DEP's LTCP Program, present information on the Alley Creek watershed characteristics and status of waterbody improvement projects, obtain public information on waterbody uses in Alley Creek, and describe additional opportunities for public input and outreach. The presentation can be found at http://www.nyc.gov/dep/ltcp. Approximately 15 stakeholders from over ten different non-profit, community planning, environmental, economic development, governmental organizations and the broader public attended the event.

  The Alley Creek LTCP Kickoff Public Meeting was the first opportunity for public participation in the development of the LTCP. In response to stakeholder comments, DEP provided detailed information for each of the following as part of the development of the LTCP:

  - CSO reductions and cost of existing and future CSO-related projects in Alley Creek;
  - Modeling baseline assumptions utilized during LTCP development;
  - Rainfall numbers and assumptions utilized during LTCP development;
  - Water quality data collection;
  - Existing Alley Creek and Little Neck Bay CSO discharges; and
  - Future public meeting announcements.

  Stakeholder comments and DEP's responses were emailed to all attendees and posted to DEP's website, and are also described in Appendix A, Long Term Control Plan (LTCP) Alley Creek Kickoff Meeting – Summary of Meeting and Public Comments Received

- Public Meeting #2: Alley Creek LTCP Alternatives Review Meeting (May 1, 2013)

  Objectives: Review proposed alternatives, related waterbody uses and water quality conditions.

  On May 1, 2013, DEP hosted a second Public Meeting to continue the water quality planning process for long term control of CSOs in Alley Creek and Little Neck Bay. The purposes of the two-hour event, held at APEC in Queens, were to: provide background and an overview of the LTCP planning process; present Alley Creek watershed characteristics and status of existing water quality conditions; obtain public input on waterbody uses in Alley Creek and Little Neck Bay; and describe the alternatives identification and selection process. The presentation is on DEP's LTCP Program

Website: http://www.nyc.gov/dep/ltcp. Ten stakeholders from over five different non-profit, community planning, environmental, economic development, governmental organizations and the broader public attended the event.

In response to stakeholder comments, DEP provided detailed information for each of the following as part of the development of the LTCP:

- Modeling baseline assumptions utilized during LTCP development;
- Rainfall data and assumptions utilized during LTCP development;
- Water quality data collection;
- Stormwater inputs/contributions to Alley Creek and Little Neck Bay;
- Green infrastructure and grey infrastructure potential alternatives;
- Ecological restoration opportunities in Alley Creek and Little Neck Bay;
- Opportunity to review and comment on the draft Alley Creek LTCP;
- Existing Alley Creek and Little Neck Bay CSO discharges; and
- Future public meeting announcements.

Stakeholder comments and DEP's responses were emailed to all attendees and posted to DEP's website, and are also described in Appendix B, Alley Creek Meeting #2 – Summary of Public Comments Received and DEP Responses.

During this Public Meeting #2, there was a high degree of public support for the DEP's findings that additional grey infrastructure based-CSO controls was not warranted due to the improvements made from the 2009 WWFP.

- Public Meeting #3: Draft LTCP Review Meeting (Fall 2013)

  Objectives: Present LTCP and associated UAAs

  This meeting is scheduled to be held in the Fall of 2013. Outcomes of the discussion and a copy of presentation materials will be posted to DEP's website.

Stakeholder Meetings

- September 12, 2012

  DEP attended the Queens Borough Cabinet Meeting and presented information on public outreach for the Alley Creek LTCP to Queens Borough President, Helen Marshall and Queens Borough Cabinet members. In addition to presenting information on public outreach, DEP answered questions regarding the Alley Creek LTCP development schedule and process, elements of the approved Alley Creek WWFP and CSO controls. DEP provided Community Board representatives with a PowerPoint presentation on September 21, 2012, to be forwarded to their constituents. The presentation was also posted to DEP's LTCP Program website.

- September 29, 2012

  DEP staffed a table at the Little Neck Bay Festival at the APEC in Douglaston, Queens. DEP distributed an Alley Creek LTCP summary, an Alley Creek LTCP Kickoff notice and other LTCP-related educational materials to attendees. Approximately 20 stakeholders from over seven organizations and the broader public asked to be added to DEP's LTCP stakeholder database.

- October 24, 2012

  DEP met with APEC staff to discuss APEC's existing educational programs and ways DEP can support and build upon these efforts. DEP will continue to meet and work with APEC throughout the development of waterbody-specific LTCPs to support the development of environmental educational information for grades K-12.

7.3 Coordination with Highest Attainable Use

In cases where existing WQS do not meet the Section 101(a)(2) goals of the CWA, or where the proposed alternative set forth in the LTCP will not achieve existing WQS or the Section 101(a)(2) goals, the LTCP will include a UAA to examine whether applicable waterbody classifications criteria or standards should be adjusted by the State. The UAA assesses the waterbody's highest attainable use, which the State will consider in adjusting WQS, classifications, criteria and developing waterbody-specific criteria.

Comprehensive analysis of baseline conditions and the future anticipated conditions after implementing the recommended LTCP projects show that Alley Creek will remain a highly productive Class I waterbody that can fully support secondary uses including nature education and wildlife propagation. Alley Creek is in attainment with its current Class I classification, but it is not feasible for the waterbody to meet the water quality criteria associated with the next highest or Class SB classification. Furthermore, combinations of natural and manmade features prevent both the opportunity and feasibility of contact recreation in Alley Creek. Little Neck Bay generally meets the Class SB criteria but fails to do so 100 percent of the time. It should be noted, however, that the summer season compliance is 100 percent at DMA Beach, the only official bathing beach in the waterbody. The continued presence of non-CSO discharges, most notably stormwater from MS4 outfalls, prevents annual attainment of Class SB standards even when 100 percent CSO volume reduction is considered. Given that CSO control alone is projected to be ineffective in meeting Class SB criteria, upgrading the classification of Little Neck Bay to Class SA under the LTCP program is not feasible.

DEP obtained public feedback on waterbody uses in Alley Creek and Little Neck Bay at the May 1, 2013, Public Meeting. It should be noted that there was a high degree of public support for DEP's findings that additional grey infrastructure based-CSO controls was not warranted due to the improvements made from the 2009 WWFP. DEP will continue to gather public feedback on waterbody uses and will provide the public UAA-related information at the third Alley Creek and Little Neck Bay Public Meeting in the Fall of 2013.

7.4 Internet Accessible Information Outreach and Inquiries

Both traditional and electronic outreach tools are important elements of DEP's overall communication effort. DEP will ensure outreach tools are accurate, informative, up-to-date and consistent, and are widely distributed and easily accessible. Refer to Table 7-1 for a summary of Alley Creek LTCP public participation activities.

DEP launched its LTCP Program website on June 26, 2012. The website provides links to documents related to the LTCP program, including CSO Orders on Consent, approved WWFP, LTCP Quarterly Reports, links to related programs such as the Green Infrastructure Plan, and handouts and poster boards distributed and displayed at public meetings and open houses. A LTCP feedback email account was also created to receive LTCP-related feedback and stakeholders can sign up to receive LTCP Program announcements via email. Refer to Appendix C, Summary of Public Comments Received via Email and DEP Responses, for this feedback.

In general, DEP's LTCP Program website:

- Describes the LTCP process, CSO related information and City-wide water quality improvement programs to date;
- Describes waterbody-specific information including historical and existing conditions;
- Provides the public and stakeholders with timely updates and relevant information during the LTCP process including meeting announcements;
- Broadens DEP's outreach campaign to further engage and educate the public on the LTCP process and related issues; and
- Provides an online portal for submission of comments, letters, suggestions, and other feedback.

Specific to Alley Creek, an Alley Creek LTCP webpage was created in September 2012 and includes the following information:

- Alley Creek public participation and education materials
  - Alley Creek and Little Neck Bay Summary Paper
  - Alley Creek Waterbody/Watershed Facility Plan
  - LTCP Public Participation Plan
- Alley Creek LTCP Meeting Announcements
- Alley Creek Kickoff Meeting Documents – October 24, 2012
  - Advertisement
  - Meeting Agenda
  - Meeting Presentation
  - Meeting Summary and Response to Comments
- Queens Borough Cabinet Presentation – September 12, 2012
- Alley Creek Meeting #2 Meeting Documents – May 1, 2013
  - Advertisement
  - Meeting Agenda
  - Meeting Presentation
  - Meeting Summary and Response to Comments

Table 7-1. Summary of Alley Creek LTCP Public Participation Activities Performed

Category	Mechanisms Utilized	Dates (*if applicable*) and Comments
Regional LTCP Participation	City-wide LTCP Kickoff Meeting and Open House	• June 26, 2012
	Annual City-wide LTCP Meeting – Modeling Meeting	• February 28, 2013
Waterbody-specific Community Outreach	Public meetings and open houses	• Kickoff Meeting: October 24, 2012 • Meeting #2: May 1, 2013 • Meeting #3: TBD
	Stakeholder meetings and forums	• Little Neck Bay Festival: September 29, 2012 • APEC meeting: October 24, 2012
	Elected officials briefings	• Queens Borough Cabinet Briefing: September 12, 2012
Data Collection and Planning	Establish online comment area and process for responding to comments	• Comment area added to website on October 1, 2012 • Online comments receive response within 2 weeks of receipt
	Update mailing list database	• DEP updates master stakeholder database (700+ stakeholders) after each meeting and briefing
	Solicit input via surveys	• TBD
Communication Tools	Program Website or Dedicated Page	• LTCP Program website launched June 26, 2012 and frequently updated • Alley Creek LTCP webpage launched October 1, 2012 and frequently updated
	Social Media	• TBD
	Media Outreach	• TBD
	FAQs	• LTCP FAQs developed and disseminated beginning June 26, 2012 via website, meetings and email
	Print Materials	• LTCP FAQs: June 26, 2012 • LTCP Goal Statement: June 26, 2012 • LTCP Public Participation Plan: June 26, 2012 • Alley Creek Summary: October 15, 2012 • LTCP Program Brochure: February 28, 2013 • Glossary of Modeling Terms: February

Table 7-1. Summary of Alley Creek LTCP Public Participation Activities Performed

Category	Mechanisms Utilized	Dates (*if applicable*) and Comments
		28, 2013 • Meeting advertisements, agendas and presentations • PDFs of poster board displays from meetings • Meeting summaries and responses to comments • Quarterly Reports • WWFPs
	Translated Materials	• As-needed basis
	Portable Informational Displays	• Poster board displays at meetings
	Advisories and Notifications	• TBD
	Construction Outreach	• N/A
Student Education	Participate in ongoing education events	• Little Neck Bay Festival: September 29, 2012
	Provide specific green and grey infrastructure educational modules	TBD
	Partner with local universities	TBD
	Offer tours of waterways	TBD

8.0 EVALUATION OF ALTERNATIVES

This section of the LTCP describes the development and evaluation of CSO control measures and watershed-wide alternatives, including those contained in the 2009 Alley Creek and Little Neck Bay WWFP. A control measure is any technology (e.g., treatment, storage, etc.), practice (e.g., NMC or BMP) or other method (e.g., source control, GI, etc.) that is capable of abating CSO discharges or the effects of such discharges on the environment. Alternatives are comprised of a single control measure or a suite of control measures that collectively will address the water quality goals and objectives for Alley Creek and Little Neck Bay. Each alternative is evaluated considering several parameters, including: feasibility of construction and implementation; improvements to the waterbody in terms of water quality parameters and aesthetics; significant reductions in the number of CSO events and annual CSO volume; and construction costs.

8.1 Considerations for LTCP Alternatives under the Federal CSO Policy

The LTCP addresses the water quality goals of the federal CWA and the New York State Environmental Conservation Law, building upon the EPA NMCs as well as the conclusions presented in the 2009 WWFP. In cases where existing WQS do not meet the Section 101(a)(2) goals of the CWA, or where the proposed alternative set forth in the LTCP will not achieve existing WQS or the Section 101(a)(2) goals, the LTCP will include a UAA to examine whether applicable waterbody classifications, criteria, or standards should be adjusted by the State. The UAA assesses the waterbody's highest attainable use, which the State will consider in adjusting WQS, classifications, criteria and developing waterbody-specific criteria.

The remainder of this Section 8.1 discusses the applicable water quality goals and how the CSO controls and watershed-wide alternatives were developed and evaluated to comply with the CWA in general and the CSO Control Policy in particular.

8.1.a Performance

Section 6 presented evaluations of baseline conditions and identified performance gaps where baseline conditions do not attain current WQS. Alley Creek and Little Neck Bay are in attainment with current DO standards, but Little Neck Bay is not in attainment with all bacterial standards. Also, Alley Creek could not attain the next highest bacteria standards for contact recreation (DEC SB Classification). Therefore, discussion of performance for Alley Creek and Little Neck Bay alternatives will focus on bacterial standards.

Results from the sensitivity analysis in Section 6 indicate that CSO control alone would not close the enterococci performance gap for Little Neck Bay. During the development of alternatives, performance will be more closely examined to evaluate the impact of various degrees of CSO reduction on attainment of WQS. LTCPs are typically developed with alternatives evaluated spanning a range of CSO volume reductions. Accordingly, this LTCP will include alternatives for zero, 25, 50, 75 and 100 percent reduction in CSO AAOV. Performance of each control measure and subsequent alternative will be measured against its ability to meet the goals of the CWA and water quality requirements at the 2040 planning horizon. It is essential that any proposed control measure be capable of meeting the modeled anticipated performance. As such, only proven control measures will be included in the plan alternatives.

8.1.b Impact on Sensitive Areas

Special consideration will be given during the development of alternatives to minimize the impact of construction, to protect existing sensitive areas, and to enhance water quality in sensitive areas. As described in Section 2, there is one sensitive area within Alley Creek and Little Neck Bay, namely the

DMA Beach. The LTCP will, therefore, address the EPA policy requirements: (a) prohibit new or significantly increased overflows; (b) 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 (c) provide reassessments in each permit term based on changes in technology, economics, or other circumstances for those locations not eliminated or relocated (EPA, 1995a).

8.1.c Cost

Cost estimates for the alternatives were computed using a costing tool that is based on parametric costing data. This approach is assumed to provide an Association for the Advancement of Cost Engineering (AACE) Class V estimate which is appropriate for this type of planning evaluation.

For the LTCP alternatives, total project cost includes the capital cost of the project, including construction, engineering and other project development costs. Annual operation and maintenance (O&M) costs are then used to calculate the total present worth or value over the projected useful life of the project. To quantify costs and benefits, alternatives are compared based on reductions of both CSO discharge volume and bacteria loading against the total cost of the alternative. The resulting graph, called the knee-of-the-curve, will be used to help select the final recommended alternative. In doing so, it is not necessarily the lowest cost alternative that will be selected, but the alternative that achieves the greatest appreciable water quality improvements at the lowest cost. Beyond the comparative evaluation of alternatives, cost-effectiveness must be evaluated from a broader perspective: recommended alternatives must be capable of achieving water quality goals in a fiscally responsible manner to ensure that limited resources are properly allocated across the overall City-wide LTCP program.

8.1.d Technical Feasibility

There are several factors considered when evaluating technical feasibility including:

- Effectiveness for controlling CSO
- Reliability
- Implementation

The effectiveness of CSO control measures will be assessed based on their ability to reduce CSO frequency, volume, and intensity. Reliability is an important operational consideration and can have an impact on overall effectiveness of a control measure. Therefore, reliability and proven history are essential factors for assessing the technical feasibility and cost effectiveness of a control measure.

Several site specific factors are considered when evaluating an alternative's technical feasibility including available space, neighborhood assimilation, impact on parks and green space, and overall practicability of installing the CSO control. In addition, the method of construction will be factored into the final selection. Some technologies require specialized construction methods that typically incur additional costs.

8.1.e Cost-Effective Expansion

All alternatives evaluated were sized to handle the 2040 design year CSO volume with the understanding that is a predicted flow value and actual volume may differ. To help mitigate the difference between predicted and actual flows, with an adaptive management framework consideration will be given to those CSO technologies that can be expanded in the future date to capture additional CSO volume should it be needed. In some cases this may affect where the facility is constructed or give preference to a facility that can be expanded at a later date with minimal cost and disruption of operation.

Breaking construction into segments allows adjustment of the design of future phases based on the performance of already constructed phases. Lessons learned during operation of the current facilities can be incorporated into the design of the future facilities. However, phased construction also exposes the local community to a longer construction period. For those alternatives that can be expanded, the LTCP will discuss how easily they can be expanded, what additional infrastructure may be required, and if additional land acquisition is needed.

As regulatory requirements change, the need for improvements in nutrient removal or disinfection could arise. The ability of a CSO control technology to be retrofitted to handle these types of processes will improve the rating of that technology.

8.1.f Long Term Phased Implementation

The final recommended plan will be structured in a way that makes it adaptable to change via expansion and modifications in response to new regulatory and/or local drivers. If applicable, a goal is for the project(s) to be implemented over a multi-year schedule. Because of this, permitting and approval requirements will need to be identified prior to selection of the alternative. If necessary a permit schedule will be developed outlining when permit applications should be submitted or renewed in order to meet the project schedule. With the exception of GI, which is assumed to occur on both private and public property, most if not all of the CSO grey technologies will be limited to City-owned property and right-of-way-acquisitions. DEP will work closely with other City agencies, and possibly the State of New York, to ensure proper coordination with these other agencies.

8.1.g Other Environmental Considerations

Impact on the environment and surrounding neighborhood will be minimized as much as possible during construction. These considerations include but are not limited to: traffic impacts, site access issues, park and wetland disruption, noise pollution, air quality, and odor emissions. In order to ensure these ancillary environmental considerations are minimized they will be identified with the selection of the recommended plan and communicated to the public. Any identified potential concerns will be addressed in a pre-construction environmental assessment.

8.1.h Community Acceptance

As described in Section 7, DEP is committed to involving the public and regulators early in the planning process through a community conversation about the scope and goals of the LTCP and continuing public involvement during its development, evaluation, and selection of plan elements. Community acceptance of the recommended plan is essential to its success. The Alley Creek and Little Neck Bay LTCP is intended to be an integral part of the community, enhancing the quality of life in the neighborhood while addressing CSOs. The public's health and safety are the first priority of the plan. Raising awareness of and access to waterbodies is a goal of the plan and will be considered during the alternative analysis. Several CSO control measures, such as GI, have been shown to enhance the community while increasing local property values and, as such, the benefits of GI will be considered in the formation of the final recommended plan.

8.1.i Methodology for Ranking Alternatives

The Alley Creek and Little Neck Bay LTCP employed a three-step procedure developed to evaluate and rank control measures and alternatives:

- Step 1: Screening of Potential Control Measures
- Step 2: Development and Ranking of Control Measures
- Step 3: Final Evaluation and Selection of Preferred Watershed-Wide Alternative

This process, with possible minor revision, could also be used for the other LTCPs within New York City. The goal of the process was to implement a triple bottom line approach when evaluating alternatives by taking into account environmental, economic, and social considerations.

An overview of the three-step procedure is as shown in Table 8-1. Overall, the methodology for ranking control measures transforms from being highly qualitative to more quantitative as the steps progress. This is particularly true for Step 3 where cost estimates, capital and annual operation and maintenance (O&M), and predicted performance data (both CSO control measures and water quality impacts) are used to perform the cost performance or knee-of-the-curve (KOTC) analysis.

Table 8-1. Three-Step Control Measure and Watershed-Wide Alternative Evaluation and Screening Process

	Step 1: Screening of Potential Control Measures	**Step 2: Evaluation and Ranking of Control Measures**	**Step 3: Final Evaluation and Selection of Preferred Watershed-Wide Alternative**
Type of Process	Qualitative	Quantitative	Cost/Performance using KOTC
Rating Criteria	Fatal flaw analysis (no quantitative metrics)	Non-economic metrics	1. Lifecycle costs: capital plus annual O&M 2. Control level performance (see below)
Purpose/Outcome	Selection of the most viable control measures for the watershed under consideration	Determination of the highest-ranked control measures for development of alternatives	1. Final ranking of alternatives based on cost per MG of CSO volume controlled ($/gallon). 2. Other KOTC parameters could also be considered such as unit cost of pollutant reduction or unit cost of days/hours of additional WQS attainment
Process Implementation	1. Develop a list of potential control measures in a workshop setting. 2. Evaluate and screen potential control measures based on applicability to the specific waterbody/ watershed. Examine for fatal flaws or weaknesses that would prevent or limit a control measure's efficacy for CSO abatement	1. Evaluate, score and rank the remaining control measures from Step 1. 2. Develop alternatives for the watershed using the highest ranked control measures, 3. Alternatives will be subjected to economic and cost-performance evaluations in Step 3	1. Use the most recent waterbody and watershed modeling data to transform the process into a more quantitative direction. 2. Develop updated costing templates with the addition of annual O&M costs. 3. Determine water quality gaps. 4. Perform KOTC analysis using the most viable watershed-wide alternatives

In Step 1 the potential technologies and control measures are evaluated qualitatively to judge their ability to meet the LTCP goals and to identify fatal flaws that could disqualify a control measure from use in the watershed under consideration. Examples of fatal flaws could include insufficient land or less than desirable siting for a particular technology, a technology that is unproven in addressing the performance objectives required or an approach or alternative that would cause wide-spread impact to the local community during and after construction.

