State of the Watershed Report
Oyster Bay/Cold Spring Harbor

Prepared For:

Friends of the Bay

In Association With:

Town of Oyster Bay

Oyster Bay, New York

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FUSS & O'NEILL

Disciplines to Deliver

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1 Introduction

Friends of the Bay has retained Fuss & O'Neill, Inc. to prepare a watershed management plan for the Oyster Bay/Cold Spring Harbor estuary and surrounding watershed. The watershed management plan is being developed in cooperation with Friends of the Bay, the Town of Oyster Bay, and other governmental entities, stakeholder groups, and the general public. The watershed management plan for Oyster Bay/Cold Spring Harbor will be developed in two phases – a *State of the Watershed Report* and a *Watershed Action Plan* – following an approach endorsed by the U.S. Environmental Protection Agency for developing watershed-based plans. The *State of the Watershed Report*, which is the subject of this document, summarizes existing environmental and land use conditions in the watershed. The subsequent *Watershed Action Plan* will identify prioritized action items to protect and improve the ecological integrity of the estuary and surrounding watershed.

1.1 Background

The Oyster Bay/Cold Spring Harbor Complex (which is comprised of Oyster Bay Harbor, Cold Spring Harbor, Mill Neck Creek, and Oyster Bay) is the cleanest estuary in western Long Island Sound and is a vital ecological, economic, and recreational resource. The approximately 6,000-acre estuary is the site of one of the most economically-important shellfisheries in the State, contains a National Wildlife Refuge, State-designated Significant Coastal Fish and Wildlife Habitats, and has been identified by New York State as an Outstanding Natural Coastal Area. Moreover, the Oyster Bay/Cold Spring Harbor Complex is connected to Long Island Sound, an Estuary of National Significance. Oyster Bay is among the 30-plus areas highlighted by the Long Island Sound Study Stewardship Initiative, in New York and Connecticut, for the ecological and/or recreational values that they support.

Despite its close proximity to New York City and the more densely developed surrounding areas of western Long Island, much of the Oyster Bay/Cold Spring Harbor Complex watershed consists of low density residential development, recreational facilities, and open space. The Village of Bayville and the hamlets of Oyster Bay, East Norwich, and Cold Spring Harbor have areas of higher density residential development, while commercial and industrial facilities are concentrated in Oyster Bay hamlet, Bayville, and on the eastern shore of Cold Spring Harbor. Waterfront land uses include existing and former operations of the Jakobsen Shipyard, the Oyster Bay Sewage Treatment Plant, and the Commander and Mobil Oil terminals, as well as public recreational facilities and residential waterfront properties (Cashin Associates, P.C., 2002).

The Oyster Bay/Cold Spring Harbor watershed has been facing increasing challenges in recent years. Illegal dumping and polluted stormwater threaten water quality, development pressure is reducing the amount of open space and increasing impervious surfaces in the watershed, and man-made dams and culverts inhibit fish passage along streams. Use impairments to shellfishing, public bathing, fish consumption, habitat/hydrology, aquatic life, and recreation have been identified for parts of the harbor complex. Future uncontrolled development in the watershed will increase the quantity of stormwater runoff to Oyster Bay/Cold Spring Harbor, despite a 2003 New York State Department of Environmental Conservation (NYSDEC) report that highlighted urban runoff as the dominant source of pathogens to the estuary complex (Pathogen Total Maximum Daily Loads for Shellfish Waters in Oyster Bay Harbor and Mill Neck Creek, Nassau County, New York, September 2003).

In addition to these findings by the NYSDEC, Defenders of Wildlife announced in October 2005 that the Oyster Bay National Wildlife Refuge (NWR) made their annual list of the ten most endangered Refuges in the country. The *Refuges at Risk: America's Ten Most Endangered National Wildlife Refuges 2005* report explains that the Oyster Bay NWR has become threatened by polluted stormwater runoff; habitat destruction; non-sustainable development; and human sewage associated with failing sewer infrastructure, and inadequate on-site septic systems. These human-induced impacts adversely affect the entire Oyster Bay/Cold Spring Harbor Complex.

Portions of the Oyster Bay/Cold Spring Harbor watershed are located within the Oyster Bay Special Groundwater Protection Area, designated a Critical Environmental Area by NYSDEC. Long Island's drinking water system was designated as the nation's first Sole Source Aquifer, requiring special protection. The Oyster Bay Special Groundwater Protection Area is one of two such state-designated areas in Nassau County for the purpose of maintaining open space for aquifer recharge. Ongoing development, intensification of land use, and everyday activities within the watershed has the potential to adversely impact groundwater and public drinking water supplies.