In Step 2, the resulting, most favorable control measures are then rated using pre-defined non-economic criteria or metrics covering the following three categories:

- Environmental Benefits
- Community and Societal Impacts
- Implementation and O&M Considerations

Factors considered for each of these three categories are described in Table 8-2. Economic considerations are not included in Step 2, but will be evaluated in Step 3, when the watershed-wide alternatives are more fully developed. The control measures are rated by assigning a score for each metric with a value of "5" indicating a highly favorable rating and a "1" indicating the most unfavorable rating. The scoring scale is shown in Table 8-3.

Table 8-2. Definitions of Step 2 Metrics

Metric	Description
A. Environmental	
A1. CSO Frequency/ Volume	Decrease in discharge frequency and AAOV.
A2. Pollutant Reduction/ Water Quality improvements	Decrease in discharge of pollutants including floatables, TSS, BOD and pathogens.
A3. Control of Discharge to Sensitive Areas	Degree to which sensitive areas, such as bathing beaches and marinas, are protected from the remaining CSO discharges.
B. Community/Societal	
B1. Environmental Justice	Degree to which the control measures affects low- and moderate-income neighborhoods.
B2. Ancillary Community Benefits	Benefits including, but not limited to, streetscape improvements; enhanced recreational opportunities; localized street flooding; and control of discharge to waterfront public access areas.
B3. Community Disruption/ Potential for Nuisances	Disruption to the affected area during construction and subsequent routine O&M of the control measures including traffic, dust, noise, aesthetics, etc.
C. Implementation and O&M	
C1. Constructability/Permitting	Possible impediments to implementation including, but not limited to: degree of construction difficulty; environmental and operational permitting; presence of hazardous materials, subsurface or topographic conditions; permanent land requirements, easements or deed restrictions; planned redevelopment; inter-governmental jurisdictional issues; and other land use and zoning requirements.

Table 8-2. Definitions of Step 2 Metrics

Metric	Description
C2. Operating Complexity/ Ease of O&M	Consistency with existing O&M practices and/or level of complexity of the project components including, but not limited to: use of chemicals; reliance on multiple sensors/meters; operation of upstream and/or downstream facilities, etc.
C3. Sustainability	Degree to which the construction and routine O&M of the control measures consumes labor, materials, chemicals, power and fuel over their useful life.

Table 8-3. Step 2 Scoring Scale

Score	General Definition
5	Highly Favorable
4	Favorable
3	Neutral
2	Unfavorable
1	Highly Unfavorable

Because the various metrics are not considered equal in terms of their relative importance, a system of weighting factors was needed to ensure that the evaluation, ranking and screening process is reflective of both DEP and community goals and objectives for the LTCP program. Different weighting factors were assigned to the three major categories of metrics with the total adding to 100 percent. Furthermore, weighting factors also were assigned to each metric within each major category as the individual metrics may have different levels of importance within the major category. The overall metric weighting factor is the product of the individual metric weight and the major category weight. The overall metric weighting factors are shown in Table 8-4.

Table 8-4. Weighting Factors for Step 2 Metrics

Major Category	Category Weighting Factor	Metric	Metric Weighting Factor
A. Environmental	0.45	A1. CSO Volume/Frequency	0.16
		A2. Pollutant Reduction/Water Quality Improvements	0.16
		A3. Control of Discharge to Sensitive Areas	0.13
B. Community/ Societal	0.25	B1. Environmental Justice	0.08
		B2. Ancillary Community Benefits	0.08
		B3. Community Disruption/ Potential for Nuisances	0.09

C.			
D.			
E. Implementation and O&M	0.30	C1. Constructability/Permitting	0.15
		C2. Operating Complexity/Ease of O&M	0.09
		C3. Sustainability	0.06

The most promising or highest ranked control measures then pass on to Step 3 where they form watershed-wide alternatives. Here, they were evaluated in greater detail using economic criteria and other cost-performance and water quality attainment criteria. Using these expanded criteria, including the latest results from both updated landside and water quality modeling, cost-performance or KOTC evaluations are performed so that the most environmentally-sound and cost-effective alternative can be selected. In order to construct the cost-performance curves, alternatives were developed to cover a range of CSO control including 25, 50, 75 and 100 percent AAOV capture and to address the performance gaps described in Section 6.3.

8.2 Matrix of Potential CSO Reduction Alternatives to Close Performance Gap from Baseline

Using this evaluation methodology, 11 control measures were deemed as being viable from the Step 1 process and passed into Step 2. They were then scored using the metrics shown in Table 8-2, scoring definitions (Table 8-3), and weighting factors (Table 8-4). The results of this step in the process are shown in Table 8-5. As shown, scores ranged from a high of 4.02 (80.4 percent) for expanding the existing CSO Retention Tank to a low of 2.17 (43.4 percent) for netting facilities. HLSS and VTS storage were also highly ranked with scores of 3.50 (70.0 percent) and 3.35 (67.0 percent), respectively. System optimization and GI also ranked in the top five control measures with scores of 2.94 (58.8 percent) and 2.92 (58.4 percent), respectively. It is important to note, however, that while GI and system optimization ranked in the top five, they were not viewed as being able to close the performance gap in water quality as standalone control measures and would need to be combined with other control measures to fulfill the LTCP goals. Disinfection of contents of the existing CSO Retention tank had a score of 2.76 (55.2 percent) and, as such, was not retained for further evaluation.

Table 8-5. Step 2 Scoring of Control Measures

	Environmental			Community/Societal			Implementation/ O&M					
CSO Control Measure	**CSO Volume & Frequency**	**Pollutant Reduction/ WQ Improvement**	**Control of Discharge to Sensitive Areas**	**Environmental Justice**	**Ancillary Community Benefits**	**Community Disruptions/ Potential for Nuisances**	**Constructability/ Permitting**	**Operating Complexity/ O&M Requirements**	**Sustainability**	**Raw Score**	**Weighted Score**	**Weighted Score % of Possible Total Score**
	16%	16%	13%	8%	8%	9%	15%	9%	6%	#	#	%
High Level Sewer Separation (HLSS)	5	3	2	4	4	2	3	5	4	32	3.50	70.0
Expand Existing CSO Retention Tank	5	5	5	3	3	4	3	4	2	34	4.02	80.4
Disinfection in Existing CSO Retention Tank	1	4	4	3	3	4	3	1	1	24	2.76	55.2
Chemically Enhanced Settling in Existing CSO Tank	1	3	2	3	3	4	4	2	1	23	2.58	51.6
Bar Screen in Existing CSO Tank	1	1	1	3	3	4	5	2	3	23	2.40	48.0
Increase Pump Station and Interceptor Capacity to WWTP	2	2	2	3	3	3	3	4	2	24	2.58	51.6
VTS Storage	5	4	5	3	3	2	2	2	2	28	3.35	67.0
Netting Facilities	1	2	1	3	3	3	3	2	3	21	2.17	43.4
Green Infrastructure	2	2	2	4	4	3	3	4	5	29	2.92	58.4
System Optimization (Sewer Enhancements)	2	2	2	3	3	5	4	3	4	28	2.94	58.8
Real Time Control (RTC)	2	2	2	5	3	5	2	2	3	24	2.49	49.8

The top-ranked control measures from Step 2, listed in Table 8-6, were further developed into alternatives by identifying specific levels of CSO control along with potential locations for implementation of the control measures. In keeping with the LTCP guidance, alternatives were developed that span a range of CSO volumetric and/or pollutant reduction controls, including the 100 percent control level. To assist in this process, the Alley Creek and Little Neck Bay watershed IW model was used to match the retained control measures to various levels of reduction in AAOV and pollutant loading, most notably bacteria. As shown in Table 8-7, alternatives were matched with targeted AAOVs ranging from 15 percent for 10 percent GI coverage to 100 percent for a 29.5 MG expansion of the existing Alley Creek CSO Retention Tank. As noted, there are multiple alternatives for the 50 percent and 75 percent AAOV targets. Expanded development of the alternatives is presented in the following sections.

Table 8-6. Control Measures Retained for Watershed-Wide Alternatives Development

Core Control Measure(s)	Remarks
HLSS	1. For closure of moderate to large performance gaps 2. Could be supplemented by GI and/or System Optimization
Expand Existing CSO Retention Tank (or Additional New Downstream Retention Tank)	1. For closure of moderate to large performance gaps 2. Could be supplemented by GI and/or System Optimization
VTS Storage	1. For closure of moderate to large performance gaps 2. Could be supplemented by GI and/or System Optimization 3. For either additional downstream or new upstream storage
GI	Limited to closure of small performance gaps
System Optimization (Sewer Enhancements)	Limited to closure of small performance gaps

Table 8-7. Potential Alternatives for Targeted AAOV Control Levels

Target AAOV Reduction Percent	Control Measures	Description
15	1. 10 percent GI Coverage	1. See Section 8.2.b
25	1. 3.0 MG Downstream Tank and 2.4 MG Upstream Tank	1. See Section 8.2.a.3
50	1. 6.5 MG Downstream Tank and 6.7 MG Upstream Tank 2. 100 percent HLSS (51 percent)	1. See Section 8.2.a.3 for tank alternatives 2. See Section 8.2.a.3 for HLSS alternative
65	1. 50 percent GI Coverage (69 percent)	1. See Section 8.2.b
75	1. 12 MG Downstream Tank 2. 3.0 MG Downstream Tank and HLSS (71 percent)	1. See Section 8.2.a.3 for tank alternatives 2. See Section 8.2.d For the hybrid tank plus alternative
100	1. 29.5 MG Downstream Tank	1. See Section 8.2.a.3

8.2.a Other Future Grey Infrastructure

"Grey infrastructure" refers to single purpose systems used to control, reduce or eliminate the discharges from CSOs. These are the technologies that have been traditionally employed by DEP and other wastewater utilities in their CSO planning and implementation programs. They include retention tanks, dedicated and centralized treatment plants, including high-rate physical-chemical treatment (also referred to as high-rate clarification) and other similar capital intensive facilities Grey infrastructure implemented under previous CSO control programs and facility plans is described in Section 4, above, and includes the Alley Creek CSO Retention Tank (a traditional, shallow, below-ground concrete retention tank) along with major related sewer system and pump station modifications.

The existing Alley Creek CSO Retention Tank captures up to 5 MG of CSO volume per storm event and was designed for capture of over 50 percent of the CSO AAOV discharged to Alley Creek and Little Neck Bay. For the purpose of this LTCP, "Other Future Grey Infrastructure" refers to potential grey infrastructure beyond any existing grey infrastructure control measures implemented under previous planning documents such as the 2009 WWFP.

8.2.a.1.1 High Level Sewer Separation

High Level Sewer Separation (HLSS) is a form of partial separation which separates the combined sewers only in the streets or other public rights-of way, while leaving roof leaders or other building connections unaltered. This is accomplished by constructing either a new sanitary wastewater system or a new stormwater system and directing flow from street inlets and catch basins to the newly separated storm sewer. Challenges associated with HLSS include constructing new sewers with minimal disruption to the neighborhoods along the proposed alignment, finding a viable location for any necessary new stormwater outfalls and avoiding conflicts with recent system improvements upstream of the Alley Creek CSO Retention Tank. Separation of sewers minimizes the amount of sanitary wastewater being discharged to receiving waters but also results in increased separate stormwater discharges (which also carry pollutants) to receiving waters.

One HLSS alternative was developed for the CSS that is tributary to Regulators 46 and 47. This will be referred to as Alternative 1. The CSS associated with these regulators is west of Alley Pond Park (see Figure 2-9), represents 86 percent of the entire Alley Creek and Little Neck Bay CSS and corresponds to 16 percent of the total watershed. An enlarged view of the area served by these two regulators is shown in Figure 8-1. Under this alternative, newly separated stormwater would be conveyed through a new municipal separate storm sewer system (MS4) to Alley Creek along the route shown in Figure 8-2. The new outfall would need to be permitted under the MS4 program.

Hydraulic modeling using the re-calibrated IW model determined that HLSS could provide up to a 51 percent reduction of the CSO AAOV. Because this level was deemed to be insufficient to close the performance gap described in Section 6.3, HLSS was also considered in combination with VTS storage (see Section 8.2.d).

Figure 8-1. Combined Sewer Service Area Tributary to Regulators 46 and 47

Figure 8-2. HLSS for CSS Tributary to Regulators 46 and 47

8.2.a.1.2 Sewer Enhancements

Sewer enhancements, also known as system optimization, aim to reduce CSO through improved operating procedures or modifications to the existing collection system infrastructure. Examples include control gate modifications, regulator or weir modifications, inflatable dams and real time control (RTC). These control measures generally retain more of the combined sewage within the existing sewer pipes during storm events. The benefits of retaining this additional volume must be balanced against the potential for sewer back-ups and flooding. Viability of these control measures are system specific, depending of existing physical parameters such as pipeline diameter, length, slope and elevation.

Evaluations performed under previous facility plans have shown that the Alley Creek and Little Neck Bay sewer system is not amenable to significant CSO reductions through sewer system enhancements or optimization. After updating the IW collection system model and re-examining the state of RTC technology, it was found that the previous conclusions are still valid and RTC is still not viable within Alley Creek and Little Neck Bay. Elevated static weir heights, opportunities for inflatable dams and/or control gates, and similar alternatives within the sewer system pipes have been eliminated from further consideration due to risk of flooding in the community. At best, alternatives relying solely on sewer enhancements would be limited to closure of small performance gaps. Although this LTCP does not propose any specific alternatives under this control measure category, sewer enhancements may be indirectly considered under other alternatives (e.g., additional storage/retention alternatives may need to include sewer enhancements if the evaluation shows pump station and sewer system conveyance limitations that impact storage dewatering).

8.2.a.1.3 Retention/Treatment Alternatives

Retention Alternatives

The objective of retention is to reduce overflows by intercepting combined sewage in an offline or inline storage element during wet weather for controlled release into the WWTP after the storm event. Retention control measures considered in this LTCP include traditional, shallow, closed concrete tanks and VTS storage. More detailed description for traditional tanks can be found in the Alley Creek and Little Neck Bay WWFP (2009).

As an alternative to a traditional shallow tank, additional capacity could be added by construction of a VTS for the purposes of storage only. Extending deeper into the ground compared to a traditional shallow tank, the VTS can provide a large storage capacity while occupying a smaller ground surface footprint. The smaller footprint may allow for versatility when siting the VTS. As with traditional shallow tanks, VTSs typically include odor control systems, washdown/solids removal systems and access for cleaning and maintenance.

Siting considerations are key factors in determining the viability of additional storage and may influence the selection of the type of tank – traditional shallow tank or VTS storage - and the location. Evaluation of the Alley Creek and Little Neck Bay watershed identified two candidate locations for siting additional retention facilities:

- Downstream near the existing CSO Retention Tank (including both adjacent to the existing tank and to the south of Northern Boulevard)
- Upstream of the existing tank at the CSO regulators for the CSS area

Retention Alternatives - Downstream Sites

Downstream sites are near the existing Alley Creek CSO Retention Tank, which is located just north of Northern Boulevard between the Cross Island Parkway and Alley Creek. Additional retention could be constructed adjacent to the existing facility, sharing the influent sewers, control structures, tank drain piping and outfall that have already been built. Several retention alternatives spanning a range of 25 to 100 percent AAOV reduction were developed near this downstream location. As shown in Table 8-8, under baseline conditions with the Alley Creek Retention Tank in operation, virtually all of the CSO discharge to Alley Creek and Little Neck Bay is conveyed through outfall TI-025, which is the outfall associated with the Alley Creek Retention Tank. In order to capture 100 percent of the 132.5 MG/yr AAOV discharged through TI-025, an additional 29.5 MG of retention would be required. For lesser captures of 75 percent, 50 percent and 25 percent, additional retention volumes of 12 MG, 6.5 MG and 3.0 MG would be required, respectively. Alternatives corresponding to these levels of CSO AAOV capture are:

- Alternative 2A - 3.0 MG Retention. Alternative 2A is designed to capture 25 percent of the CSO AAOV. Alternative 2A is a 3.0 MG traditional shallow tank located north of and abutting the existing tank but south of the marsh grass (see Figure 8-3). In essence, it is an expansion of the existing Alley Creek Retention Tank that would drain through the existing gravity drain to the Old Douglaston PS. Adequacy of the Old Douglaston PS capacity (8.5 MGD) must be evaluated to determine whether it can handle the additional volume of captured CSO. An optional approach would employ a 3.0 MG VTS storage facility instead of a traditional shallow tank (see Figure 8-4). The VTS alternative would significantly reduce the footprint required for a new retention tank but would extend to a much greater depth in order to provide the same storage volume. Because this would place the bottom of the VTS below the drain pipe at the existing Alley Creek Retention Tank, the VTS would not be drained by gravity but would instead require new pump facilities to dewater the VTS between rain events.

- Alternative 2B – 6.5 MG Retention. Alternative 2B is designed to capture 50 percent of the CSO and requires a volume of 6.5 MG. Alternative 2B is a VTS storage facility located north of the existing tank but south of the marsh grass wetland (see Figure 8-5). An optional approach would employ a traditional tank located south of Northern Boulevard, as shown in Figure 8-6. To fit within the proposed sites, the 6.5 MG retention alternatives require depths that extend below the drain pipe at the existing Alley Creek Retention Tank and, therefore, will require new pump facilities to dewater them between rain events.

- Alternative 2C – 12 MG Retention. Alternative 2C is a 12 MG traditional rectangular concrete tank designed to capture 75 percent of the CSO AAOV. The proposed location is south of Northern Boulevard, as shown in Figure 8-7. The required tank depth would extend below the drain pipe at the existing Alley Creek Retention Tank and, therefore, this alternative would require new pump facilities to dewater the tank.

- Alternative 2D – 29.5 MG Retention. Alternative 2D is designed to capture 100 percent of the CSO AAOV. This alternative is comprised of a 29.5 MG rectangular tank and a pumping facility to dewater the tank between rain events. The proposed location for the facility is south of Northern Boulevard as shown in Figure 8-8.

Siting Consideration. The proposed location for these alternatives carries with it potential siting restrictions. The existing retention tank is located adjacent to wetlands in designated special Forever Wild Park Land. Special permits and permissions from regulatory agencies and potentially from the DPR would need to be obtained in order to construct in this area. Note that the larger traditional tank expansions (50, 75 and 100 percent capture) would be difficult to site in the region north of the existing Alley Creek Tank without encroaching into the marsh grass wetland area. Therefore, traditional tank alternatives for 50 to100 percent capture were placed south of the Alley Creek Retention Tank. Due to the limited space at this location, however, the required volume cannot be obtained unless the new tanks are deeper than the existing tank.

Dewatering Considerations. With the exception of Alternative 2A (3.0 MG traditional tank expansion), all of these retention alternatives are deeper than the existing tank and, therefore, cannot drain by gravity to the Old Douglaston PS. Instead, they would require new pump stations to pump the captured sewage either directly to the collection system in the direction of the Tallman Island WWTP or to the Old Douglaston PS (a two-pump process).

Retention alternatives would temporarily store captured CSO volume until the end of the rain event, after which they would be dewatered into the collection system for conveyance to the Tallman Island WWTP. Potentially competing constraints must be evaluated to determine the feasibility of any retention alternative. The captured CSO volume must be pumped within a reasonable time following a storm event to avoid generation of odor and corrosion associated with septic conditions and to dewater the retention tank before the next storm event. At the same time, however, the collection system must be evaluated to determine whether it can convey the additional dewatering flow to Tallman Island WWTP. There are two locations where flow restrictions may limit the conveyance capacity (Flushing Interceptor Chamber 2 is limited to 58 MGD and Flushing Interceptor Regulator 9 is limited to 65 MGD). The dewatering scheme for any expanded Alley Creek and Little Neck Bay retention would need to be coordinated with the dewatering from the existing Alley Creek Retention Tank, along with dewatering from the Flushing Bay Retention Tank, to ensure that conveyance system capacity is not exceeded. Furthermore, dewatering flows from all of these retention facilities combined with dry weather flow must not exceed the Tallman Island WWTP design dry weather flow of 80 MGD peak.

The treatment plant and conveyance system constraints were included in the IW model in order determine whether they are significant enough to prevent any alternative from being dewatered within the target time of 2-3 days. As shown in Table 8-8, all of the alternatives can be dewatered within the target time.

Table 8-8. Dewatering Time for Retention Alternatives

Outfall	Waterbody	Total AAOV in MG/yr				
		Baseline	**100 Percent Capture**	**75 Percent Capture**	**50 Percent Capture**	**25 Percent Capture**
TI-007	Alley Creek	0.1	0.1	0.1	0.1	0.1
TI-008	Alley Creek	0.0	0.0	0.0	0.0	0.0
TI-009	Little Neck Bay	0.0	0.0	0.0	0.0	0.0
TI-025	Alley Creek	132.5	0.0	33.4	66.8	99.7
Total		132.6	0.1	33.5	66.9	99.8
Additional Tank Volume Required (MG)		--	29.5	12.0	6.5	3.0
Additional Dewatering Capacity for Retention Alternatives (MGD)		NA	15	6	3.5	1.5
Dewatering Time for Retention Alternatives (days)		NA	2.0	2.0	1.8	1.9

Figure 8-3. Alternative 2A - 3 MG Downstream Tank

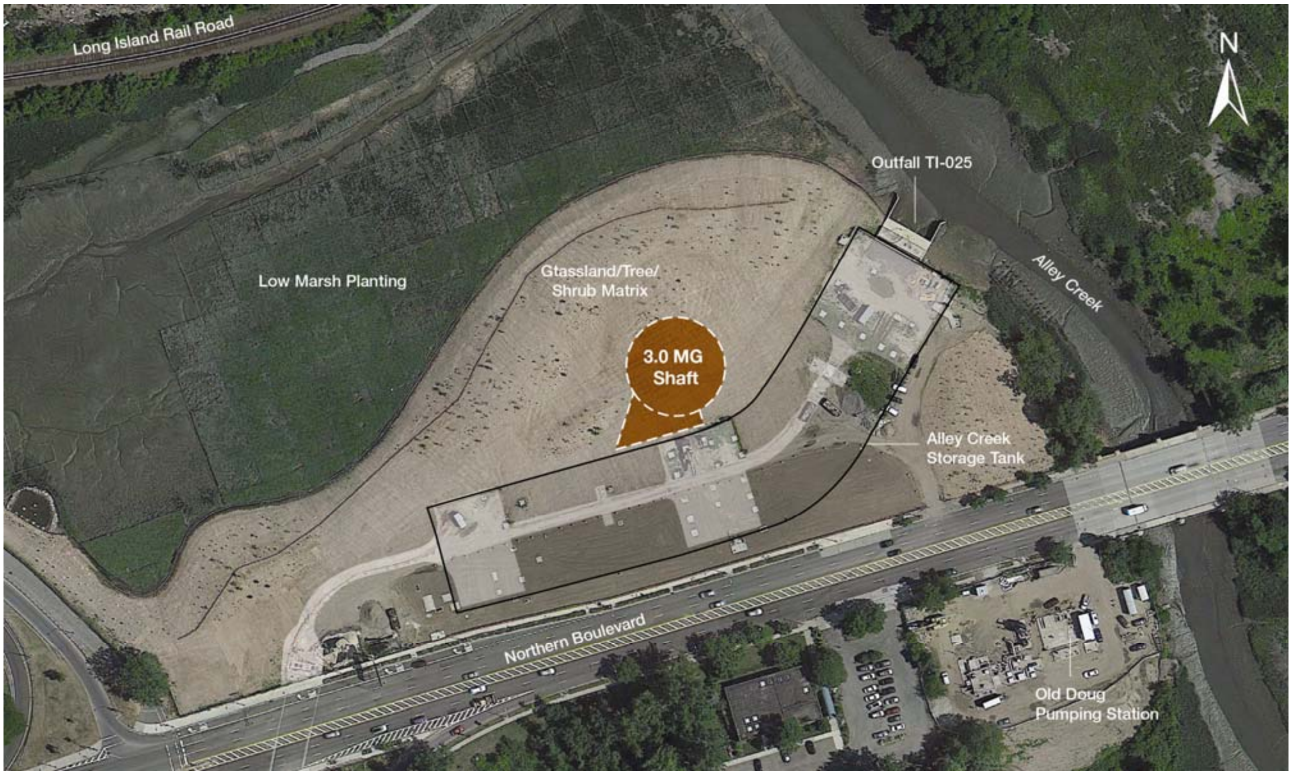


Figure 8-4. Alternative 2A – Optional Approach for 3 MG Downstream Tank

Figure 8-5. Alternative 2B – 6.5 MG Downstream Tank

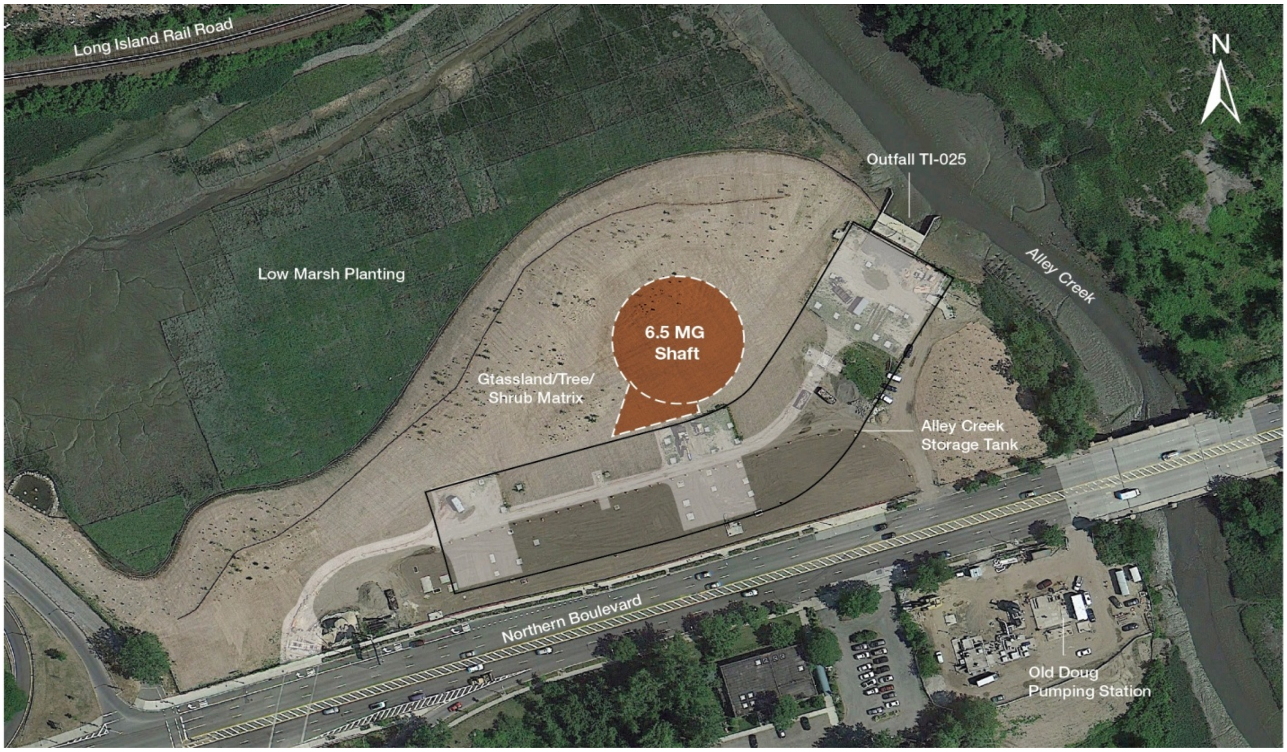


Figure 8-6. Alternative 2B – Optional Approach for 6.5 MG Downstream Tank

Figure 8-7. Alternative 2C - 6.5 MG Downstream Tank

Figure 8-8. Alternative 2D – 29.5 MG Downstream Tank)

Retention Alternatives - Upstream Sites

As an option to locating retention tanks or shafts downstream near the existing Alley Creek Retention Tank site, there may be advantages to locating retention facilities upland in the collection system, closer to the CSS. Overflow capture at these upland areas would be more concentrated as the flow has not yet mixed with flows from stormwater from the downstream separate sewer system (SSS). Therefore, capture of a smaller volume of more concentrated combined sewage from the upland area may reduce the pollutant load to the waterbodies to the same extent as a larger volume of more dilute sewage captured at the existing retention tank facility. However, the upstream CSS area is more highly developed than that near the existing Alley Creek Retention Tank site making it more difficult to find suitable retention tank sites upland. Because of the difficulty finding a suitable site, traditional shallow tanks were not considered for upstream locations. Instead, VTS, which have a smaller footprint, were considered as LTCP alternatives at upland sites. Two such alternatives were developed, both located within the interchange for the Long Island and Clearview Expressways and designed to capture CSO flow from Regulators 46 and 47:

- Alternative 3A is VTS storage designed to capture 25 percent of the CSO AAOV. It is comprised of a 2.4 MG vertical shaft along with a 96-inch diameter conduit to convey flow from Regulators 46 and 47 to the shaft and a force main to convey pump-back from the vertical shaft to the interceptor (see Figure 8-9).

- Alternative 3B is VTS storage designed to capture 50 percent of the CSO AAOV. It is comprised of a 6.7 MG vertical shaft along with 78-inch x 84-inch and 108-inch x 84-inch conduits to convey flow from Regulators 46 and 47 to the shaft, and a force main to convey pump-back from the vertical shaft to the interceptor (see Figure 8-10).

In both cases VTS storage would be located in City parkland or in New York State Department of Transportation (NYSDOT) property. Thus, both DPR and NYSDOT could be involved in the siting and permitting should these alternatives progress further in the evaluation process.

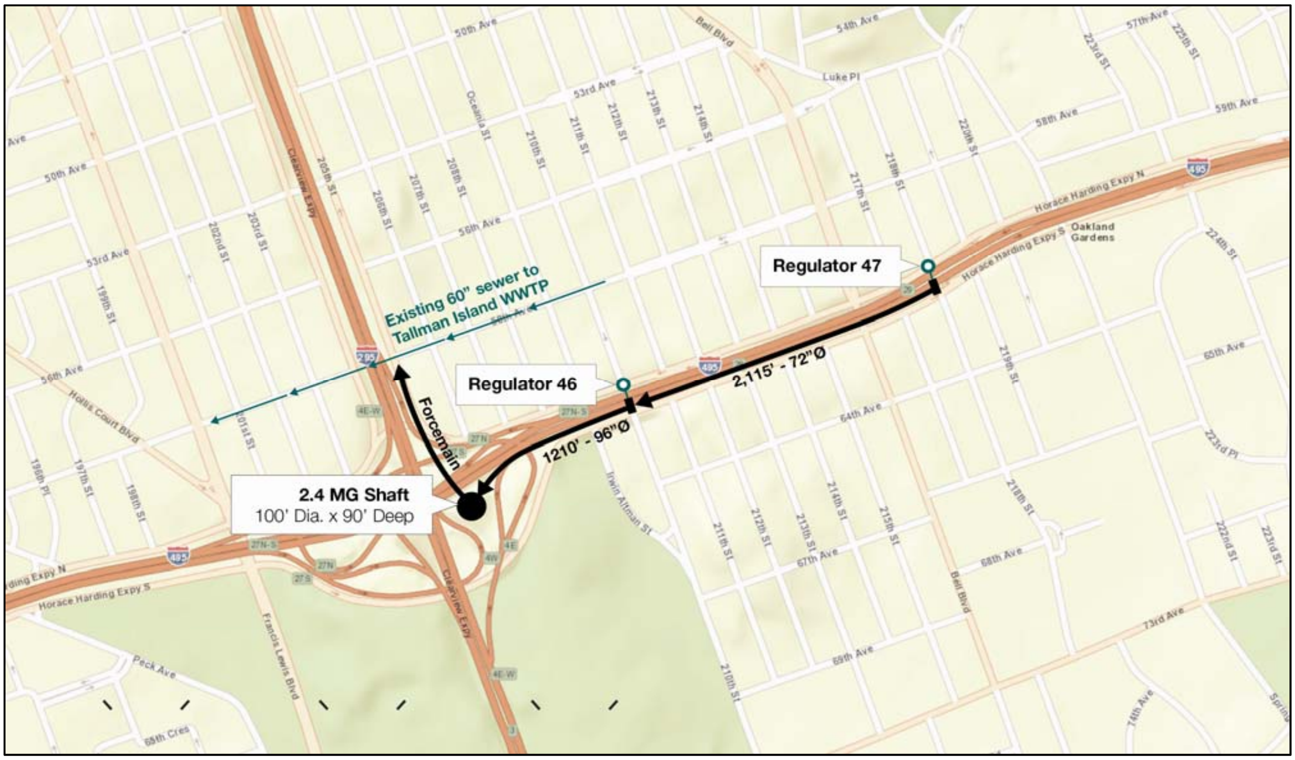


Figure 8-9. Alternative 3A - 2.4 MG Upstream Tank

Figure 8-10. Alternative 3B - 6.7 MG Upstream Tank

8.2.b Other Future Green Infrastructure (Various Levels of Penetration)

As discussed in Section 5, DEP expects 45 acres of implemented GI to be managed in onsite private properties in Alley Creek and Little Neck Bay watershed by 2030. This acreage would represent 3 percent of the total combined sewer impervious area in the watershed. This GI has been included in the baseline model projections, and as such, is not categorized as an LTCP alternative. For the purpose of this LTCP "Other Future Green Infrastructure" is defined as GI alternatives that have not been implemented under previous facility plans and that have not been included in the baseline models.

Two future GI alternatives were developed:

- Alternative 4A - GI developed for 10 percent of the combined sewer service area in the Alley Creek and Little Neck Bay watershed. This alternative corresponds to the overall level of GI proposed in the NYC Green Infrastructure Plan. The expected CSO AAOV reduction for this alternative is 15 percent.

- Alternative 4B - GI developed for 50 percent of the combined sewer service area in the Alley Creek and Little Neck Bay watershed. The expected CSO AAOV reduction for this alternative is 65 percent.

Difficulty finding sites to implement GI control measures is one of the challenges associated with GI. While the City-wide goal is to develop GI for 10 percent of New York City's land area, detailed evaluations of the Alley Creek and Little Neck Bay service area found that sufficient, suitable land area is difficult to find. Greater levels of GI would require implementation on public ROW in addition to the assumed level of private GI implementation (3 percent) in the baseline conditions. Alternative 4A would require 1,148 ROW bioswales, while Alternative 4B would require the equivalent of 5,743 ROW bioswales. Alternative 4B (50 percent of the Alley Creek and Little Neck Bay watershed) would not be possible without developing GI in Alley Pond Park and diverting some runoff into the park. As mentioned in Section 8.2.a.3., this park is designated special Forever Wild Park Land, and special permits and permissions from regulatory agencies and potentially from DPR would need to be obtained in order to construct in this area. Due to the potential siting difficulties, Alternative 4B is not viable and is eliminated from further consideration.

Also, as noted in the City of New York Green Infrastructure Plan, GI in the Alley Creek and Little Neck Bay watershed may not be cost-effective. With a large retention tank already in place, improvements in CSO reduction through GI would be relatively marginal and would likely have a high unit cost on a dollar per captured gallon basis. It is important to recognize that the high cost of GI with marginal improvement in water quality makes additional GI less cost-effective.

8.2.c Hybrid Green/Grey Alternatives

Hybrid green/grey alternatives are those that combine traditional grey control measures with green control measures to achieve the benefits of both. Using the two technologies together can potentiate their ability to minimize CSO volume, optimize the collection system capacity, and capture storm water flows before it enters the system thereby reducing CSO. However, preliminary evaluation of GI alternatives indicated the water quality benefits are not sufficiently cost-effective to warrant the development of any hybrid green/grey alternatives.

8.2.d Hybrid Grey/Grey Alternatives

Because it is unlikely that HLSS alone would be capable of reducing CSO volume beyond 50 percent, a hybrid combination of HLSS with additional retention was considered. This alternative (Alternative 5) could take one of the following forms:

- HLSS plus closed concrete tank expansion at the existing Alley Creek Retention Tank site
- HLSS plus VTS storage at the existing Alley Creek Retention Tank

Such combinations would be faced with the same challenges as when HLSS and retention control measures were considered independently, namely:

- Siting issues similar to those for tank expansion and VTS storage (park alienation, wetlands, permitting)
- Street disruptions associated with HLSS
- The need for routing of major new storm sewers and the permitting of a new MS4 outfall associated with HLSS

Alternative 5 essentially combines HLSS of Alternative 1 for the areas upstream of Regulators 46 and 47 as described in Section 8.2.a.1 a new 3.0 MG tank (or 3.0 MG upstream VTS storage) from Alternative 2A (or 2D) located downstream at the Alley Creek Retention Tank site as described in Section 8.2.a.3.

8.2.e Retained Alternatives

A summary of the alternatives developed for the Alley Creek and Little Neck Bay LTCP is presented in Table 8-9. These alternatives will be subjected to economic and cost-performance evaluations in Step 3.

Table 8-9. Summary of Alternatives

Alternative	Description
1. HLSS	New HLSS for the CSS tributary to Regulators 46 and 47.
2A. 3.0 MG Additional Downstream Retention	New traditional tank expansion north of the existing Alley Creek CSO Retention Tank or new VTS storage at the existing Alley Creek Retention Tank site.
2B. 6.5 MG Additional Downstream Retention	New VTS storage or new traditional tank expansion at the existing Alley Creek CSO Retention Tank site.
2C. 12 MG Additional Downstream Retention	New traditional tank expansion south of the existing Alley Creek CSO Retention Tank.
2D. 29.5 MG Additional Downstream Retention	New traditional tank expansion south of the existing Alley Creek CSO Retention Tank.
3A. 2.4 MG Additional Upstream Retention	New upstream VTS storage for the CSS tributary to Regulators 46 and 47.
3B. 6.7 MG Additional Upstream Retention	New upstream VTS storage for the CSS tributary to Regulators 46 and 47.
4A. 10 percent Green Infrastructure	GI for 10 percent of the CSS area in the Alley Creek and Little Neck Bay watershed.
5. Hybrid - HLSS plus Storage Tank	HLSS for the CSS served by Regulators 46 and 47 plus additional 3.0 MG downstream retention at existing Alley Creek CSO Retention Tank site.

8.3 CSO Reductions and Water Quality Impact of Retained Alternatives

In order to evaluate their effects on the pollutant loadings and water quality impacts, the retained alternatives listed in Table 8-9 were analyzed using both the Alley Creek and Little Neck Bay watershed (IW) and receiving water or waterbody ERTM models. Evaluations of CSO AAOV reductions and bacterial load reductions for each alternative are presented below. In all cases, the reductions shown are relative to the baseline conditions described in Section 6.

8.3.a CSO Reductions for Retained Alternatives

Table 8-10 summarizes the projected CSO reductions for the retained alternatives. Performance of the alternatives ranged from zero to 100 percent CSO AAOV reduction.

Table 8-10. CSO AAOV Performance

Alternative	CSO Volume (MGY)	AAOV Reduction Percent
Baseline Conditions	132	0
1. HLSS	65	51
2A. 3.0 MG Additional Downstream Retention	98	25
2B. 6.5 MG Additional Downstream Retention	65	50
2C. 12 MG Additional Downstream Retention	33	75
2D. 29.5 MG Additional Downstream Retention	0	100
3A. 2.4 MG Additional Upstream Retention	98	25
3B. 6.7 MG Additional Upstream Retention	65	50
4A. 10 percent Green Infrastructure	112	15
5. Hybrid – HLSS plus 3.0 MG Retention	38	71

8.3.b Bacterial Reductions for Retained Alternatives

A summary of the projected pathogen discharges for the retained alternatives is presented in Table 8-11. Values shown in this table represent the total discharge into Alley Creek and Little Neck Bay from both CSO and stormwater. With respect to bacterial discharges, the best performing alternative was 100 percent retention (Alternative 2D) which reduces the fecal loading by roughly 50 percent and the enterococcus loading by 42 percent. Because of the pollutants contained in stormwater, none of the CSO control alternatives can eliminate all of the bacteria discharged to Alley Creek and Little Neck Bay. HLSS (Alternative 1) was the worst performing alternative, yielding a net increase in enterococci. Although HLSS reduces CSO and its associated pollutants, it also significantly increases the volume of annual stormwater discharges. For HLSS, the increased pollutant loads associated with the increased stormwater exceeded the benefits from the reduced CSO.