The Oyster Bay/Cold Spring Harbor Complex is also the site of one of the most economically-important shellfisheries in the State. The Frank M. Flower & Sons, Inc. shellfish company, along with more than 80 independent commercial baymen, annually harvests up to 90% of New York's oyster crop and up to 33% of the State's hard clam crop from the heart of the National Wildlife Refuge. Most of the waters of Oyster Bay are classified SA, the highest and best water quality determination for shellfishing – an unusual distinction given its proximity to New York City and the fact that the harbors to the west have been closed for more than 30 years. The detrimental impact of degraded water quality on shellfishing in the estuary complex is evident as Oyster Bay Harbor, Mill Neck Creek, and its tidal tributaries are among the 69 water bodies on the New York State list of impaired waters for shellfish harvesting, and the NYSDEC has decertified all shellfish harvesting areas in Mill Neck Creek and some shellfish harvesting areas in Oyster Bay. The harbor complex is also a highly productive area for marine finfish and an important wintering area for a variety of waterfowl (Cashin Associates, P.C., 2002).

1.2 Development of the Report

The following tasks were completed in developing this *State of the Watershed Report* for the Oyster Bay/Cold Spring Harbor Complex:

- Reviewed existing data, studies, and reports on the Oyster Bay/Cold Spring Harbor Complex and its watershed.
- Compiled and analyzed available Geographic Information System (GIS) data.
- Consulted with the Friends of the Bay, the Town of Oyster Bay and Town of Huntington, local villages and hamlets, and state agencies regarding available land use information, mapping, and land use planning regulations.

- Identified and delineated subwatersheds within the overall harbor complex watershed.
- Conducted a comparative subwatershed analysis to prioritize watershed field inventories and management plan recommendations.
- Reviewed existing land use regulatory controls.

This report documents current watershed conditions for the following topics:

- Historical and social perspective (Section 3).
- Natural resources including geology and soils, topography, hydrology, wetlands and watercourses, and fish and wildlife resources (Section 4).
- Water quality including classifications and trends based on available monitoring data (Section 5).
- Watershed modifications including dams, water supply, wastewater discharges, and regulated sites (Section 6).
- Land use and land cover (Section 7).
- Pollutant loading (Section 8).

In addition, the results of a comparative subwatershed analysis (Section 9), watershed field inventories (Section 10), and land use regulatory review (Section 11) are also presented.

1.3 Prior Watershed Studies and Planning Documents

The Oyster Bay/Cold Spring Harbor Complex has long been recognized as a unique and highly valued ecological, economic, and recreational resource by the local residents, visitors, and all levels of government. As a result, a large number of prior watershed studies and related land use planning efforts have been undertaken by the watershed municipalities, Nassau County, NYSDEC, Friends of the Bay, and other agencies and stakeholder groups. This State of the Watershed Report incorporates and builds upon the extensive information available from these previous studies and reports to document current conditions and trends in the Oyster Bay/Cold Spring Harbor Complex. The following watershed-related studies have been completed for the harbor complex.

- Oyster Bay Mill Pond Dam Fish Passage Assessment Project, Oyster Bay-Cold Spring Harbor Watershed (Gomez and Sullivan Engineers, P.C., undated);
- Water Quality Data Evaluation, Oyster Bay/Cold Spring Harbor, 2000 – 2006 (Fuss & O'Neill, Inc., January 2009);
- Annual Water Quality Monitoring Program Reports, 1999 – 2008 (Friends of the Bay);
- Mill River Watershed Study and Public Stewardship Program (Cashin Associates, P.C., December 2007);
- Bailey Arboretum Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);
- Francis Pond Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);

- Kentuck Brook Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);
- Mill River Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);
- Tiffany Brook Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);
- White's Creek Subwatershed, Stormwater Runoff Impact Analysis and Candidate Site Assessment Report (Cashin Associates, P.C., October 1, 2007);
- Build-Out and Cumulative Impact: Oyster Bay Hamlet (Cashin Associates, July 2007);
- Pathogen Total Maximum Daily Loads for Shellfish Waters in Oyster Bay Harbor and Mill Neck Creek (NYSDEC, September 2003);
- Oyster Bay/Cold Spring Harbor Complex Harbor Management Plan (Cashin Associates, P.C., June 2002);
- Mill Pond Outflow Study Water Quality Testing Program (Cashin Associates, P.C., 2001);
- Local Waterfront Revitalization Program for Huntington Harbor, Town of Huntington (Cashin Associates, P.C., April 2000);
- Mill River Watershed Study Sampling and Water Quality Testing (Cashin Associates, P.C.);
- Oyster Bay/Cold Spring Harbor Complex Stormwater Management/Coastal Water Quality Improvement Program Report (Town of Oyster Bay, 1995).

1.4 Ongoing Watershed Conservation and Restoration Efforts

There are a number of ongoing and recently completed efforts to maintain the existing high-quality natural resources of the harbor complex and its watershed, as well as to restore or improve the condition of other degraded resources. Many of these efforts are described in the studies and reports identified in the previous section. Notable ongoing or recently completed watershed conservation and restoration efforts are summarized below.