Table 8-11. Summary of the Projected Pathogen Discharges

Alternative	Enterococci Loading (Counts/Year x 10^{12})	Enterococci Reduction Percent	Fecal Loading (Counts/Year x 10^{12})	Fecal Reduction Percent
Baseline Conditions	345.3	0	918.2	0
1. HLSS	364.0	-5.4	867.2	5.5
2A. 3.0 MG Additional Downstream Retention	309.1	10.5	814.0	12.5
2B. 6.5 MG Additional Downstream Retention	272.5	21.1	687.7	25.1
2C. 12 MG Additional Downstream	235.6	31.8	571.5	37.8

Table 8-11. Summary of the Projected Pathogen Discharges

Alternative	Enterococci Loading (Counts/Year x 10^{12})	Enterococci Reduction Percent	Fecal Loading (Counts/Year x 10^{12})	Fecal Reduction Percent
Retention				
2D. 29.5 MG Additional Downstream Retention	199.5	42.2	458.2	50.1
3A. 2.4 MG Additional Upstream Retention	293.6	15.0	742.2	19.2
3B. 6.7 MG Additional Upstream Retention	247.0	28.5	585.5	36.2
4A. 10 percent Green Infrastructure	362.7	5.4	862.1	6.1
5. Hybrid -3.0 MG Storage plus HLSS	345.0	0.1	814.0	11.4

Figure 8-11 shows the relationship between the reductions in CSO AAOV and total enterococci loading. Alternatives in the region above the diagonal line have a higher reduction in total enterococci loading per unit of CSO AAOV reduction. Upstream retention alternatives fall into this region, which can be explained by considering that because the upstream flow has not yet been diluted by stormwater from the separately sewered areas, the flow captured upstream is more concentrated. Therefore, each gallon captured upstream would remove more bacteria than a gallon captured downstream near the existing Alley Creek Retention Tank.

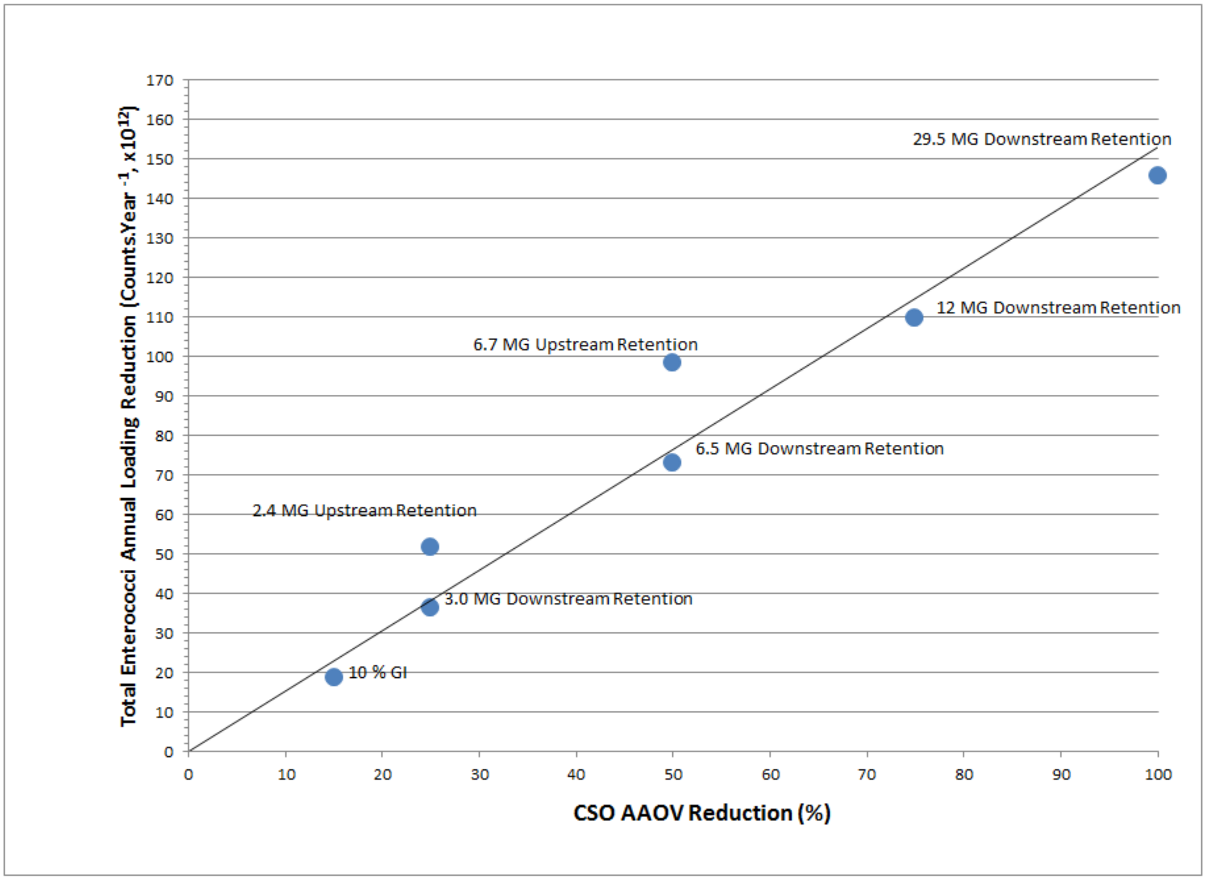


Figure 8-11. CSO AAOV Reductions vs. Annual Total Enterococci Loading Reduction

8.3.c Water Quality Impacts

Alley Creek. Alley Creek is a Class I waterbody. Historic and recent water quality monitoring, along with baseline condition modeling using ERTM, revealed that Alley Creek is currently in attainment with the Class I fecal bacteria criteria. For Class I, enterococci standards do not apply. Hence, no performance gap needs to be addressed through CSO control alternatives with respect to current waterbody classification. If raising the waterbody classification to the next level is considered, none of the alternatives would result in attainment with Class SB standards. As explained in the gap analysis presented in Section 6.3, bacterial loadings from other sources such as stormwater and dry weather pathogen loadings have significant influence on the fecal and enterococci concentrations to the extent that even the 100 percent CSO retention alternative will not result in attainment of the Class SB standards for either fecal coliform or enterococci in Alley Creek.

Little Neck Bay. Little Neck Bay is a Class SB waterbody. As described in Section 6, Little Neck Bay is in attainment with the Class SB fecal coliform criteria essentially 100 percent of the time throughout the baseline 10 year period. With respect to Enterococci, attainment under baseline conditions varies with location in Little Neck Bay as described in Section 6. In general, attainment occurred over 98 percent of the time at the north end of the bay near East River, but dropped off to just below 70 percent of the time at the southern end near Alley Creek. Near DMA Beach, the sole sensitive area in the Alley Creek and Little Neck Bay watershed, attainment with the 30-day GM standard occurred 100 percent of the time from roughly April 1 through October, a period which includes bathing season (June 1 – September 1). However, there are some limited excursions above the enterococci standard outside of this period. Overall, the 10-year simulation is in compliance 93 percent of the time at the DMA Beach. The alternatives evaluated as part of this LTCP were not capable of closing this performance gap for enterococci standards. Even 100 percent CSO retention had a marginal effect, raising the overall annual attainment of enterococci standards at DMA Beach to 95 percent of the time - just a 2 percentage point improvement. A similar marginal improvement occurred at the northern end of the bay near East River where attainment was already near 100 percent of the time, with attainment rising just 0.2 percent from 98.5 to 98.7 percent of the time near Harbor Survey Station E11. As explained in the gap analysis presented in Section 6.3, enterococci loadings from other sources such as stormwater and dry weather pathogen loadings have significant influence on the GM concentration of enterococci to the extent that even the 100 percent CSO retention alternative will not result in compliance with the Class SB standards for enterococci at all times.

8.4 Cost Estimates for Retained Alternatives

Using a triple bottom line approach considering environmental, economic and social impacts of the proposed alternatives requires accurate cost estimates for each alternative. Methodology for developing these costs is dependent on the type of technology and its unique operation and maintenance requirements. Capital costs are Probable Bid Cost (PBC). Total present worth costs were estimated from capital cost estimated plus operation and maintenance costs, with an assumed interest rate of 3 percent over a 20-year life cycle. All costs are in May 2013 dollars.

8.4.a HLSS

Costs for the Alternative 1 (HLSS) include the costs for the local storm sewers and the trunk sewers to convey the stormwater to Alley Creek. Trunk sewer costs are based on the sewer diameter, length, and depth of cover. Manhole costs are based on diameter of the manhole and depth. Where necessary, cost of pile supports for both the trunk sewer and manholes are included.

Cost for the collector sewers is based on the total drainage area to be separated (see Figures 8-1 and 8-2) which is 843 acres. The total cost for HLSS is $658 million (May 2013 dollars), calculated as shown in Table 8-12.

Table 8-12. HLSS Costs

	HLSS PBC May 2013 ($ Million)
HLSS PBC	$657
Annual O&M	$0.1
Total HLSS Present Worth	$658

8.4.b Retention

Cost estimates for retention using traditional tanks were based on actual bid costs from similar existing tanks built in the City of New York. A cost curve plotting the storage volume (MG) against the actual bid cost was developed for the existing tanks, with all costs escalated to May 2013 dollars. Cost estimates for retention alternatives using traditional tanks were then read from the cost curve.

Estimated costs for VTS storage include costs for construction of the shafts along with associated costs including odor control equipment, earth work, concrete work, influent and effluent structure, chemical storage and control building, mechanical equipment, electrical equipment, instrumentation and control, process equipment, and site work. Costs are dependent on the desired storage volume and do not include any costs associated with land acquisition. For VTS storage located at the upstream site, costs for conduits to convey flow from Regulators 46 and 47 to the VTS, as well as conduits to convey dewatering flow from the VTS to the existing collection system are also included.

As shown in Table 8-13, costs for retention alternatives range from $93M to $569M.

Table 8-13. Retention Alternatives Costs

Retention Alternative	Capital Cost ($ Million)	Annual O&M Cost ($ Million)	Present Worth PBC May 2013 ($ Million)[1]
2A. 3.0 MG Additional Downstream	$83	$0.7	$93
2B. 6.5 MG Additional Downstream	$145	$0.8	$156
2C. 12 MG Additional Downstream	$294	$1.1	$310
2D. 29.5 MG Additional Downstream	$535	$2.3	$569
3A. 2.4 MG Additional Upstream	$101	$0.8	$113
3B. 6.7 MG Additional Upstream	$160	$0.9	$173

Notes:

1. O&M costs assume 20 year useful life.
2. Average of costs for traditional shallow tank and VTS storage options

8.4.c Green Infrastructure

The estimated capital cost for Alternative 4A (10 percent GI) is $41M. With an expected annual O&M cost of $1.48M and a 20-year life cycle, the present worth estimate is $63M.

8.4.d Hybrid HLSS plus Additional Retention

A total cost of $751M for Alternative 5 (hybrid of HLSS plus additional retention) was obtained by adding the costs for HLSS (Alternative 1) to the costs for Alternative 2A (3.0 MG additional downstream retention), as shown in Table 8-14.

Table 8-14. Hybrid HLSS Plus 3.0 MG Retention

Item	Present Worth May 2013 ($ Million)
HLSS	$658
3.0 MG Additional Tank Storage	$93
Total	**$751**

8.5 Cost-Attainment Curves for Retained Alternatives

The final step of the analysis is determining the cost-effectiveness of the alternatives based on their projected water quality improvement, operational cost, and projected probable cost to construct.

8.5.a Cost-Performance Curves

Figure 8-12 shows the percent CSO AAOV reduction compared to the total PBC of the project. Percent of CSO capture ranges from 0 percent (baseline) to 100 percent AAOV reduction (additional 29.5 MG downstream retention) with costs spanning up to $751M (additional 3.0 MG downstream retention with HLSS). A cost curve was developed based on alternatives that were judged more cost-effective. Less cost-effective alternatives, shown in red, were not included in the cost curve. For example, for 50 percent AAOV reduction, the 6.5 MG Downstream Retention alternative was more cost-effective than the 6.7 MG Upstream Retention alternative. Therefore, the 6.5 MG Downstream alternative would be preferred with respect to CSO AAOV reduction and was used in the creation of the cost curve rather than the 6.7 MG Upstream Retention alternative. While the resulting curve does not show a clear knee-of-curve, a slight inflection can be seen between the 12 and 29.8 MG Downstream Retention alternatives.

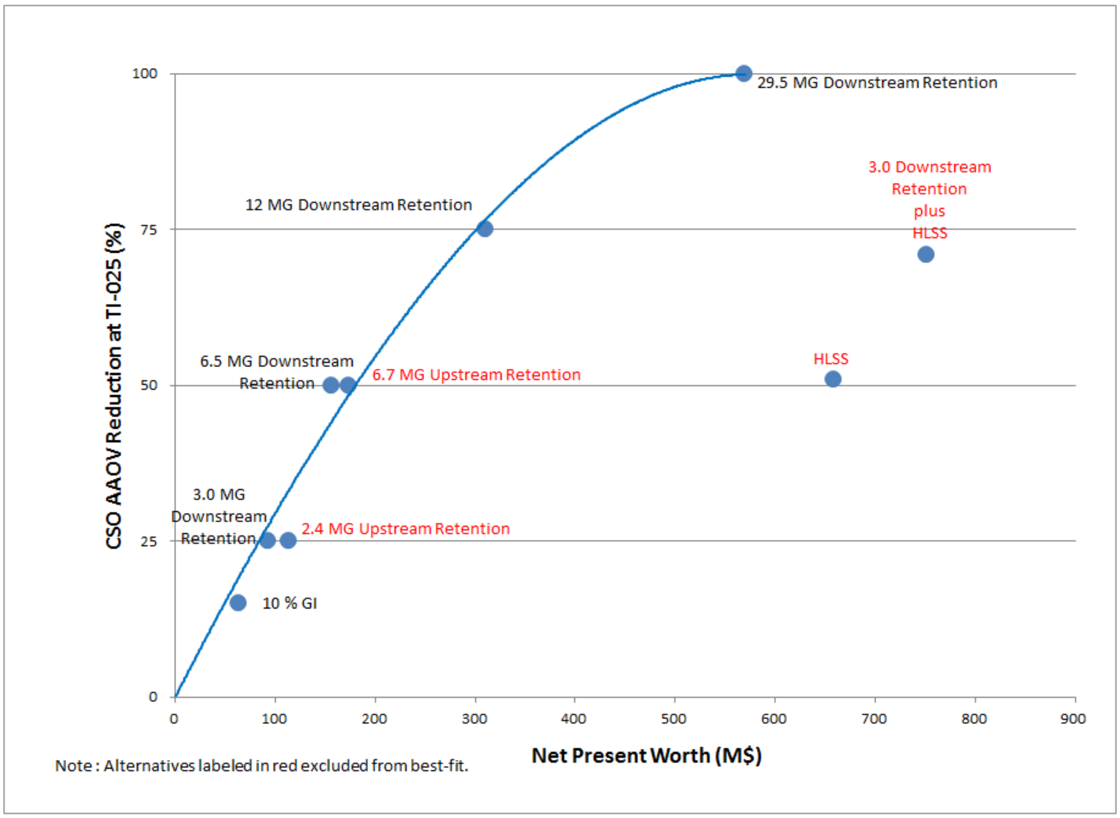


Figure 8-12. Cost vs. CSO AAOV Reduction

Along with overall CSO reduction, a goal of the LTCP is to reduce pathogen loadings to the waterbody to the extent such loadings are caused by CSOs. Figure 8-13 shows the cost of the retained alternatives compared to annual total enterococci loading reduction. The enterococci loading is represented with two vertical axes. One axis shows percent enterococcus loading reductions at TI-025 (the CSO outfall for the existing Alley Creek Tank) and represents the reduction of enterococcus from CSO sources. The other axis shows percent enterococcus loading reduction based on all sources – CSO and stormwater. Because CSO is not the only source of bacteria and some alternatives (notably HLSS) affect stormwater discharge volumes in addition to CSO volumes, attainment of standards cannot be evaluated based on enterococcus discharged at TI-025 alone. Therefore, the axis representing total enterococcus from all sources was selected as the primary axis. Percent total enterococci loading reduction ranges from 0 percent (baseline) to 42 percent reduction (additional 29.5 MG downstream retention) with costs spanning up to $751M (additional 3.0 MG downstream retention with HLSS). Capturing 100 percent of CSO at outfall TI-025 reduces enterococcus loading to Alley Creek by a maximum 42 percent at a cost of $569M. As with the CSO AAOV vs cost figure (Figure 8-11), the cost curve for enterococcus loading reduction was based on selected alternatives judged to be the most cost-effective. The less cost-effective alternatives, shown in red, were excluded from the curve.

As with the previous AAOV reduction curve, there is no discernable KOTC. However, as with AAOV, the curve starts to flatten as the CSO AAOV increases, indicating that increasing volume reductions become less cost-effective.

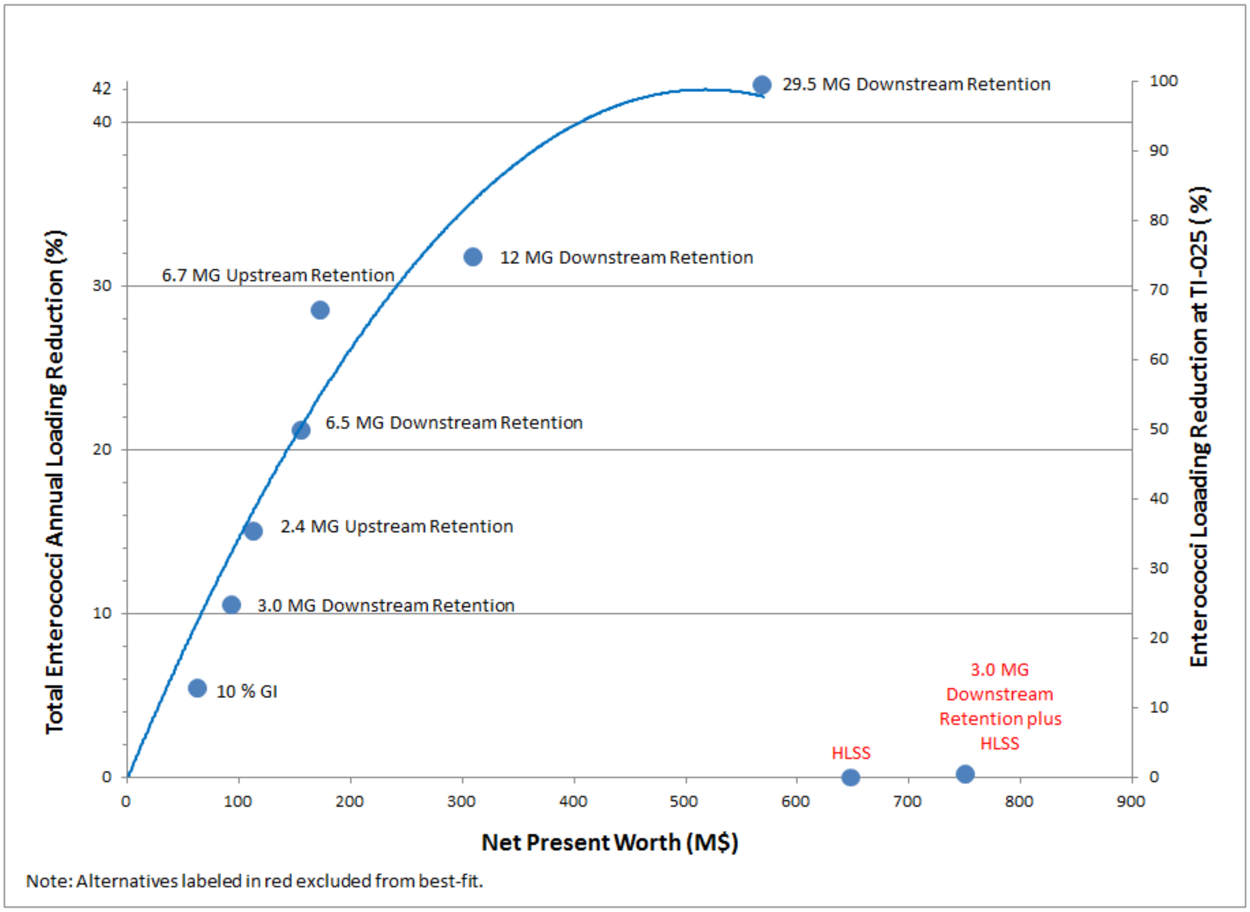


Figure 8-13. Cost vs. Total Enterococci Loading Reduction

8.5.b Cost-Attainment Curves

As previously discussed, attainment of fecal coliform standards occurs essentially 100 percent of the time for both Alley Creek and Little Neck Bay under baseline conditions. Because there was no performance gap, cost-attainment curves for fecal coliform were not developed.

Attainment of enterococci standards for Little Neck Bay varied with time of year and location in the bay. At the northern end of the Bay, the performance gap was small with attainment occurring 98.5 percent of the time at sampling location E11 under baseline conditions. Figure 8-14 shows the modeled improvement in attainment at location E11 for each alternative. As previously discussed, the improvements shown are marginal, rising just 0.2 percent for the alternative with the greatest improvement (Alternative 2B – 29.5 MG Downstream Retention). These marginal improvements come at a significant cost – up to $569M for the 29.5 MG Downstream Retention alternative.

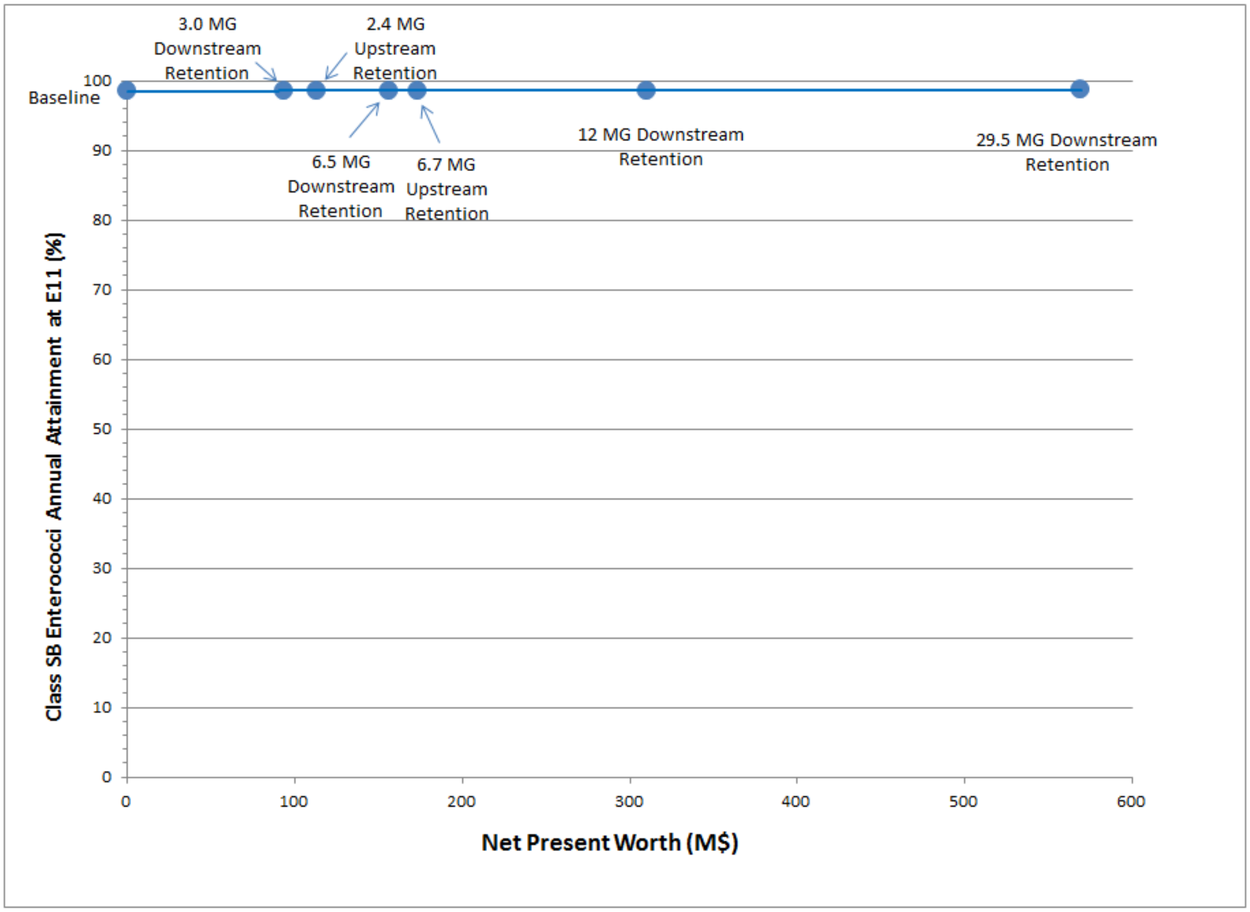


Figure 8-14. Cost vs. Enterococci Annual Attainment at Little Neck Bay

Figure 8-15 shows the ability of each alternative to attain Class SB WQS at DMA Beach as a function of the total project cost. Baseline conditions are in attainment with these standards approximately 93.4 percent of the time. Capturing 100 percent of the CSO resulted in only a 1.4 percent increase in attainment, with all other alternatives having a lesser degree of improvement. The cost attainment curve for sampling location LN1 (see Figure 8-16) is essentially identical to the curve for DMA Beach.

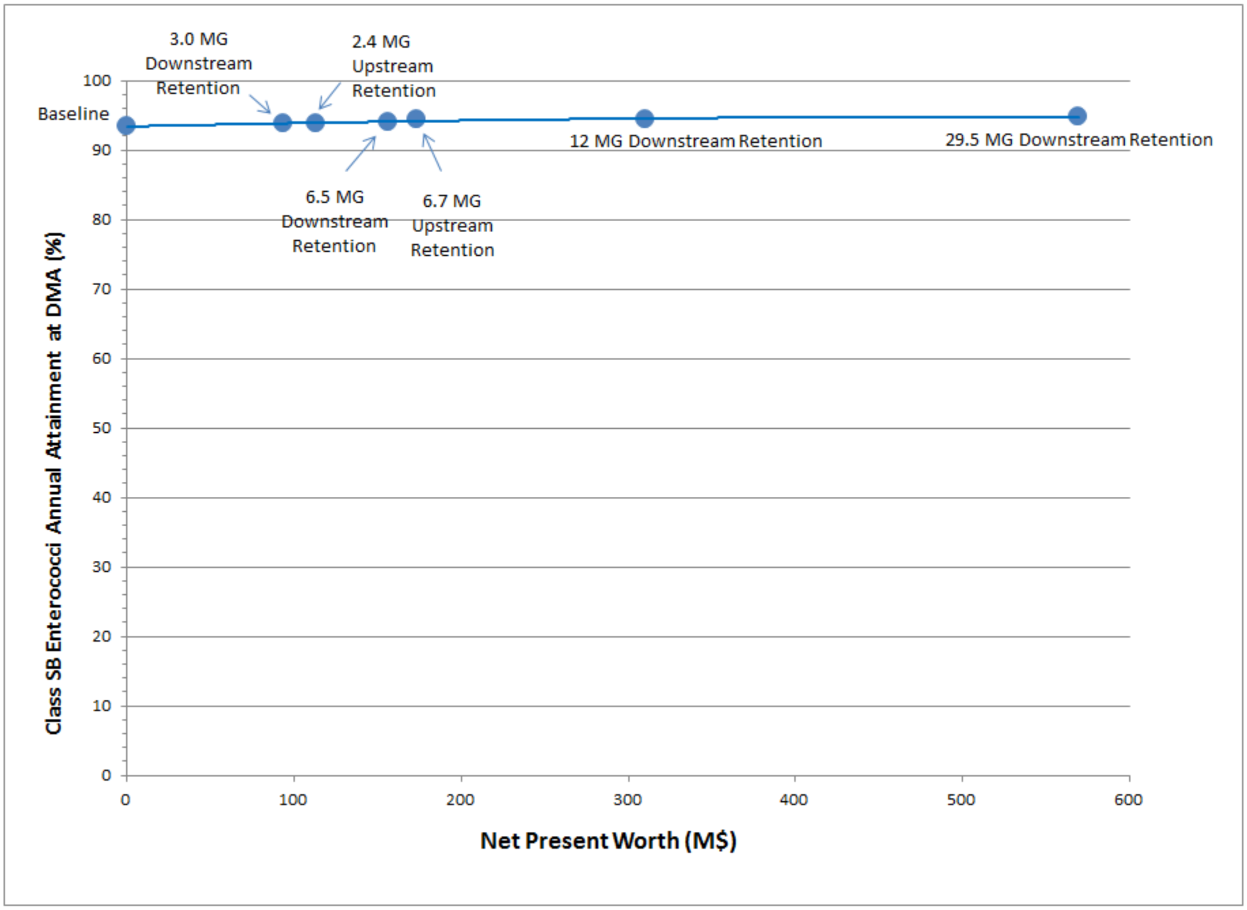


Figure 8-15. Cost vs. Enterococci Annual Attainment at DMA Beach

Figure 8-17 shows the ability of each alternative to attain Class SB WQS at Station OW2 in the mixing zone between Alley Creek and Little Neck Bay as a function of the total project cost. Baseline conditions are in attainment with these standards approximately 78.9 percent of the time. Capturing 100 percent of the CSO resulted in only a 3 percent increase in attainment, with all other alternatives having a lesser degree of improvement.

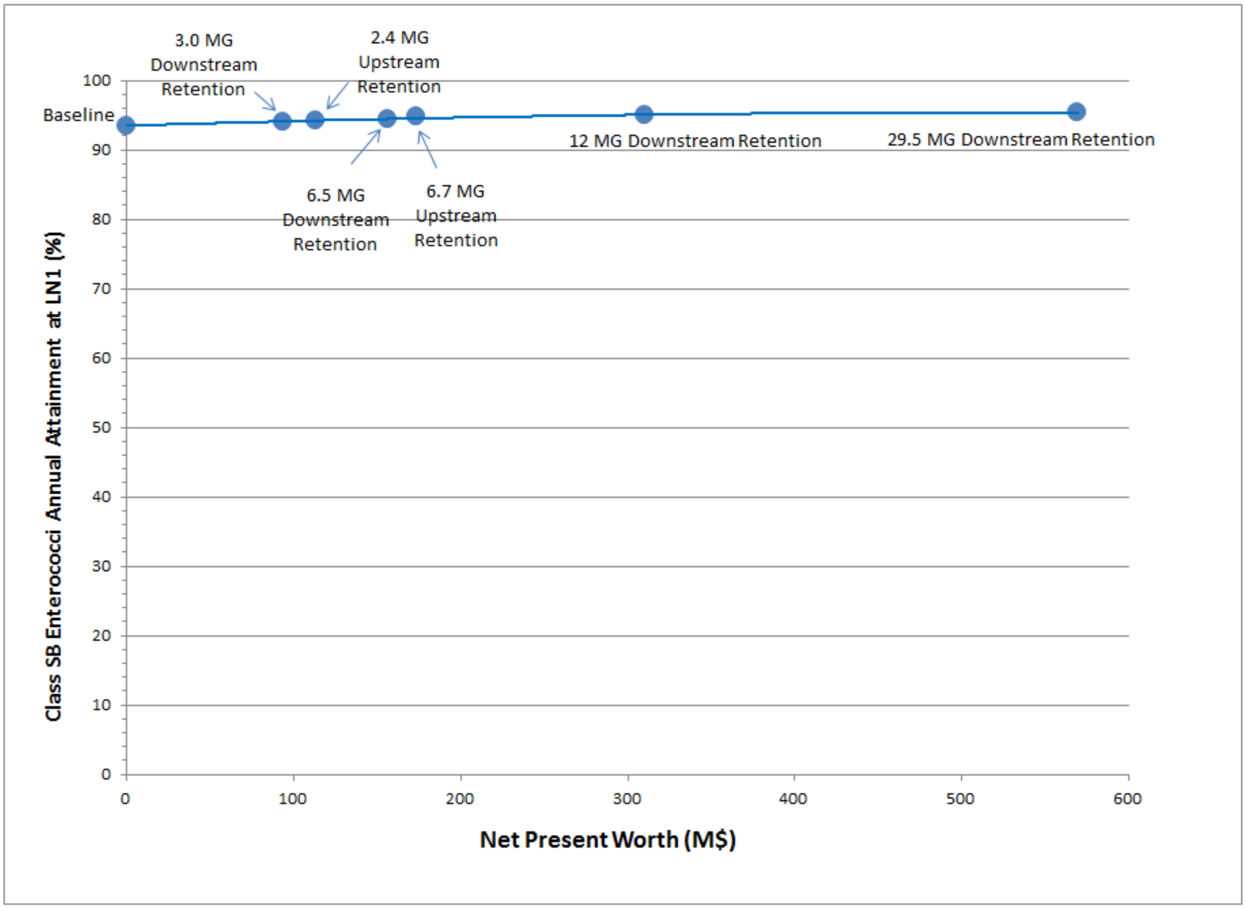


Figure 8-16. Cost vs. Enterococci Annual Attainment at LN1

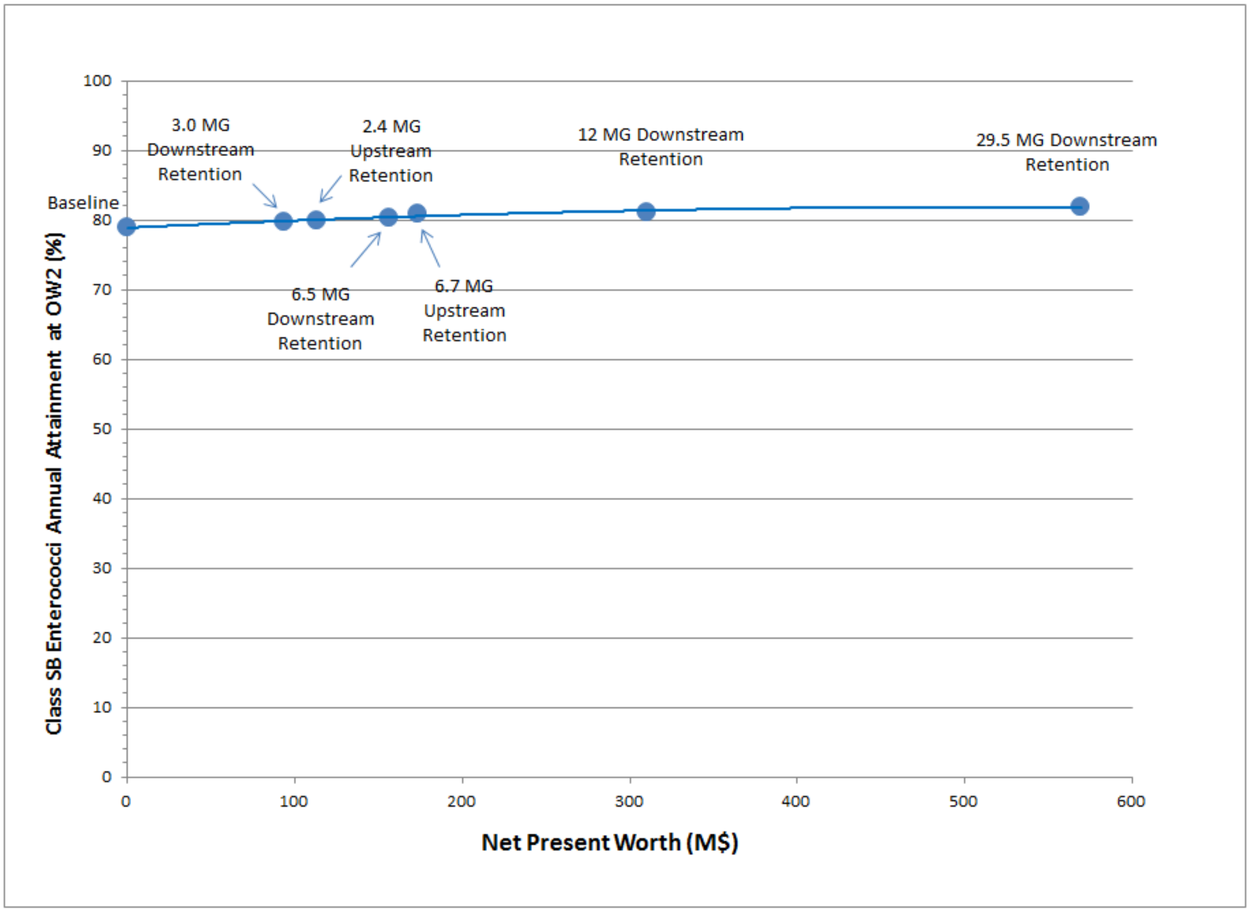


Figure 8-17. Cost vs. Enterococci Annual Attainment at OW2

Results show that capturing additional volume of CSO, regardless of the degree of capture, does not significantly improve the attainment of the WQS. The remaining non-attainment of standards is caused by other sources of discharge, including stormwater and waterfowl which are specifically not addressed in the LTCP process. Ecological and physical changes to the characteristics of the waterbody may also be contributing to non-attainment. In addition, non-impaired swimming at DMA Beach would require elimination of localized sources (non-CSO) of pathogens in the vicinity.

8.6 Use Attainability Analysis (UAA)

A UAA is a structured and scientific assessment of the factors affecting the attainment of uses of a waterbody as specified in the CWA. The UAA process specifies that States can remove a designated use which is not an existing use if the scientific assessment can demonstrate that attaining the designated use is not feasible for at least one of six reasons:

- Naturally occurring pollutant concentrations prevent the attainment of the use; or
- Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

- Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

- Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or

- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

- Controls more stringent than those required by Sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

As part of the LTCP, elements of a UAA, including the six conditions presented above will be used to determine if changes to the designated use is warranted, considering a potential adjustment to the next lowest or the next highest designated use classification as appropriate. UAAs for Alley Creek and Little Neck Bay are attached hereto as Appendices D and E, respectively.

8.6.a Use Attainability Analysis Elements

An objective of the CWA is to provide for the protection and propagation of fish, shellfish, wildlife, and recreation in and on the water. Cost-effectively maximizing the water quality benefits associated with CSO reduction is a cornerstone of this LTCP Update. The 2012 Order on Consent Goal Statement stipulates that in situations where the proposed alternatives presented in the LTCP will not achieve these objectives, the LTCP will include a UAA.

To simplify this process, DEP and DEC have developed a framework that outlines the steps taken under the LTCP in two possible scenarios:

- Waterbody meets WQ goals. This may either be the existing WQS (where Class SB is already designated) or an upgrade (where other standards exist). In either case, a high-level assessment of all of the factors that define a given designated use is performed, and if the level of control required to meet this goal can be reasonably implemented, a change in designation may be pursued following implementation and post-construction monitoring.

- Waterbody does not meet WQ goals. If this is the case, and a higher level of control is not feasible, the UAA must justify the shortcoming using at least one of the six criteria listed above. It is assumed that if 100 percent elimination of CSO sources does not enable attainment, the UAA would include factor #3 at a minimum as justification (human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place).

8.6.b Fishable/Swimmable Waters

As noted in Section 8.1 and in other previous sections, the goal of this LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific WQS, consistent with EPA's CSO policy and subsequent guidance. DEC considers the SA and SB classifications as fulfillment of the CWA goals of fully supporting these goals.

8.6.c Assessment of Highest Attainable Use

The attached UAAs, supported by the findings of the LTCP analyses, document that, although the existing WQS is being met for Alley Creek, upgrading to SA and SB goals cannot be achieved, and the highest attainable use for Alley Creek is a Class I waterbody as it is currently defined. While Little Neck Bay generally meets the Class SB criteria, including nearly one hundred percent compliance at DMA Beach, this waterbody fails to meet the criteria hundred percent of the time. The existing WQS for Little Neck Bay fulfills the CWA goals and is generally achievable if a wet weather advisory is established discouraging primary contact recreation up to 72 hours after a storm.

8.7 Water Quality Goals

Based on the analyses of the waterbodies and the WQS associated with the designated uses, the following conclusions can be drawn:

Alley Creek. Alley Creek remains a highly productive Class I waterbody that can fully support secondary uses including nature education and wildlife propagation. Alley Creek is in attainment with its current Class I classification, but because of the factors presented in the attached Alley Creek UAA, it is not feasible for the waterbody to meet the water quality criteria associated with the next highest or Class SB classification. Furthermore, combinations of natural and manmade features prevent the opportunity and feasibility of contact recreation in Alley Creek.

Little Neck Bay. Little Neck Bay generally meets the Class SB criteria but fails to do so 100 percent of the time (Figure 6-3). It should be noted, however, that the summer season compliance is nearly 100 percent at DMA Beach, the only official bathing beach in the waterbody (Figure 6-4). The continued presence of non-CSO discharges, most notably stormwater from MS4 outfalls, prevents attainment of Class SB standards at all times; even with 100 percent CSO control is considered. Given that CSO control alone proved ineffective in meeting Class SB criteria, upgrading the classification of Little Neck Bay to Class SA under the LTCP program is not feasible.

It should be noted, however, that a large portion of Little Neck Bay attains the 30-day rolling average enterococci criterion greater than 90 percent of the time annually (Figure 6-3) and greater than 96 percent of the time (Figure 6-4) during the recreational season. There also appears to be a transition zone at the head end of Little Neck Bay that has some degree of impairment due to the influence of Alley Creek. Inner Little Neck Bay does not achieve full attainment of the enterococci water quality standard primarily due to stormwater and CSO discharges during wet weather. Therefore, the designated use of primary contact recreation is not advisable during and for some period after a wet weather event. A potential tool to satisfy regulatory requirements, while not fully meeting standard attainment, is the temporary suspension of uses during and after wet weather as part of a wet weather advisory similar to those used by the DOHMH for bathing beaches around the City. Depending on the location of the bathing beach, DOHMH issues advisories that swimming should not be practiced for certain periods of time after rainfall events.

Figure 8-18 presents an analysis that established the duration of a wet weather advisory. For all summer rain events from 2002 through 2011, the amount of time after a rain event that enterococci concentrations in inner Little Neck Bay would return to levels less than 130 org/100mL was calculated using model baseline conditions. The figure shows that the time generally increases with greater rainfall amounts. For rainfall events of about 1 inch, it takes a period of about 32 hours for the inner portion of Little Neck Bay to return to enterococci concentrations below 130 org/100mL. After approximately 1.25 inches of rain, which takes about 38 hours to return to safe levels, the curve begins to flatten out and the length of time does not increase as rapidly with greater rainfall. Other factors such as the duration and intensity of the storm affect the shape of the curve. An analysis similar to this could be used to determine when primary contact recreation should be suspended in inner Little Neck Bay. The wet weather advisory could be a single length of time, or tiered depending on the amount of rainfall or some other factor.