Friends of the Bay continues to be a leading environmental advocate, committed to the protection of the Oyster Bay/Cold Spring Harbor estuary and its surrounding upland communities. Friends of the Bay is actively involved in water quality protection, watershed and wetlands conservation, land use planning, research, education, and community action and advocacy.

Friends of the Bay has been monitoring the water quality within the Oyster Bay/Cold Spring Harbor Complex since 1999. Today, Friends of the Bay conducts weekly monitoring at 19 locations, from April through October, within Oyster Bay, Mill Neck Creek, and Cold Spring Harbor, as well as additional monitoring at selected streams and outfalls to the estuary. The volunteer water quality monitoring program provides high quality data to continue the dissolved oxygen-testing baseline established by Nassau County's Department of Health in 1972, screens for water quality impairments, supports the Total Maximum Daily Load (TMDL) for pathogens that has been established for Oyster Bay and Mill Neck Creek, evaluates long-term water quality trends, documents the effects of water quality improvement programs, and educates and involves citizens and public officials about water quality protection.

In partnership with the Town of Oyster Bay and Nassau County, Friends of the Bay has been working to improve the water quality of Mill Neck Creek. The shellfish beds in this water body have been closed since 1983. The long-term goal is to reopen all 300 acres. To achieve this goal Friends of the Bay and its municipal partners have worked to obtain funding to improve wastewater treatment and stormwater runoff. A landmark groundbreaking occurred in April 2009 for long-awaited upgrades to sewer and water infrastructure to connect the homes in the Birches residential subdivision, located on the west side of Oak Neck Creek in the Locust Valley area, to the Glen Cove sewage treatment plant. This project will eliminate chronic cesspool overflows to Mill Neck Creek. Friends of the Bay has also been providing outreach to residents regarding the importance of conducting routine maintenance of their onsite wastewater treatment systems.

The Town of Oyster Bay, in partnership with Friends of the Bay, has been working to restore, enhance, and protect the Mill River, which is a major tributary to the Oyster Bay/Cold Spring Harbor Complex. The Town of Oyster Bay completed a watershed study and public stewardship plan in December 2007 to characterize the natural resources of the Mill River watershed, develop strategies to mitigate stormwater quality impacts to the Mill River and the harbor complex, and develop a public outreach/education materials and program. Nassau County has also completed subwatershed stormwater studies for a number of the harbor complex subwatersheds, including Mill River, White's Creek, Tiffany Creek, and others. These studies identify specific stormwater improvement projects that can be implemented in each subwatershed to restore and protect water quality within the estuary and its tributaries.

In July 2009, Oyster Bay was named the second case study location for the National Fish and Wildlife Federation Long Island Futures Fund project entitled "Watershed Trading to Improve the LIS Water Quality" (pilot case study is of the Saugatuck River Watershed in Connecticut). It is believed that the introduction of pollutant trading can reduce the overall cost to meet the reduction goal (e.g., 10% of non-point source Total Nitrogen, TN) as well as serve as a solution to the conflict between economic development and environmental protection and connect stakeholders (municipalities, agriculture, industry, etc.) in a watershed approach. The goal of this project is to assist involved entities including states, municipalities, and watershed groups, overcome the multitude of barriers to implementing a successful water pollution control program while accelerating the water quality improvement in the LIS. This project will build on watershed management initiatives, such as this one, to create a baseline for current watershed planning efforts. A guidance manual will be produced at the conclusion of this project, the LIS Trading Guidance Manual, which will serve as a guide for all LIS watershed entities on the technical, policy, regulatory, and administrative issues involved in pollutant trading and the "lessons learned" in the pilot watersheds.

A number of efforts are underway to restore diadromous fish (sea-run brook trout and other species) to the Mill River and other areas of the harbor complex. The Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay recently recently completed a fish passage feasibility study for the Oyster Bay/Cold Spring Harbor Complex, and specifically for the Mill River. Results of these feasibility evaluations will guide the next steps relative to specific fish passage restoration projects and design alternatives.

Friends of the Bay, in cooperation with the Town of Oyster Bay and Nassau County, using Town and County funds (e.g., SEA Fund and other bond funds) successfully acquired the Mill Pond Overlook property for $4.5 million in 2006. The purchase of this 3.6-acre site prevented the adverse affects development of this parcel would have had on the Mill Pond, the National Oyster Bay Wildlife Preserve, and Oyster Bay. The Town is currently in the process of securing $59,000 in grant funding which the Town will match to develop a restoration plan to return the property to its natural state. The site is fenced and not currently open to the public. Under prior ownership, the Mill Pond site had been poorly maintained and an illegal dumping site for the prior owners asphalt business.