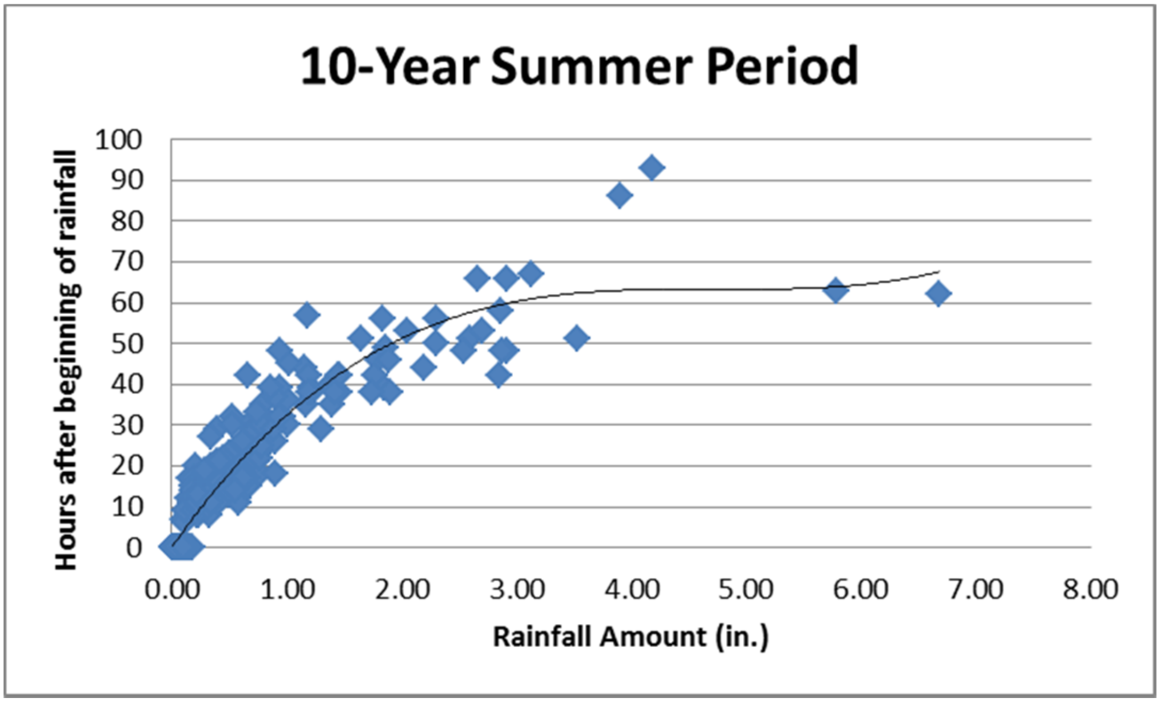


Figure 8-18. Duration of Elevated Enterococci Concentrations after Summer Rain Events

8.8 Recommended LTCP Elements to Meet Water Quality Goals

The recommended LTCP elements described in this section are the culmination of efforts by DEP to attain the existing WQS. DEP recognizes that achieving water quality objectives may require more than the simple reduction in CSO discharges. DEP CSO Control Facility Planning for these waterbodies began in 1984 predating the current LTCP program. The Alley Creek CSO Facility Plan was accepted by DEC in 2000. The principal facility of the 2003 Alley Creek CSO Facility Plan, and the later 2009 WWFP, was the construction of a 5 MG CSO Retention Tank and its new CSO outfall TI-025 to Alley Creek.

With the facility now in operation CSO volume has been reduced to 132 MG annually. Several alternatives were investigated which captured some portion or all of the remaining CSO discharge out of outfall TI-025. Based on water quality modeling, complete capture of all CSO discharge to the waterbody results in a negligible improvement of water quality at a substantial cost. Alternatives capturing less than 100 percent of the CSO discharge would have an even less significant effect on water quality. Therefore, no alternative is cost-effective and the recommended LTCP elements are the baseline conditions - namely the 2009 Alley Creek and Little Neck Bay WWFP recommendations plus 3 percent GI through on-site stormwater management on private properties. As such, the LTCP recommends that the CSO facility continue to operate without additional changes.

9.0 Long Term CSO Control Plan Implementation

As discussed in Sections 6 and 8 of this document, the Alley Creek and Little Neck Bay LTCP does not recommend any new grey infrastructure to be implemented to further address the CSO discharges in the watershed. This recommendation was based on the outcome of the facility planning and water quality improvement evaluations completed under the LTCP and the progress made from implementing the recommendations of the 2009 WWFP and earlier DEP facility plans. These improvements have resulted in improved water quality in Alley Creek and Little Neck Bay with only minor gaps in attaining WQS remaining, primarily from non-CSO sources.

There are, however, some recommendations that are being made as part of the LTCP in order to address the pollutant load contributions from other wet and dry weather sources that may be necessary to comply with the CWA and similar City and State laws and regulations.

It should also be noted that during the development of the 2017 Citywide LTCP, the findings of the Alley Creek and Little Neck Bay LTCP may be reassessed. As additional information become available, including findings from ERTM modeling runs from other LTCPs, or in response to regulatory changes, these and changing conditions may warrant an adjustment this plan.

9.1 Adaptive Management (Phased Implementation)

Based on the outcome of the facility planning and water quality improvement evaluations completed as part of the LTCP, and the progress made from implementing the recommendations of the 2009 WWFP and earlier DEP facility plans, DEP does not recommend the implementation of new grey infrastructure to further address the CSO discharges in the watershed. As demonstrated throughout the LTCP, the remaining minor gaps in attaining WQS remaining are primarily due to non-CSO sources.

Although not recommended as a CSO control strategy in this LTCP, DEP will continue to investigate the localized non-CSSO sources of pollution in the upper Alley Creek watershed including the direct drainage into Oakland Lake and other tributaries. While it is currently understood that waterfowl comprise a significant portion of these pollutant loadings, this should be quantified to the extent practical. A work plan for such investigations will be developed by DEP which will outline the work to be performed within prescribed tributary areas of the watershed. These investigations will complement ongoing data collection programs such as the Post Construction Monitoring (PCM), the Harbor Survey (HS) and Sentinel Monitoring (SM) programs, enhancing the source characterization and supporting potential variations of designated uses in the future.

9.2 Implementation Schedule

Because the sources of bacteria causing WQS violations are attributed to non-CSO sources, there is no specific implementation schedule associated with the Alley Creek and Little Neck Bay LTCP.

9.3 Operation Plan/O&M

As there are no new CSO control facilities warranted for Alley Creek and Little Neck Bay, optimization of the operation of the existing Alley Creek CSO Retention Tank will remain a focus for DEP. This will ensure that the tank provides the maximum level of AAOV reduction through timely post-storm dewatering and inter-storm dewatering of dry weather flow from the storm sewers, infiltration and tank seepage.

9.4 Projected Water Quality Improvements

Improvements in the water quality of the two waterbodies are expected to continue as the result of ongoing efforts to further quantify localized sources of pollution in the upper Alley Creek watershed and the application of 3 percent GI throughout the watershed. These improvements will be tracked and documented through continued DEP water quality monitoring as part of the PCM and Harbor Survey Programs. Other pollutant reduction programs, such as those pertaining to MS4s, would be implemented based on findings of future watershed characterization and modeling that demonstrated cost-effective improvements in the water quality of the two waterbodies.

9.5 Post Construction Monitoring Plan and Program Reassessment

There is no new or expanded monitoring proposed as part of the Alley Creek and Little Neck Bay LTCP. However, ongoing DEP programs will continue, including PCM associated with the Alley Creek CSO Retention Tank and the Harbor Survey program. This is in addition to DMA Beach monitoring and Sentinel Monitoring of the shoreline. Harbor Survey data collected from Stations AC1, LN1 and E11 will be used to periodically review and assess the water quality trends in the waterbodies. Collectively, the data from these programs could form the basis of additional recommendation for inclusion in, as appropriate, the 2017 Citywide LTCP.

9.6 Consistency with Federal CSO Policy

The Alley Creek and Little Neck Bay LTCP was developed to comply with the requirements of the EPA CSO Control Policy, including applicable guidance documents, and the broader CWA goal that the waterbodies shall support fishable and swimmable water quality. The LTCP revealed that Alley Creek currently meets the Class I bacteria criteria but cannot support the next highest Class SB standard even with 100 percent CSO AAOV reduction. It also showed, however, that Alley Creek is not suitable for contact recreation for the several natural and manmade factors listed in the UAA discussion of Section 8.6. As such, a UAA has been prepared and is attached to the LTCP as a means to formally demonstrate and acknowledge the suitability of continued Class I designation for Alley Creek.

Unlike Alley Creek, the Class SB Little Neck Bay, while classified for contact recreation, does not fully comply with all of its applicable bacteria criteria on an annual basis. As was discussed in Sections 6 and 8, the Class SB enterococci criteria are generally not met in the mixing zone between Alley Creek and Little Neck Bay, primarily as the result of wet weather discharges and to a lesser extent baseflow contamination from natural sources. Modeling showed that this remains true even with a projected 100 percent AAOV reduction of the CSO discharges. As was noted in Section 8.6, however, there are also limited opportunities for secondary contact uses of this portion of the inner Bay and no formal public or private beaches. During the recreational season, all of the applicable bacteria criteria are projected to be met throughout the vast majority of Little Neck Bay, but most importantly at the DMA Beach, the only designated bathing beach.

Because of this non-attainment, however minor, a UAA was also prepared for Little Neck Bay and is attached to the LTCP. However, in this case, the UAA resulted in a proposed wet weather advisory for the mixing zone area between the two waterbodies.

9.7 Compliance with WQ Goals

Because Alley Creek is currently meeting its Class I bacterial standards, but cannot support swimmable water quality (Class SB), nor is it suitable for such uses. This is because natural and manmade features, such as lack of access, marshy tidal flat conditions, and the fact that there are no practical means or opportunities to improve its water quality to attain the next highest use of primary contact recreation. The UAA, described above, was prepared to document these findings.

With the exception of the limited mixing zone with Alley Creek, Little Neck Bay generally complies with the Class SB bacteria criteria, but does not do so on an annual basis. As such, a UAA was also prepared for this waterbody as well. As discussed above, DEP is committed to further identify and quantify these non-CSO sources of contamination in addition to the ongoing data collection programs such as the Post Construction Monitoring (PCM), the Harbor Survey (HS) and Sentinel Monitoring (SM) programs, enhancing the source characterization and supporting potential variations of designated uses in the future.

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11.0 Glossary

µg/L:	Microgram per liter
1.5xDDWF:	One and One-half Times Design Dry Weather Flow
2-D:	Two-Dimensional
2xDDWF:	Two Times Design Dry Weather Flow
3-D:	Three-Dimensional
A Posteriori Classification:	A classification based on the results of experimentation
A Priori Classification:	A classification made prior to experimentation
AAOV:	Annual Average Overflow Volumes
ACO:	Administrative Consent Order
ADWF:	Average Dry Weather Flow
ALJ:	Administrative Law Judge
APEC:	Alley Pond Environmental Center
AWT:	Advanced Wastewater Treatment
BASINS:	Better Assessment Science Integrating Point and Non-point Sources
BAT:	Best Available Technology
BEACH:	Beaches Environmental Assessment and Coastal Health
bgy:	billon gallons per year
BMP:	Best Management Practice
BNR:	Biological Nutrient Removal
BOD:	Biochemical Oxygen Demand
BSD:	Brooklyn Sewer Datum
BWSO:	Bureau of Water and Sewer Operations
CAC:	Citizens Advisory Committee
CALM:	Consolidated Assessment and Listing Methodology
CATI:	Computer Assisted Telephone Interviews

CB:	Community Board
$CBOD_5$:	Carbonaceous Biochemical Oxygen Demand
CCMP:	Comprehensive Conservation Management Plan
CD:	Community District
CEA:	Critical Environmental Area
CEG:	Cost-Effective Grey
CEQR:	City Environmental Quality Review
CERCLIS:	Comprehensive Environmental Response, Compensation and Liability Information System
CFR:	Code of Federal Regulation
CIP:	Capital Improvement Program
COD:	Chemical Oxygen Demand
Conc:	Abbreviation for “Concentration”.
Cr+6:	Chrome+6
CSO:	Combined Sewer Overflow
CSS:	Combined Sewer System
CWA:	Clean Water Act
CWP:	Comprehensive Waterfront Plan
CZB:	Coastal Zone Boundary
DCIA:	Directly Connected Impervious Areas
DCP:	New York City Department of City Planning
DDWF:	Design Dry Weather Flow
DEC:	New York State Department of Environmental Conservation
DEP:	New York City Department of Environmental Protection
DMA Beach:	Douglas Manor Association Beach
DMR:	Discharge Monitoring Report
DNA:	Deoxyribonucleic Acid
DO:	Dissolved Oxygen

DOB:	NYC Department of Buildings
DOC:	Dissolved Organic Carbon
DOF:	Department of Finance
DOH:	New York State Department of Health
DOHMH:	New York City Department of Health and Mental Hygiene
DOT:	New York City Department of Transportation
DPR:	New York City Department of Parks and Recreation
DSNY:	Department of Sanitation of New York
DWF:	Dry Weather Flow
E. Coli:	Escherichia Coli.
EBP:	Environmental Benefit Project
EIS:	Environmental Impact Statement
EMAP:	Environmental Monitoring and Assessment Program
EMC:	Event Mean Concentration
EPA:	United States Environmental Protection Agency
EPMC:	Engineering Program Management Consultant
ERTM:	East River Tributaries Model
ERTM:	East River Tributaries Model
ET:	Evapotranspiration
FEIS:	Final Environmental Impact Statement
FOG:	fats, oils, and grease
FOIA:	Freedom of Information Act
FSAP:	Field Sampling and Analysis Program
GI:	Green Infrastructure
GIS:	Geographical Information System
GM:	Geometric Mean
gpd/ft:	gallons per day per foot

gpd/sq ft:	gallons per day per square foot
GPD:	Gallons per Day
GPS:	Global Positioning System
GRTA:	NYC Green Roof Tax Abatement
GSD:	Green Site Development
H_2S:	Hydrogen Sulfide
HCP:	Habitat Conservation Plans
HGL:	Hydraulic Gradient Line
HLSS:	High Level Sewer Separation
HRT:	High Rate Treatment
I/I:	Inflow/Infiltration
IBI:	Indices of Biological Integrity
IDNP:	Illegal Dumping Notification Program
IEC:	Interstate Environmental Commission
IFCP:	Interim Floatables Containment Program
In situ: .	Measurements taken in the natural environment
in.:	Abbreviation for “Inches”.
IPP:	Industrial Pretreatment Programs
IW:	InfoWorks CS™
JABERRT:	Jamaica Bay Ecosystem Research and Restoration Team
JEM:	Jamaica Eutrophication Model
JFK:	John F. Kennedy International Airport
KOTC:	Knee-of-the-Curve
LA:	Load Allocation
lb/day/cf:	pounds per day per cubic foot
lbs/day:	pounds per day
LC:	Loading Capacity

LGA:	LaGuardia Airport
LID:	Low Impact Development
LID-R:	Low Impact Development - Retrofit
LIRR:	Long Island Railroad
LPC:	Landmark Preservation Commission
LTCP:	Long Term Control Plan
LUST:	Leaking Underground Storage Tank
mf/L:	Million fibers per liter
mg/L:	milligrams per liter
MG:	Million Gallons
MGD:	Million Gallons Per Day
MHI:	Median Household Income
mL:	milliliters
MLW:	Mean Low Water
MOS:	Margin of Safety
MOSF:	Major Oil Storage Facilities
MOU:	Memorandum of Understanding
MPN:	Most probable number
MS4:	Municipal separate storm sewer systems
MSS:	Marine Sciences Section
NEIWPCC:	New England Interstate Water Pollution Control Commission
NH3-N:	Ammonia (NH_3)
NMC:	Nine Minimum Control
NMFS:	National Marine Fisheries Service
No./mL (or #/mL):	Number of bacteria organisms per milliliter
NOAA:	National Oceanic and Atmospheric Administration
NPDES:	National Pollutant Discharge Elimination System

NPL:	National Priorities List
NPS:	Non-Point Source
NURP:	Nationwide Urban Runoff Program
NWI:	National Wetland Inventory
NYCDOB:	New York City Department of Buildings
NYCEDC:	New York City Economic Development Corporation
NYCRR:	New York State Code of Rules and Regulations
NYD:	New York District
NYSDOS:	New York State Department of State
O&M:	Operation and Maintenance
OGI:	Office of Green Infrastructure
OMB:	Office of Management and Budget
ONRW:	Outstanding National Resource Waters
Ortho P:	Ortho Phosphorus
P[H]:	**pH** is a measure of the activity of the hydrogen ion. **p[H]**, which measures the hydrogen ion concentration, is closely related to, and is often written as, pH, pure water has a pH very close to 7 at 25°C. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline.
PAH:	Polycyclic Aromatic Hydrocarbons
PCBs:	Polychlorinated Biphenyls
PCM:	Post Construction Monitoring
PCS:	Permit Compliance System
PE:	Primary Effluent
PERC:	Perchloraethylene
POTW:	Publicly Owned Treatment Plant
pounds per day:	lbs/day; unit of measure
ppm:	Parts per million
PS:	Pump Station or Pumping Station
PTPC:	Probable Total Project Cost

Q:	Symbol for Flow (designation when used in equations)
RCRAInfo:	Resource Conservation and Recovery Act Information
REMAP:	Regional Environmental Monitoring and Assessment Program
RL:	Reporting Limit
RNA: Acid.	Ribonucleic
ROWB:	Right-of-way bioswales
RTC:	Real-Time Control
RWQC:	Recreational Water Quality Criteria
SCADA:	Supervisory Control and Data Acquisition
scfm:	standard cubic feet per minute
SEQRA:	State Environmental Quality Review Act
SF:	Square foot
SIU:	Significant Industrial User
SNAD:	Special Natural Area District
SNWA:	Special Natural Waterfront Area
SOD:	Sediment Oxygen Demand
SOP:	Standard Operating Procedure
SPDES:	State Pollutant Discharge Elimination System
SPIL: t	Site Spill Identifier Lis
SRF:	State Revolving Fund
SSM:	Single sample maximum
SSO:	Sanitary Sewer Overflow
SSS:	Separate sewer system
SSWS:	Separate Storm Water System
STORET:	Storage and Retrieval
STV:	Statistical Threshold Value
SWEM:	System-wide Eutrophication Model

SWMM:	Stormwater Management Model
SWPP:	Stormwater Protection Plan
TC:	Total coliform
TDS:	Total Dissolved Solids
TKN:	Total Kjeldahl Nitrogen
TMDL:	Total Maximum Daily Load
TOC:	Total Organic Carbon
TOGS:	Technical and Operational Guidance Series
Total P:	Total Phosphorus
TSS:	Total Suspended Solids
UAA:	Use Attainability Analysis
UAE:	Use Attainability Evaluation
UER-WLIS:	Upper East River – Western Long Island Sound
ug/L:	Microgram per liter
ULURP:	Uniform Land Use Review Procedure
USA:	Use and Standards Attainment Project
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
USFWS:	United States Fish and Wildlife Service
USGS:	United States Geological Survey
UST:	Underground storage tanks
UV:	Ultraviolet Light
VSS:	Total Volatile Suspended Solids
VTS:	Vertical Treatment Shaft
WAC:	Watershed Advisory Committee
WI/PWL:	Waterbody Inventory/Priority Waterbody List
WLA:	Waste Load Allocation

WPCP:	Water Pollution Control Plant
WQS:	Water Quality Standards
WRP:	Waterfront Revitalization Program
WWFP:	Waterbody/Watershed Facility Plan
WWOP:	Wet Weather Operating Plan
WWTP:	Wastewater Treatment Plant
XP-SWMM:	USEPA watershed/sewershed model software program
Zooplankton:	Free-floating or drifting animals with movements determined by the motion of the water.

Appendices

Appendix A: Long Term Control Plan (LTCP) Alley Creek Kickoff Meeting – Summary of Meeting and Public Comments Received

On October 24th, 2012 DEP and the New York State Department of Environmental Conservation (DEC) co-hosted a Public Kickoff Meeting to initiate the water quality planning process for long term control of combined sewer overflows in the Alley Creek and Little Neck Bay Waterbody. The two-hour event, held at the Alley Pond Environmental Center in Queens served to provide overview information about DEP's Long Term Control Plan (LTCP) Program, present information on the Alley Creek watershed characteristics and status of waterbody improvement projects, obtain public information on waterbody uses in Alley Creek, and describe additional opportunities for public input and outreach. The presentation can be found at http://www.nyc.gov/dep/ltcp. Fifteen stakeholders from over 10 different non-profit, community planning, environmental, economic development, governmental organizations and the broader public attended the event.