The U.S. Fish and Wildlife Service, NYSDEC, and other state and local government agencies, as well as Friends of the Bay, have been working to protect and restore tidal wetlands and coastal habitat within the estuary. One such project, the Centre Island tide gate project, was designed to restore approximately 20 acres of degraded tidal wetland located in the "Eastover Marsh", which had been dissected by a road that restricted the tidal flow to a large section of the marsh. This reduction caused water to stagnate, and Phragmites and other less desirable plant species dominated much of the marsh for years. To increase tidal flow and restore the marsh, two culverts were installed with a self regulating tide gate on one and a traditional flap tide gate on the other, which was the first time a self-regulating tide gate was installed in New York State.

The Oyster Bay/Cold Spring Harbor Complex was declared a federal No-Discharge Zone (NDZ) for vessel sewage, regulated under Section 312 of the Clean Water Act. The designation prohibits the discharge of sewage (whether treated or untreated) from vessels, providing an additional level of protection to address water quality issues associated with sewage contamination in marine waters.

There are also multiple efforts underway at the local, county, and state level to acquire open space within the harbor complex watershed to protect water quality and provide other environmental, recreational, and quality-of-life benefits. The State of New York, Nassau and Suffolk Counties, and the Town of Oyster Bay and the Town of Huntington have identified properties in the watershed for open space acquisition. In February 2008, the Nassau County Legislature acquired most of the 31-acre Smithers Estate in Mill Neck for open space preservation. This important acquisition creates a continuous preserve all the way to the Oyster Bay National Wildlife Refuge, helping to protect water quality and the health of the Oyster Bay/Cold Spring Harbor estuary system.

Other ongoing watershed protection/restoration and related land use planning activities include planning for Oyster Bay's Western waterfront (formerly Jacobson's Shipyard) and eastern waterfront, smart growth initiatives, and other site-specific development proposals.

2 Study Area Description

2.1 Municipal Jurisdictions

The Oyster Bay/Cold Spring Harbor Complex watershed is an approximately 39 square-mile watershed located in Nassau and Suffolk Counties on Long Island (*Figure 2-1*). As shown in *Table 2-1*, approximately 80 percent of the watershed is located within the Town of Oyster Bay and its incorporated villages and unincorporated villages and hamlets. A small portion (less than 2 percent) of the watershed is located in Glen Cove, also in Nassau County. The remaining 18 percent of the watershed is within the Town of Huntington and its incorporated villages in Suffolk County.

Table 2-1. Political Jurisdictions Within the Watershed

County	Town	Village/Hamlet	Area in Watershed (sq. miles)	% of Watershed
Nassau			**31.97**	**81.9%**
	Glen Cove		0.70	1.8%
		Glen Cove	*0.70*	*1.8%*
	Oyster Bay		31.28	80.2%
		Old Brookville	*0.57*	*1.5%*
		Lattingtown	*1.11*	*2.8%*
		Laurel Hollow	*2.95*	*7.6%*
		Woodbury	*2.73*	*7.0%*
		Hamlet of Oyster Bay	*1.27*	*3.3%*
		Cove Neck	*1.32*	*3.4%*
		Muttontown	*2.94*	*7.5%*
		Syosset	*0.68*	*1.7%*
		Bayville	*0.73*	*1.9%*
		Locust Valley	*0.91*	*2.3%*
		Upper Brookville	*3.58*	*9.2%*
		Bayville (Unincorporated)	*0.12*	*0.3%*
		Mill Neck	*2.70*	*6.9%*
		Oyster Bay Cove	*3.79*	*9.7%*
		Centre Island	*1.04*	*2.7%*
		Glen Head	*0.33*	*0.9%*
		Matinecock	*2.66*	*6.8%*
		Brookville	*0.81*	*2.1%*
		East Norwich	*1.04*	*2.7%*
Suffolk			**7.04**	**18.1%**
	Huntington		7.04	18.1%
		Lloyd Harbor	*2.22*	*5.7%*
		Cold Spring Harbor	*2.50*	*6.4%*
		West Hills	*2.19*	*5.6%*
		Huntington	*0.14*	*0.4%*

Within the watershed, the primary jurisdiction lies with the Town of Oyster Bay and the Town of Huntington, each of which has authority to regulate land use and the underwater lands within its boundary and within unincorporated villages and hamlets. The Towns also have authority to regulate over-water use of coastal waters within its boundaries, but which lie outside of the 1,500-foot area of over-water jurisdiction of the incorporated villages. Each town also has a proprietary authority to control the placement of structures on underwater lands within their respective ownerships, including areas within the incorporated villages'

Figure 2-1

1,500-foot area of over-water jurisdiction. The incorporated villages have authority to regulate land use activities and the use of underwater lands within their respective boundaries, as well as authority to regulate the over-water use of coastal waters within 1,500 feet of their corporate boundaries. For the towns, incorporated and unincorporated villages, there are certain restrictions regarding the use of underwater lands within the Oyster Bay National Wildlife Refuge, which is owned and regulated by the U.S. Fish and Wildlife Service (Cashin Associates, P.C., 2002).

A basic profile of the watershed is provided in *Table 2-2*. Later sections of this document provide more detailed information on these watershed characteristics.

Table 2-2. Profile of the Oyster Bay/Cold Spring Harbor Complex Watershed

Area	39.3 square miles (25,136 acres)
Stream Length	Approximately 7.9 miles
Subwatersheds	14 subwatersheds defined for this study
Jurisdictions	2 Counties (Nassau and Suffolk) 3 Towns 24 Villages/Hamlets
Water Quality	Identified impairments for Mill Neck Creek and its tidal tributaries, Cold Spring Harbor and its tidal tributaries, and Oyster Bay Harbor.
Current Impervious Cover	12.3%
Subwatersheds with the Highest Restoration Potential (Section 9)	Mill Neck Creek Bailey Arboretum Mill River Cold Spring Brook White's Creek
Major Transportation Routes	Jericho Turnpike (State Route 25) Northern Boulevard/N. Hempstead Turnpike (State Route 25A) Pine Hollow Road (State Route 106) Harbor Road (State Route 108)
Significant Natural and Historic Features	Caumsett State Park Cold Spring Harbor State Park Sagamore Hill National Historic Site in Cove Neck Tiffany Creek Preserve Stillwell Woods Muttontown Preserve Roosevelt Memorial Park Charles T. Church/ Shu Swamp Nature Sanctuary Village Woods Park Mill Neck Preserve Centre Island Town Park Beekman Beaches Theodore Roosevelt Audubon Sanctuary Planting Fields Arboretum Bailey Arboretum Cold Spring Harbor Laboratory Cold Spring Harbor Fish Hatchery Raynham Hall

2.2 Estuary

The Oyster Bay/Cold Spring Harbor estuary is located on the north shore of Long Island, spanning approximately 40 linear miles of shoreline and covering approximately 10 square miles (6,400 acres) of open water and intertidal area (Cashin Associates, P.C., 2002). The waterbodies that comprise the estuary are:

- *Oyster Bay Harbor* – the approximately 2,500 acres between the Bayville Bridge and Plum Point on Centre Island. The mapped embayments associated with Oyster Bay Harbor include Beekman Beach, Oyster Bay Harbor proper, and Oyster Bay Cove.

- *Mill Neck Creek* – a tributary to Oyster Bay Harbor, located west of the Bayville Bridge, with an approximately 300-acre watershed.

- *Cold Spring Harbor* – the approximately 1,360 acres located south of a line between Cooper's Bluff in Cove Neck and West Neck Beach in the Village of Lloyd Harbor, including approximately 275 acres within the Town of Huntington. The embayments that are associated with Cold Spring Harbor include Inner Harbor and Cold Spring Brook.

- *Oyster Bay* – the approximately 2,240 acres between Centre Island and the Lloyd Neck peninsula, which connects Oyster Bay Harbor and Cold Spring Harbor to Long Island Sound.

2.3 Watershed

For the purpose of this report, the Oyster Bay/Cold Spring Harbor Complex watershed is divided into 14 subwatersheds, from which surface runoff potentially enters the estuary. The subwatershed delineations are based on information from a variety of sources including previous watershed studies, municipal infrastructure mapping and GIS data, USGS topographic mapping, GIS data provided by Nassau County, and the EPA/USGS National Hydrology Dataset Plus. Subwatersheds were also delineated to facilitate assessment and development of watershed management plan recommendations. The subwatersheds include the area tributary to stormwater recharge basins. *Figure 2-2* depicts the subwatersheds identified in this report, and *Table 2-3* summarizes basic characteristics of the subwatersheds. Brief descriptions of the subwatersheds follow *Table 2-3*.

Figure 2-2

Table 2-3. Oyster Bay Subwatersheds

Subwatershed Name	Area (acres)	Area (square miles)	% of OB/CSH Watershed	Watershed Acronym
Bailey Arboretum	526	0.82	2.1%	BAI
Beaver Brook	4,793	7.49	19.1%	BEA
Centre Island	802	1.25	3.2%	CTR
Cold Spring Brook	4,810	7.52	19.1%	CSB
Cold Spring Harbor	3,004	4.69	12.0%	CSH
Kentuck Brook	1,516	2.37	6.0%	KBR
Lloyd Neck	893	1.40	3.6%	LNK
Mill Neck Creek	1,010	1.58	4.0%	MNC
Mill River	2,159	3.37	8.6%	MRV
Oyster Bay Harbor	1,679	2.62	6.7%	OBH
Tiffany Creek	1,894	2.96	7.5%	TFY
Upper Kentuck Brook	451	0.71	1.8%	UKB
Upper White's Creek	1,310	2.05	5.2%	UWC
White's Creek	289	0.45	1.1%	WCR
Harbor Complex Watershed	**25,136**	**39.3**		

The Centre Island subwatershed (CTR) contains all but the northern edge of the Centre Island peninsula and extends along the southern edge of the land connecting Centre Island to Oak Neck. CTR contains the entire village of Centre Island and the unincorporated village of Bayville. The 802 acre subwatershed is approximately 3.2% of the total watershed area of the harbor complex. The northeastern portions of the watershed discharge to Oyster Bay, while the southern and western portions drain to Oyster Bay Harbor.