The Alley Creek LTCP Kickoff Public Meeting was the first opportunity for public participation in a LTCP for the Alley Creek and Little Neck Bay Waterbody. As part of DEP's LTCP Public Participation Plan, Alley Creek's Long Term Control Planning process will be posted on DEP's website, shown above. The public will have more opportunities to provide feedback and participate in the development of Alley Creek's waterbody-specific LTCP. Specific questions asked during the Alley Creek LTCP public kickoff meeting are summarized below with DEP's responses for each.

- What are the CSO related projects in Alley Creek? When will they be built? How much did they cost?
  - *Sewer improvements and a new outfall have already been constructed to help increase sewer system capacity and reduce sewer surcharging and street flooding. This project consisted of installing storm sewers and the construction of a new outfall at a cost of $93 million. In addition, a combined sewer overflow (CSO) retention facility was built to collect about 5 million gallons of combined sewage during rain event. This facility, also referred to as a CSO retention tank, reduces CSOs discharging to Alley Creek by more than 50% or 517 million gallons per year (MGY) down to 256 MGY. The remaining CSO receives partial treatment before being discharged. This facility was built at a cost of $29 million.*

- Which CSO outfalls are connected to the CSO tank? Is TI-024 connected to the tank?
  - *Outfalls TI-008 and TI-025 are connected to the CSO tank. TI-025 receives partially treated overflow from the tank and TI-008 will rarely overflow (under extreme storms) due to the reconfiguration of Chamber 6 weir to divert all flows for a design storm towards the tank. Outfall TI-024 is connected to a pump station relief which rarely overflows.*

- Are the CSO projects that have been built included in the baseline of the model?
  - *Yes, the CSO improvement projects will be part of the baseline in the model.*

- Is DEP using JFK rainfall data only? What years of rainfall numbers is DEP using to model and plan for the long term control of combined sewer overflows in Alley Creek? How is climate change being taken into account?
  - *DEP has been using local rain gauge data (LaGuardia Airport and Douglaston Pump Station) and supplementing with radar rainfall data to support the model calibrations. However, to provide consistency in planning for citywide LTCP projects, DEP is using a specific rainfall record from JFK for baseline and alternatives' analyses scenarios. 2008 data from JFK which includes an annual rainfall of 46.3 inches was chosen based on*

statistical analyses. Projections for future rainfall and sea level rise conditions will be incorporated into the modeling scenarios as will a longer rainfall record covering the last 10 years (2002-2011) to assess pathogen compliance for meeting the appropriate water quality standards.

- Does the model take into account wastewater treatment plants that are not controlled by DEP, such as the Great Neck Wastewater Treatment Plant (WWTP) in Nassau County?
    - *Yes, the model accounts for flows and loadings based on discharge monitoring reports for the Belgrave WWTP in Great Neck.*

- How is the water quality data being collected in the Alley Creek and Little Neck Bay Waterbody? Is it automated or manual? Is data being collected from the CSO tank?
    - *DEP's Harbor Survey program collects ambient water quality grab samples at 3 locations in Alley Creek and Little Neck Bay weekly during recreational season (May 1-September 30) and monthly during non-recreational season (October 1-April 30). In addition, NYC DOHMH monitors Douglas Manor Association Beach 5-times in a 30-day period during recreational season for bacteria indicator concentrations. The ambient water quality monitoring data will be supplemented by additional water quality surveys that DEP will conduct in the fall of 2012 during wet and dry weather periods. Overflow data from the tank is being collected as part of the post-construction monitoring program, which will also be used to refine the model for supporting the LTCP project.*

- Does the model simulate tides? Was the sampling activity timed with the tides?
    - *The model does simulate tides. Kings Point is the closest tide station maintained by the National Oceanic and Atmospheric Administration (NOAA). Tidal adjustment factors developed by NOAA are applied to the Kings Point data to develop tidal conditions within AC/LNB waterbody. AC/LNB is part of the larger East River Tributaries Model (ERTM) to be used for the receiving water quality analyses. ERTM covers from Long Island Sound through the lower New York Bay/ Newark Bay areas and simulates the entire tidal variations within this area, calibrated based on NOAA gage data from Sandy Hook (NJ), The Battery and Kings Point. For the additional water quality sampling to be performed by DEP, sampling will take place in morning and afternoon surveys and bottom and top layer samples are collected. This is the protocol for city-wide sampling, being performed in a number of waterbodies over a period of several years.*

- Does the model simulate actual storms?
    - *Yes, the model simulates actual storms for an annual rainfall record. Spatially varied hourly rainfall records are provided as input, but the models have the ability to take 5-minute data if available and needed to meet a project need. Outputs can be generated at 5-minute intervals, although the receiving water quality models typically require hourly average inputs from the watershed models.*

- What is the plume in the satellite images of Alley Creek and Little Neck Bay in the presentation? Could it be smoke?
    - *As this is an image retrieved from publicly available Google maps, which are snapshots taken at different time periods, it is likely that these images had captured cloud cover. Images available from different public-domain sites were reviewed and this cloud cover didn't exist in those images.*

- What is the estimate of total CSO that goes into Little Neck Bay? What is the estimate for the total diluted sewage into Little Neck Bay?
    - *With the tank online, it is projected that 256 MGY of partially treated CSOs would be discharged to Alley Creek before flowing into Little Neck Bay. While the new annual rainfall from 2008 will create more overflows (in comparison to the above estimates developed from 1988 rainfall), DEP anticipates that the tank will perform better than projected and reduce CSOs further. DEP will continue to monitor the post-construction performance of the tank and will update the model with new data and use to generate revised annual overflows into Alley Creek and eventually into the Little Neck Bay.*

- Are there plans for separate sewers in the watershed/waterbody?
    - *DEP will evaluate the potential for separate sewers in the combined sewer area of the watershed and other alternatives as part of the LTCP development process. Stormwater from some portions of the Alley Creek/Little Neck Bay watershed are currently managed using seepage pits and the DEP's capital plan includes installation of new storm sewers in these areas since the seepage pits were originally built as temporary structures to manage Stormwater until new storm sewers were built.*

- Is DEP installing a new outfall on Udall's Cove? Where was storm water going before (at Udall's Cove)? How are storm water outfalls planned in Little Neck Bay and how is this related to the Bluebelt program?
    - *DEP, working with the Department of Parks and Recreation, is installing a new storm sewer outfall and outlet-stilling basin. Previously the stormwater runoff went directly overland into the cove. The project is similar to the DEP Bluebelt program which discharges stormwater into a managed wetland with a forebay before discharging to a receiving waterbody via an outfall structure.*

- When will a date be set for the second public meeting for Alley Creek and Little Neck Bay Long Term Control Plan Public Participation process?
    - *The next public meeting is scheduled for winter 2013. DEP will provide the date of the next meeting to stakeholders and community members well in advance to ensure maximum participation.*

Appendix B: Long Term Control Plan (LTCP) Alley Creek Public Meeting #2 – Summary of Meeting and Public Comments Received

On May 1, 2013, DEP hosted a second Public Meeting to continue the water quality planning process for long term control of combined sewer overflows (CSOs) in Alley Creek and Little Neck Bay. The purpose of the two-hour event, held at the Alley Pond Environmental Center in Queens, was to provide background and an overview of the LTCP planning process, present Alley Creek watershed characteristics and status of existing water quality conditions, obtain public input on waterbody uses in Alley Creek/Little Neck Bay, and describe the alternatives identification and selection process. The presentation is on DEP's LTCP Program Website: http://www.nyc.gov/dep/ltcp. Ten stakeholders from more than five different non-profit, community planning, environmental, economic development, governmental organizations and the broader public attended the event.

The Alley Creek LTCP Public Meeting #2 was the second opportunity for public participation in the LTCP development process for Alley Creek/Little Neck Bay. As part of DEP's LTCP Public Participation Plan, all Alley Creek/Little Neck Bay LTCP development process documents will be posted on the above website. The public will have additional opportunities to provide feedback and participate in the development of this LTCP. Specific questions asked during the meeting and DEP's responses are summarized below.

- What is the overall goal for water quality in Alley Creek/Little Neck Bay?
  - *The goal of each LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific water quality standards, consistent with the Federal CSO Policy and water quality goals of the Clean Water Act. Specific water quality goals for all individual LTCPs are subject to public input and evaluation or potential alternatives during the LTCP development process.*

- Will the draft LTCP, to be issued in June 2013, be available for public comment?
  - *Yes, all stakeholders will have the opportunity to review and comment on the draft LTCP. DEP will submit the draft LTCP to DEC on June 30, 2013, at which time DEC will review and determine a date for public release and comment.*

- Regarding the graphs in the presentation, what are the modeled lines colored red and black and is the scale logarithmic?
  - *The red lines are model predictions at the top portion of water quality model segments. Each water quality model cell has ten layers from top to bottom. The black represent bottom depth predictions. Yes, the scale is logarithmic.*

- What are the acceptable levels of enterococci and fecal coliform in Alley Creek/Little Neck Bay?
  - *The fecal coliform monthly geometric mean standard is 200 per 100mL for Class SB (Little Neck Bay) and 2,000 per 100 mL for Class I (Alley Creek). The enterococci standard is 435 per 100 mL for Class SB (Little Neck Bay) and is not listed for Class I waterbodies (Alley Creek).*

- Do the values of enterococci go up to 1,000 per 100 mL? Are the enterococci measured data typically below model predications?
  - *The enterococci values do approach 1,000 per 100 mL. However, data are variable: sometimes model results are higher and sometimes lower. In general, the model results generally follow the trends in the data.*

- Based on the bar graphs of pollutant loadings in the presentation, are the largest loads to Alley Creek/Little Neck Bay from non-CSO sources?
  - *Yes, according to the data, stormwater appears to be the source of large pollutant loadings into Alley Creek and Little Neck Bay.*

- Is the bacteria measured in Little Neck Bay resulting from impacts of unsewered areas of Douglas Manor?
  - *No, based on the data, the water quality impacts from Douglas Manor appear to be localized.*

- Is DEP collaborating with Nassau County on reducing storm water pollution load?
  - *DEP anticipates future collaboration with Nassau County during the Municipal Separate Storm Sewer System (MS4) Citywide Permit development and implementation process.*

- What is grey infrastructure?
  - *Grey infrastructure typically denotes large-scale, centralized end-of-pipe controls such as retention tanks or sewer modifications. Examples include: bending weirs, CSO retention tanks and high level storm sewer separation.*

- What is the difference between detention and retention?
  - *Detained stormwater flows are captured, stored and then slowly released to the sewer system. Retained stormwater flows are captured and either infiltrate into the ground, undergo evapotranspiration, or are recycled onsite, and are not released to the sewer system.*

- In the *NYC Green Infrastructure Plan*, a three percent application rate (on private property) is assumed to occur by 2040. What is the basis of this?
  - *DEP estimates that through redevelopment and required adherence to DEP's revised Standards for Stormwater Release Rates, which requires redevelopment and new development projects to achieve a more stringent stormwater release rate in combined sewer areas, that green infrastructure will be implemented on private property. This percentage was developed based on redevelopment project applications received by the New York City Department of Buildings (DOB) over the last 10 years. In addition, DEP offers grants through the NYC Green Infrastructure Grant Program for private and residential properties in combined sewer areas.*

- Why is there not more green infrastructure planned in Alley Creek/Little Neck Bay?
  - *A 10 percent green infrastructure application alternative is being evaluated for the Alley Creek/Little Neck Bay LTCP, based on DEP's target of 10 percent green infrastructure application rate citywide (that is, 10% of the impervious combined sewer area) in combined sewer areas. A 50 percent green infrastructure application alternative (of the impervious combined sewer area) is also being evaluated.*

- The potential project footprint for the 29.5 million gallon CSO retention tank draft alternative would be large. Can DEP consider non-structural alternatives and green infrastructure solutions instead of grey infrastructure alternatives?
  - *As discussed during the presentation, the goal of each LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific water quality standards, consistent with the Federal CSO Policy and water quality goals of the Clean Water Act. Therefore, DEP is required to evaluate a myriad of potential alternatives, which will include green infrastructure, during the alternatives analysis component of the LTCP development process. The*

alternatives analysis is utilized to gauge potential CSO reductions and associated water quality improvements and does not take into account constructability.

- Regarding the draft alternatives, what is the difference between an "upstream" and "downstream" tank?
  - *An upstream tank would capture flows at the upstream combined sewer area. A downstream tank would capture flows near the combined sewer outfall The downstream tank would need to be larger to achieve the same amount of combined sewer flow reduction since there is more stormwater mixed in.*

- Has the existing five million gallon Alley Creek CSO retention tank resulted in water quality improvements?
  - *Based on initial assessments, the CSO retention tank has contributed to water quality improvements. DEP will continue to assess and quantify water quality improvements.*

- Can the LTCP requirements be modified so that the plan addresses other sources as well as CSOs?
  - *The purpose and scope of all LTCPs, including the Alley Creek/Little Neck Bay LTCP where stormwater is the largest source of watershed pollutants, is to address CSOs in combined sewer areas and not other sources of water quality impairments (e.g., directly discharged stormwater inputs in separately sewered areas). The forthcoming MS4 Citywide Permit will include requirements related to stormwater inputs from separately-sewered drainage areas.*

- The focus of this LTCP should be changed to reducing storm sewer runoff into marsh land and improving habitat, and overall emphasis should be on ecology, rather than recreation.
  - *Each LTCP is a comprehensive evaluation of long term solutions to reduce CSOs and improve water quality in New York City's waterbodies and waterways and does not focus on reducing storm sewer runoff. Improved or increased recreation is one of the main considerations required for each LTCP. Regarding enhanced ecology, in 2011, DEP completed a $20 million environmental restoration of the northern portion of Alley Pond Park in Bayside, Queens. DEP constructed eight acres of tidal wetlands and eight acres of native coastal grassland and shrubland habitat in an effort to reduce CSOs in Alley Creek and Little Neck Bay. The new plantings and restored wetlands absorb stormwater runoff, reducing the amount that enters and overwhelms the combined sewer system during wet weather events.*

- DEP should consider acquiring property as a means of water quality protection.
  - *In order to control significant amounts of stormwater and to achieve potential water quality improvements equivalent to potential improvements from grey and/or green infrastructure, DEP would need to acquire numerous larger properties, which may be infeasible considering the built-out and highly urbanized nature of New York City. DEP believes that its broad citywide effort to effectively manage stormwater and CSOs using a hybrid grey/green infrastructure approach will lead to improved water quality.*

- DEP should invest in salt marsh restoration. What kind of pollution reduction could be anticipated from salt marshes?
  - *The New York City Department of Parks and Recreation's (DPR) ongoing and complementary watershed planning and restoration efforts would likely include these evaluations in non-CSO areas contributing to Alley Creek/Little Neck Bay. DEP will be providing support for these efforts even after the submittal of the LTCP on June 30, 2013. Dependent upon the design of the salt marsh, some pollution reduction may be possible.*

- At the end of the public meeting, Mr. Paul Kenline (NYSDEC) read a prepared statement on behalf of NYSDEC. A summary of the statement is included below:

  In March 2012, the State entered into a revised Order on Consent with DEP. This order provides the regulatory and technical framework for New York City to achieve compliance with the Clean Water Act's water quality goals through the development and implementation of CSO Long Term Control Plans. For the next 48 months, the City is required to submit ten waterbody-specific Long Term Control Plans for the State to review, culminating in a Citywide Long Term Control Plan in 2017. The Plans are required to achieve the highest attainable uses of the waters, regardless of their current New York State DEC water quality classification and standards. [1]With your input, and in collaboration with the City and EPA, the State will determine what types of water uses will be available to the public by evaluating, selecting and implementing CSO reduction projects or alternatives, including integrating the City's green infrastructure program. This June, DEP is required to submit for review the first of these water quality planning reports, for the Alley Creek/Little Neck Bay waterbodies and the combined sewage drainage areas. The State has had numerous technical discussions and will continue these discussions with the City over issues with the proposed Long Term Control Plan, including evaluating baseline conditions of the sewage treatment system concerning the CSO volume discharged to New York City's waters, verification of baseline conditions, and that DEP has verified the Long Term Control Plan assumption that all sewers are clean and free of significant sediment and/or obstructions by conducting representative physical inspections of larger diameter sewers within the drainage area (Technical Memorandum to DEC regarding Estimation of Sediment Levels for Pipes Represented in the Hydraulic Model of the NYC Sewer System used for LTCP Reporting (DEP, June 21, 2013)). DEC looks forward to reviewing the draft LTCP so that these technical issues may be vetted by the Department's technical staff. The State thanks you again for your interest and participation.

[1] NOTE: DEP does not agree with NYSDEC's statement that the Long Term Control Plans are required to achieve the highest attainable uses of the waters, though the Plans will assess the waterbody's highest attainable use. The CSO Consent Order includes the following statement of the goal of the LTCP:
The goal of this LTCP is to identify appropriate CSO controls necessary to achieve waterbody- specific water quality standards, consistent with EPA's 1994 CSO Policy and subsequent guidance. Where existing water quality standards do not meet the Section 101(a)(2) goals of the Clean Water Act, or where the proposed alternative set forth in the LTCP will not achieve existing water quality standards or the Section 101(a)(2) goals, the LTCP will include a Use Attainability Analysis examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State. The Use Attainability Analysis will assess the waterbody's highest attainable use, which the State will consider in adjusting water quality standards, classifications, or criteria and developing waterbody-specific criteria.

Appendix C: Summary of Public Comments Received via Email and DEP Responses

- March 29, 2013: Thanks for keeping us all in the loop on the LTCP. That was an eye-opening meeting for me. I, and some of those with whom I spoke, left the meeting wondering if there are other DEP forums in which more feedback is solicited on the direction that the LTCP is taking. For example, I've been told that what largely got people recycling is that it was promoted in schools. When kids came home talking about it, adults started taking more interest. Along those lines, it occurred to me that the City has a captive audience of over a million public school kids. Why don't they all know about how the City functions as infrastructure? Why don't they all know to not do dishes, laundry etc. during rain events? Is there a process in the development of the LTCP for public input like this?
    - *Thanks for writing in. We completely agree. We do have an Education component at DEP to help introduce kids to their City's infrastructure; however this is mostly geared towards the Water Supply system and the watershed. While we would certainly like to do much more, we are also constrained by our resources. However, your suggestion is a good one and we have been exploring ways to tap into the school network to get the word out about what everyone can be doing to improve our City's water and sewer infrastructure.*

- April 17, 2013: I am unable to find the LTCP for Jamaica Bay, Paerdegat Basin that was apparently approved in February 2007. Is that document available? Also, does the Coney Island Water Pollution Control Plant have a Wet Weather Operating Plan?
    - *Thank you for your questions. The Waterbody Watershed Facility Plans (WWFP) for Jamaica Bay and Paerdegat Basin, one of Jamaica Bay's tributaries, was completed in October 2011 and can be found here:*
      http://www.hydroqual.com/projects/ltcp/wbws/jamaica_bay.htm.
    - *WWFPs were the precursor to Long Term Control Plans (LTCPs). The Jamaica Bay and Tributaries LTCP will be completed in June 2016. Please refer to our LTCP Program Website for additional information:*
      http://www.nyc.gov/html/dep/html/cso_long_term_control_plan/index.shtml. The Coney Island Wastewater Treatment Plant (WWTP) does have a wet weather operating plan.

Appendix D: Alley Creek Use Attainability Analysis

EXECUTIVE SUMMARY

The New York City Department of Environmental Protection (DEP) has performed a Use Attainability Analysis (UAA) in accordance with the 2012 CSO Order on Consent for Alley Creek, a tributary of Little Neck Bay, currently designated as a Class I waterbody. The mouth of Alley Creek is located approximately 500 feet north of the Long Island Railroad (LIRR) Bridge. The majority of the flow into the creek occurs north of the Long Island Expressway (LIE) as shown in Figure 1.

Detailed analyses performed during the Alley Creek and Little Neck Bay Long Term Control Plan (LTCP) concluded that the designated Class I secondary contact recreational uses in Alley Creek are in full attainment (100 percent) for fecal coliform criterion. However, based on this technical assessment, it is not feasible to upgrade this waterbody for primary contact recreation. On the basis of these findings, the New York City Department of Environmental Protection (DEP) is requesting, through the UAA process, that the New York State Department of Environmental Conservation (DEC) retain Alley Creek as a Class I waterbody.

Figure 1. Aerial view of Alley Creek

INTRODUCTION

Regulatory Considerations

DEC has designated Alley Creek as a Class I waterbody, defined as "suitable for fish, shellfish and wildlife propagation and survival". The best usages of Class I waters are "secondary contact recreation and fishing" (6 NYCRR 701.13). The next highest use is a Class SB waterbody, which is defined as "suitable for fish, shellfish and wildlife propagation and survival." The best usages of Class SB waters are "primary and secondary contact recreation and fishing" (6 NYCRR 701.11). The SB classification is presumed by DEC to be equivalent to attaining the fishable and swimmable goals of the CWA.