The Mill Neck Creek subwatershed (MNC) wraps around Mill Neck Creek, extending from approximately the Bayville Bridge west to the large pond southwest of Factory Pond Lane, and from that pond east to the northern tip of Mill Neck. The subwatershed is located in the villages of Bayville, Locust Valley, Lattingtown, and Mill Neck. The subwatershed is relatively small in area (1,010 acres), but is downstream of approximately 29% of the watershed area contributing to the Oyster Bay/Cold Spring Harbor Complex. Oak Neck Creek is tributary to Mill Neck Creek on the north; the Beaver Lake and Kentuck and Upper Kentuck Brook subwatersheds discharge to Mill Neck Creek on the southern side of the subwatershed; and Bailey Arboretum discharges to the western side of Mill Neck Creek through the large pond southwest of Factory Pond Lane.

The Kentuck Brook (KBR) subwatershed is located within the Town of Oyster Bay and the City of Glen Cove, at the western edge of the watershed contributing to the Oyster Bay/Cold Spring Harbor Complex. Kentuck Brook is a freshwater stream that flows from Glen Cove northeast to the southwest corner of Beaver Lake. This subwatershed is approximately 1,516 acres or 6% of the total watershed area of the harbor complex.

The Upper Kentuck Brook (UKB) subwatershed is located primarily within the Village of Old Brookville in the southwestern corner of the watershed, with the northwest corner of the watershed located in Glen Cove. This southern limit of this 451-acre subwatershed runs approximately parallel to Pound Hollow Road and perpendicular to Brookville Lane and is bounded by Piping Rock Road to the East. This subwatershed discharges to the Kentuck Brook subwatershed near Frost Pond Road.

The Beaver Lake (BEA) subwatershed is located within the Town of Oyster Bay and the Villages of Brookville, Muttontown, Upper Brookville, Matinecock, and Mill Neck. The approximately 4,793-acre subwatershed is nearly 2 miles in length, extending from Cedar Swamp Road (Route 107) in the south to Mill Neck Creek. The downstream portion of the watershed consists of a series of freshwater ponds and wetlands connected by stream segments. The upstream waterbody is Upper Francis Pond, located near the intersections of Oyster Bay road and Mill Hill Road, which discharges to Lower Francis Pond, Shu Swamp, and finally into Beaver Lake. Beaver Lake receives discharge from Kentuck Brook before discharging into Mill Neck Creek.

The Mill River (MRV) subwatershed is located within the Town of Oyster Bay and the Villages of Muttontown, East Norwich, Upper Brookville and Mill Neck and the Hamlet of Oyster Bay in the northeastern portion of Nassau County. The approximately 2,159-acre watershed extends from wetlands in the Muttontown Preserve north under North Hempstead Turnpike (State Route 25A) to Mill Pond, a large pond located between Oyster Bay-Glen Cove Road and West Main Street. The pond also receives drainage from multiple stormwater outfalls and sluices from the encircling roads and outflows under Main Street, discharging through the tidal segment of Mill River into Oyster Bay Harbor (Cashin Associates, P.C., 2007).

The Upper White's Creek (UWC) subwatershed is an approximately 1,310-acre watershed located within the Town and Hamlet of Oyster Bay and the villages of upper Brookville, East Norwich, Muttontown, Syosset, and Oyster Bay Cove. The creek is centered along Route 106, which becomes South Street in the downstream White's Creek (WCR) subwatershed. According to a recent analysis of stormwater runoff in the watershed, the area of the entire White's Creek watershed has been reduced significantly in size by the installation of recharge basins and other drainage infrastructure that contain storm runoff volume from roads, subdivision developments, and commercial and industrial sites. Consequently, the Upper White's Creek subwatershed should provide little or no stormwater runoff (Cashin Associates, P.C., 2007).

White's Creek (WCR) is located downstream of the Upper White's Creek subwatershed and consists of a short section of tidal creek and a narrow segment of freshwater creek. According to the recent stormwater analysis of the subwatershed (Cashin Associates, P.C., 2007), the tidal creek receives drainage from stormwater outfalls located at the northerly end of South Street. Runoff from the majority of the subwatershed, carried in street gutters and a network of underground piping, discharges at these outfalls. The report states that the freshwater segment is a channelized stream located between South Street and White Street that carries runoff from the drainage infrastructure in municipal parking lots and surrounding roadways. The area contributing runoff is approximately 289 acres and is located primarily within the Hamlet of Oyster Bay.

The Tiffany Creek (TFY) subwatershed is an approximately 1,894-acre subwatershed located within the Town of Oyster Bay, within the villages of Oyster Bay Cove, Laurel Hollow, and Cove Neck. Tiffany Creek extends from its headwaters near the intersection of Cove Road and Yellow Cote Road to the outflow into Oyster Bay Cove. According to a recent analysis of stormwater runoff in the Tiffany Creek subwatershed (Cashin Associates, P.C., 2007), the brook is comprised of a short tidal segment and a longer freshwater segment. The tidal segment is influenced by the Oyster Bay Cove tidal changes and receives stormwater runoff from areas northeast of Tiffany Road. The freshwater segment is a partially channelized stream located between Cove Neck Road and Yellow Cote Road and receives surface runoff from adjacent residential properties and nearby roads. At the downstream end of the freshwater segment, there is a small pond located just south of Cove Neck Road.

The Oyster Bay Harbor (OBH) subwatershed consists of the 1,679 acres, extending from the Bayville Bridge in the west to Cove Neck peninsula in the east, that discharge directly to Oyster Bay Harbor. This subwatershed is located in the Town of Oyster Bay and the Villages of Mill Neck, Oyster Bay Cove, Cove Neck, and the Hamlet of Oyster Bay. There are no significant streams in the watershed; Spring Lake in the western portion of the watershed off of Cleft Road is the largest water feature within the subwatershed.

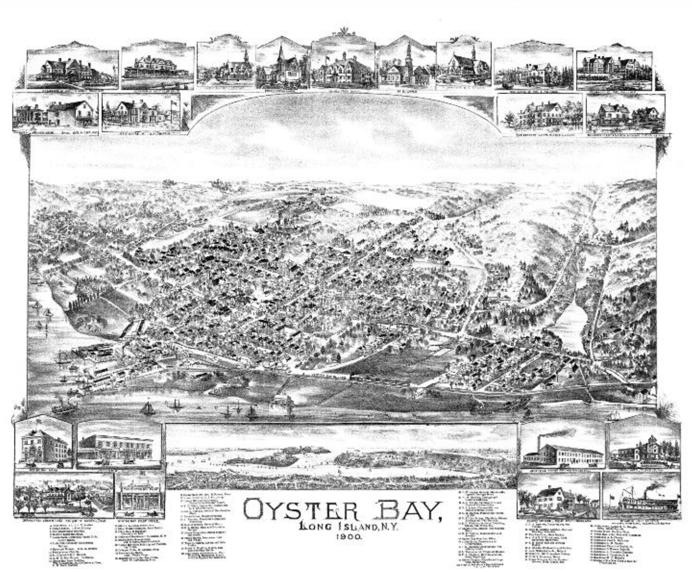
The eastern side of the Cold Spring Brook (CSB) subwatershed is located in the Town of Oyster Bay and the Villages of Syosset, Woodbury, and Laurel Hollow in Nassau County, and the western side of the subwatershed is located in the Town of Huntington and the Villages of Cold Spring Harbor and West Hills in Suffolk County. The subwatershed is approximately 4,810 acres, making it and the Beaver Lake subwatershed the largest in the harbor complex watershed, each comprising roughly 19% of the total watershed area. The headwaters of Cold Spring Brook are located south of Jericho Turnpike. The brook is parallel to Harbor Road before discharging to Cold Spring Harbor downstream of Route 25A (Lawrence Hill Road).

The Cold Spring Harbor (CSH) subwatershed is approximately 3,004 acres, extending from Cove Neck peninsula in the west to Lloyd Harbor in the east, that drain directly into Cold Spring Harbor. The western side of the subwatershed is located in Nassau County in the Town of Oyster Bay and the Villages of Cove Neck, Oyster Bay Cove and Laurel Hollow. The eastern side of the subwatershed is located in the Suffolk County Town of Huntington and the Villages of Huntington and Cold Spring Harbor. Several small streams, running approximately parallel to the shoreline, drain the subwatershed.

Lloyd Neck subwatershed (LNK) is located on the western portion of Lloyd Neck, north of Lloyd Harbor in the Village of Lloyd Harbor in the Town of Huntington. The subwatershed is approximately 3.6% of the watershed area contributing to the harbor complex. While there are no large streams in the watershed, there is a freshwater pond south of Whitewood Point with two mapped tributaries, which drains directly to Oyster Bay.