Federal criteria[1] also provide additional guidance that may be implemented by New York State. Non-designated beach areas of infrequent primary contact recreation require that the single sample maximum enterococci measurement never exceed 501 per 100mL.

Federal policy recognizes that the uses designated for a waterbody may not be attainable for reasons other than CSOs, and the UAA has been established as the mechanism to modify the WQS in such a case. Here, Alley Creek meets the designated use classification. However, elimination of all CSOs will not result in attainment of the higher SB classification.

This UAA identifies the attainable and existing uses of Alley Creek and compares them to those designated by DEC. An examination of several factors related to the physical condition of the waterbody

[1] In 2012 the EPA issued new Recreational Water Quality Criteria (RWQC) recommendations which could impact compliance in this waterbody. DEC has not adopted the RWQC at this time.

and the actual and possible uses suggests that the uses listed in the SB classification may not be attainable.

Under federal regulations (40 CFR 131.10), six factors may be considered in conducting a UAA:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the waterbody to its original conditions or to operate such modification in a way that would result in the attainment of the use; or

5. Physical conditions related to the natural features of the waterbody, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

6. Controls more stringent than those required by sections 301(b) and 306 of the Act [CWA] would result in substantial and widespread economic and social impact.

Identification of Existing Uses

The Alley Creek watershed is primarily residential with some commercial, industrial, and open space/outdoor recreation areas. The immediate shorelines of Alley Creek are wholly contained within Alley Pond Park, and tidal wetlands extend from the open water portion of Alley Creek to its banks in most areas.

Figure 2. NYSDEC Wetlands Inventory (2009, WWFP)

Much of Alley Creek's wetlands are designated parks. However, direct public access to Alley Creek is minimal because of the wetlands. There are no kayak launching locations or swimmable/wadable beach areas in this watershed. In summary, the marshland nature of the waterbody (Figure 2), its comparatively small incised channel that can be seen in the middle during low tides, and the substrate unsuitable for wading or bathing (Figure 3), make the waterbody unsuitable for primary contact uses.

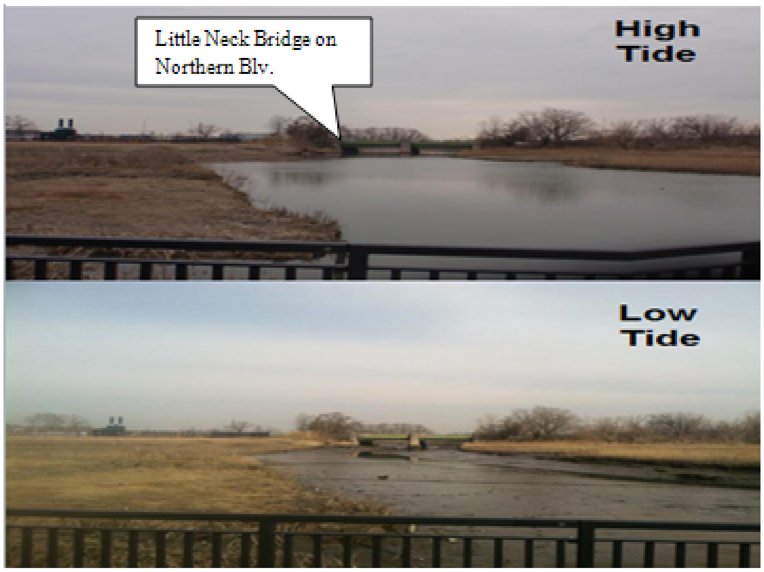

Figure 3. Looking North at Little Neck Bridge on Northern Boulevard

Local residents are known to fish in the area near the LIRR Bridge at the mouth of Alley Creek via small water craft, and from the Little Neck Bridge on Northern Boulevard. An increasingly popular use of Alley Pond Park is camping, wildlife observation and hiking (Figure 4).

Figure 4. Urban Park Rangers Day Camp Program

A significant number of waterfowl reside in Alley Pond Park and are regularly visible on the waters of Alley Creek, Oakland Lake and other tributary ponds, as shown in Figure 5. The evidence gathered at this time suggests that it is possible that this population is contributing pathogen loads to Alley Creek.

ATTAINMENT OF DESIGNATED USES

Alley Creek is a Class I waterbody, suitable for secondary contact recreation and aquatic life propagation and survival.

Figure 5. Waterfowl Population at Tributary Pond

As noted previously, Alley Creek is used infrequently for recreation of any kind, and no evidence of primary contact recreation could be identified. However, as part of the LTCP, an analysis was performed on the viability of Alley Creek meeting the WQS for the next highest classification, SB.

Water quality modeling and observed data indicate that the existing Class I WQS is being achieved. With respect to the Class SB WQS, the attainment of enterococci numeric criteria in Alley Creek is not possible due to additional pollutant sources other than CSO (namely, urban stormwater and waterfowl/wildlife). A component analysis on enterococci concentrations in Alley Creek showed that non-attainment of the Class SB geometric mean of 35 during the worst 30-day period occurred throughout, and was a consequence of multiple sources of pathogen loads. Sensitivity analyses performed with removing individual sources indicate that no single source removed, including 100 percent CSO control, can lead to Class SB WQS attainment. Conclusions reached through these analyses are described below.

CONCLUSIONS

Alley Creek attains the existing Class I WQS but cannot fully achieve the highest attainable fishable and swimmable goals – Class SB - of the CWA due to non-CSO sources from Oakland Lake and other natural sources in the upper Alley Creek watershed. Alley Creek is not used for primary contact recreation, so the non-attainment of fishable/swimmable standard would not impair waterbody uses. Non-attainment of Class SB standards are attributable to the following UAA factors:

- Naturally occurring pollutant concentrations (waterfowl) prevent the attainment of the use (UAA factor #1)
- Naturally-occurring (tidal) low water levels in the receiving water in this vicinity (UAA factor #2)
- Human caused conditions (urban runoff) create high bacteria levels that prevent the attainment of the use and that cannot be fully remedied for large storms (UAA factor #3)

It should be emphasized that the Alley Creek watershed is among very few urban watersheds within New York City with extensive vegetation and wetland features. Human intervention in terms of boat access should be minimized or eliminated to maintain the natural characteristic of this watershed. This limited use concept was supported by many in attendance at the second public meeting held on May 1, 2013.

RECOMMENDATIONS

Alley Creek attains the current Class I water quality standard. Modifying the WQS to Class SB standards in Alley Creek is not appropriate given the marsh, wetlands and tidal flat nature of the waterbody, existing uses and the lack of adequate access points. Moreover, achievement of the SB WQS is not feasible given the current and projected dry and wet weather pollution loads, even following 100 percent control of CSO discharges. Therefore, revising the WQS is not recommended at this time.

Appendix E: Little Neck Bay Use Attainability Analysis

EXECUTIVE SUMMARY

The New York City Department of Environmental Protection (DEP) has performed a Use Attainability Analysis (UAA) in accordance with the 2012 CSO Order on Consent for a small portion of Little Neck Bay, which is currently designated as a Class SB waterbody. Detailed analyses conducted during development of the Alley Creek and Little Neck Bay Long Term Control Plan (LTCP) concluded that the vast majority of Little Neck Bay meets its designated recreational uses for a high percentage of the time, 100 percent for fecal coliform and 100 percent for enterococci criteria during the recreational season between June and September. Annual average attainment is projected to be 100 percent for fecal coliform and 93.5 percent for enterococci criteria. However, there are periods of non-attainment in the mixing zone area between inner Little Neck Bay and Alley Creek. While these are primarily due to discharges from CSO and stormwater outfalls, there are also some dry weather sources of pollution in the upper Alley Creek watershed including those created by large waterfowl populations and potentially other sources as well. DEP is committed to tracking and quantifying these localized sources within the watershed.

On the basis of these findings, DEP is requesting, at this time, through the UAA process, approval from the New York State Department of Environmental Conservation (DEC) to implement a wet weather advisory in the tidal mixing zone of inner Little Neck Bay following wet weather events. The duration of the advisory would range between 24 to 72 hours following a rainfall occurrence. Uses within this portion of Little Neck Bay are restricted to secondary contact – primarily boating and fishing - due to its shallowness during low tides and the nearly complete absence of public access and bathing areas.

INTRODUCTION

Regulatory Considerations

DEC has designated Little Neck Bay as a Class SB waterbody, which is defined as “suitable for fish, shellfish and wildlife propagation and survival.” The best usages of Class SB waters are “primary and secondary contact recreation and fishing” (6 NYCRR 701.11). The SB classification is presumed to be equivalent to attaining the fishable and swimmable goals of the CWA.

Federal criteria[1] also provide additional guidance that may be implemented by states. Non-designated beach areas of infrequent primary contact recreation require that the single sample maximum enterococci measurement never exceed 501 per 100mL.

Federal policy recognizes that the uses designated for a waterbody may not be attainable for reasons other than CSOs, and the UAA has been established as the mechanism to modify the WQS in such a case. This UAA identifies the attainable and existing uses of Little Neck Bay and compares them to those designated by DEC, in order to provide data to establish appropriate WQS for this waterbody. WQS have been established for this waterbody assuming that they can attain fishable and swimmable uses. However, several factors related to the physical condition of the waterbody and the actual and possible uses suggest that these uses may not be attainable. Under federal regulations (40 CFR 131.10), six factors may be considered in conducting a UAA:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of

[1] In 2012 the EPA issued new Recreational Water Quality Criteria (RWQC) recommendations which could impact compliance in this waterbody. DEC has not adopted the RWQC at this time.

effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the waterbody to its original conditions or to operate such modification in a way that would result in the attainment of the use; or

5. Physical conditions related to the natural features of the waterbody, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

6. Controls more stringent than those required by sections 301(b) and 306 of the Act [CWA] would result in substantial and widespread economic and social impact.

Existing Conditions

The Little Neck Bay watershed is primarily residential with some commercial, industrial, and open space/outdoor recreation areas. The land which immediately surrounds Little Neck Bay is largely residential. Several large and notable transportation corridors cross the watershed that limit access to some portions of the waterbody. Figure 1 shows these corridors and the site accessibility limitations that are discussed below and further depicted in Figures 2 through 6.

The Douglas Manor section of Queens occupies the eastern shore of Little Neck Bay, the majority of which is within zoning requiring low density, single family detached homes on large lots. The R1-2 zone requires a minimum lot width of 60 feet; this would allow a maximum of 95 single family properties along the entire eastern shoreline of Little Neck Bay.

Figure 1. Alley Creek/Little Neck Bay Accessibility Sites

Figure 2. A Path to the Waterbody from 233rd Street

Because of the low density residential character of the neighborhood, there is minimal public access to the eastern shoreline. There is no fencing limiting access, and there is no signage discouraging swimming or boating. As shown in Figure 2, there is an informal path to the waterbody from the sidewalk on 233rd Street (Site 1 – Figure 1). A local resident states that he uses the path to reach to the waterbody for fishing. He fishes up to the LIRR Bridge using a kayak or wading. He also stated that when the tide is high enough, boats from the Bayside Marina enter the southern reaches of the Bay providing access for fishing in the vicinity of the mouth of Alley Creek.

The western shoreline of Little Neck Bay is largely bound by a pedestrian promenade (Brooklyn-Queens Green Way) between the Cross Island Parkway and the shoreline of Little Neck Bay, providing significant opportunity for waterbody access.

As shown in Figure 3, it is possible to fish from most of the length of this promenade (Site 3 – Figure 1). The Bayside Marina, located on the western shore about 1.2 miles north of the mouth of Alley Creek, includes a dock from which fishing can occur in addition to tender operation for moored recreational boats. At the southern portion of the western shoreline, the bank changes to wetland with no access from the landside (Site 4 – Figure 1), from which waterfront access is limited by a wide patch of tidal wetlands. While the marshland nature of the waterbody does not support recreational use, there is no signage discouraging swimming or boating, and no fencing impeding access. This is shown in Figure 4.

Figure 3. Fishing Along the Western Shoreline

Figure 4. Wetlands Along the Western Shoreline

With the exception of the beach belonging to the DMA Beach, Little Neck Bay is used infrequently for primary contact recreation from the shoreline, largely limited to intentionally accessible areas such as beaches, promenades, and docks. Figure 5 shows the eastern shoreline which is characterized by relatively shallow sloping bathymetry and private property which limits public access along this shoreline. As depicted in Figure 6, the majority of existing uses occur north of the shallow intertidal reach of Little Neck Bay south of the conspicuous, unnamed point (Site 2 – Figure 1) along the eastern shore about 1,500 feet north of the mouth of Alley Creek, a roughly triangular patch of approximately 35 acres of surface water. This area cannot be readily accessed by swimmers or waders and only very shallow-draft boats can safely navigate these waters and only during certain phases of the tide. Figure 7 depicts the Mean Lower Low Water (MLLW) line from the NOAA navigation chart.

Figure 5. Private Properties on the Eastern Shoreline

Both DMA and the Bayside Marina provide tender services for moored recreational vessels that occupy a large portion of the surface water south of Fort Totten. As a consequence of densely spaced moorings and shallow waters to the south, it is likely that boaters head north to the Long Island Sound and Upper East River where more open water exists, and from which boats may travel to further destinations.

Figure 6. Private Properties on the Eastern Shoreline

ATTAINMENT OF DESIGNATED USES

Little Neck Bay is a Class SB waterbody, suitable for primary contact recreation. As noted previously, with the exception of the DMA Beach, Little Neck Bay is used infrequently for primary contact recreation, perhaps least of all in the shallow intertidal mixing zone between Alley Creek and inner Little Neck Bay, where access is extremely limited and water depths are inadequate.

Water quality modeling and observed data indicate that this use is protected to a large degree, although not at all times at every location. The modeling indicates that attainment of enterococci criteria in Little Neck Bay gets progressively closer to 100 percent as one moves from the mouth of Alley Creek towards the northern end of Little Neck Bay where it meets with the Long Island Sound. Outside the inner Little Neck Bay the 30-day geometric mean (GM) for enterococci is attained over 99 percent of the time. However, a component analysis on enterococci concentrations in Little Neck Bay showed that non-attainment of the GM of 35 during the worst 30-day period occurred throughout, and was a consequence of multiple pathogen loads. These include stormwater, dry weather inflow from Oakland Lake, and boundary conditions at the East River in addition to CSO discharge. The removal of no single component, including 100 percent CSO control, indicates that full attainment of the Class SB standards will not be met year round or seasonally.

It should be noted that the dry weather sources of pollution, while characterized in the LTCP for the purposes of waterbody modeling, require some degree of follow-up investigations into their causes and possible mitigation. For example, while large populations of waterfowl were observed, and illicit sanitary connections to the stormwater system were found and corrected, it is possible that other sources also exist that affect the water quality of Alley Creek and consequently, inner Little Neck Bay. The LTCP noted that continued efforts to identify such sources will continue.

Model calculations for enterococci show that during the maximum 30-day GM period that occurs in Alley Creek and inner Little Neck Bay, NYC stormwater and CSOs each contribute approximately 45 percent to the GM concentration. Because the Alley Creek Tank only overflows 3.5 percent of the total hours during the year, other sources contribute to nonattainment of the criteria during other portions of the year. There are several permitted stormwater discharge points owned by both New York City and Nassau County.

Figure 7. MLLW Line from NOAA Chart

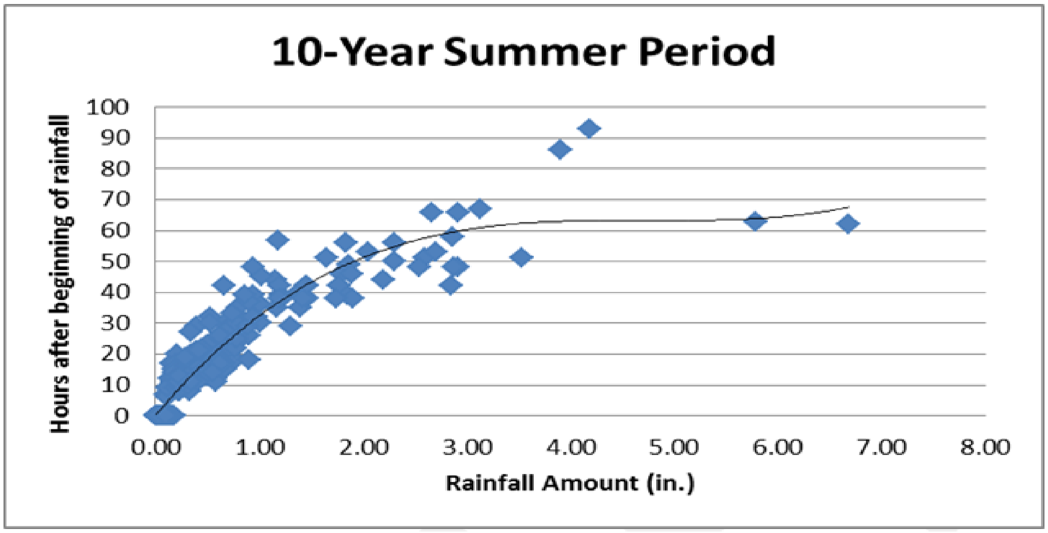

Figure 8. Recovery Time as a Function of Storm Volume

An analysis was conducted using 10 years of data from 2001 through 2011 to predict the time to recover in the mixing zone area between Alley Creek and inner Little Neck Bay following a rain event. In order to be conservative, the primary contact recreation criterion of 130 counts/100 ml from the 2012 Recreational Water Quality Criteria (RWQC) recommendations was used in this analysis. As shown in Figure 9, this criterion is again attained in inner Little Neck Bay as the result of both mixing and decays after some time lag from a wet weather event. While the time to recover back to the criterion of 130 counts/100mL varies based on the characteristics of the rain event, this analysis suggests that an advisory of between 24 and 72 hours would be a reasonable time frame for the inner portion of Little Neck Bay adjacent to Ally Creek.

DEP has been using model projections in various waterbodies and near beaches to assist with advisories that are typically issued twice a day. This recovery time is essentially the timeline within which the waterbody will not support primary contact recreation and is intended to advise the water users of the potential health risk associated with this use during this time period.

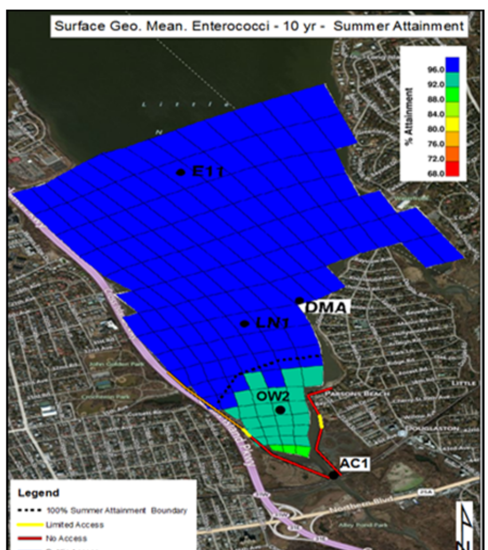

Figure 9. Surface GM Enterococci – 10 yr – Summer

CONCLUSIONS

The majority of Little Neck Bay attains the fishable and swimmable goals of the CWA over 99 percent of the time. However, predicted periods of non attainment would occur in a small portion where Little Neck Bay meets Alley Creek, which is south of the MLLW line on the NOAA chart, In this area, only limited access to the waterbody is possible. As a result, it is used by a very small population. Non-attainment may be attributable to the following UAA factors:

- Naturally occurring pollutant concentrations prevent the attainment of the use vicinity [See UAA factor #1 (40 CFR 131.10(g)(2)]
- Naturally-occurring (tidal) low water levels in the receiving water in this vicinity (See UAA factor #2 (40 CFR 131.10(g)(2))
- Human caused conditions (urban runoff) create high bacteria levels that prevent the attainment of the use and that cannot be fully remedied for large storms [See UAA factor #3 (40 CFR 131.10(g)3)].

RECOMMENDATIONS

The majority of Little Neck Bay attains the fishable and swimmable goals of the CWA over 99 percent of the time. Because non-attainment of Class SB standards in Little Neck Bay is relatively infrequent, and largely confined to the defined mixing area between Alley Creek and inner Little Neck Bay, revising the WQS is not recommended at this time. Rather, DEP recommends an advisory recommending that primary contact waterbody use is not advisable following wet weather events.

Based on the analyses conducted in the LTCP, and summarized in Figure 8, the wet weather advisory, which would be limited to the tidal mixing zone of inner Little Neck Bay, would range between 24 to 72 hours following a rainfall occurrence. The advisory could be a single duration, or alternatively based upon the volume of rainfall with categories including: 0-0.5 inches, 0.5-1.0 inches, 1.0-3.0 inches and greater than 3.0 inches.