3 Historical and Social Perspective

3.1 History of the Watershed



The area including the Oyster Bay/Cold Spring Harbor Complex watershed was purchased by colonists from the Native Americans in 1653, with the exception of Lloyd Neck and Centre Island, which were not purchased until 1664 and 1665, respectively. The Oyster Bay/Cold Spring Harbor waterways have attracted merchants and colonization throughout the centuries. During the 17th century, common occupations were related to maritime activities, such as boat builders, carpenters, innkeepers, shipwrights and surveyors. The clay deposits on Centre Island began to be used for brick-making. Commerce and populations increased through the 18th century. By the mid-19th century and the invention of the steamboat, Long Island Sound became a popular summer vacation resort destination (McGee, 1997).

Scientific exploration of Cold Spring Harbor and Oyster Bay began in the early 20th century with the development of a biological laboratory to study the freshwater rivers, springs, tidal flats, and saltwater harbor. The Cold Spring Harbor Laboratory of Quantitative Biology is still in operation more than 100 years later, conducting world-renowned research. The laboratory boasts seven Nobel Prize winners (McGee, 1997).

In the time following World War II, prominent people continued to commute to Oyster Bay from New York City. Business and shopping increased in the area. Current waterfront commerce and activities include: Petro-Commander Oil Corporation, Oyster Bay Marine Center, Frank M. Flower and Sons, three yacht clubs (Seawanhaka Corinthian, Sagamore, and Oak Cliff), and various beaches and a sport club. Commercial oystering remains a prominent industry in Oyster Bay which began in the second half of the 19th century, with underwater shellfish lands leased by the Town of Oyster Bay. The harbor bottom and Mill Neck Creek are important oystering grounds. Prior to World War II, the shellfish in Oyster Bay were plentiful and supported four major oyster harvesting companies and independent baymen. By 1960, the oyster populations began to dwindle and the Flower and Sons Company began a shellfish hatchery to replenish the harbor stock. Today, the Frank M. Flower & Sons, Inc. shellfish company, along with more than 80 independent commercial baymen, annually harvests up to 90% of New York's oyster crop and up to 33% of hard clams from the Oyster Bay/Cold Spring Harbor estuary. The continued success of commercial shellfishing in Oyster Bay remains a concern for town and village government due to threatened water quality from development and other activities in the harbor and its watershed (McGee, 1997).

3.2 Population and Demographics

The population and demographics of the Oyster Bay/Cold Spring Harbor Complex watershed reflect the trends within the Town of Oyster Bay and Nassau County, since the Town of Oyster Bay comprises approximately 80% of the total watershed area. Information on the population and demographics of the watershed are based on information from the Nassau County Master Plan, the U. S. Census Bureau, the Long Island Power Authority, and the Long Island Index Report.

According to the 2008 Nassau County Master Plan Update (Nassau County, April 2009), the County has experienced two periods of major population growth over the past 100 years (*Figure 3-1*). The first occurred in the 1920s as part of the New York area's initial suburban expansion and the second occurred during the 1950s following the passing of the Servicemen's Readjustment Act ("G.I. Bill") and the end of World War II, both of which led to a dramatic increase in single home ownership for returning veterans and their families.

According to data from the U.S. Census Bureau's 2006 American Community Survey, the Town of Oyster Bay population is approximately 299,635. The population is 48.5% male and 51.5% female, with 47.3% of the population between the ages of 25 and 59. Approximately 32.0% of Oyster Bay's population is below age 25, with 20.7% age 59 or older.

The Nassau County population trend from 1900 through 2006 provided by the U.S. Census Bureau depicts two drastic periods of growth on Long Island, in the 1920s and again in the 1950s (*Figure 3-1*). According to a Long Island population study conducted by the Long Island Regional Planning Board, the population of Long Island by 2010 is expected to remain at the present level of 1.3 million people. The population within the harbor complex watershed is also anticipated to remain relatively stable, as there is little remaining developable land in the watershed.

According to the 2000 U.S. Census, the Town of Oyster Bay racial and ethnic characteristics are 86.5% white, 1.8% Black or African American, 7.6% Asian, 0.1% American Indian and Alaska Native, and 6.6% Hispanic or Latino of any race. The Town of Oyster Bay population has a higher percentage of white residents compared to the U.S. population average of 73.9%, and has a notably lower Black or African American and Hispanic or Latino population compared to the U.S. averages of 12.4% and 14.8%, respectively. There is a higher population of Asian residents in Oyster Bay, with a percentage of 7.6%, as compared to the national average of 4.4%.

The average household and family sizes in Oyster Bay are similar to the average U.S. population at 3.0 and 3.4 people, respectively. The median value of single-family owner-occupied homes in Oyster Bay is $556,800, which is considerably higher than the U.S. median $185,200. The median household income is $97,934 (in 2006 dollars) which is more than twice the U.S. median of $48,451. The percentage of families and individuals below the poverty level are less than the U.S. average; 2.4% of families are below the poverty level, compared with 9.8% in the U.S., and similarly 4.1% of individuals as compared to 13.3% in the U.S. are below the poverty level.

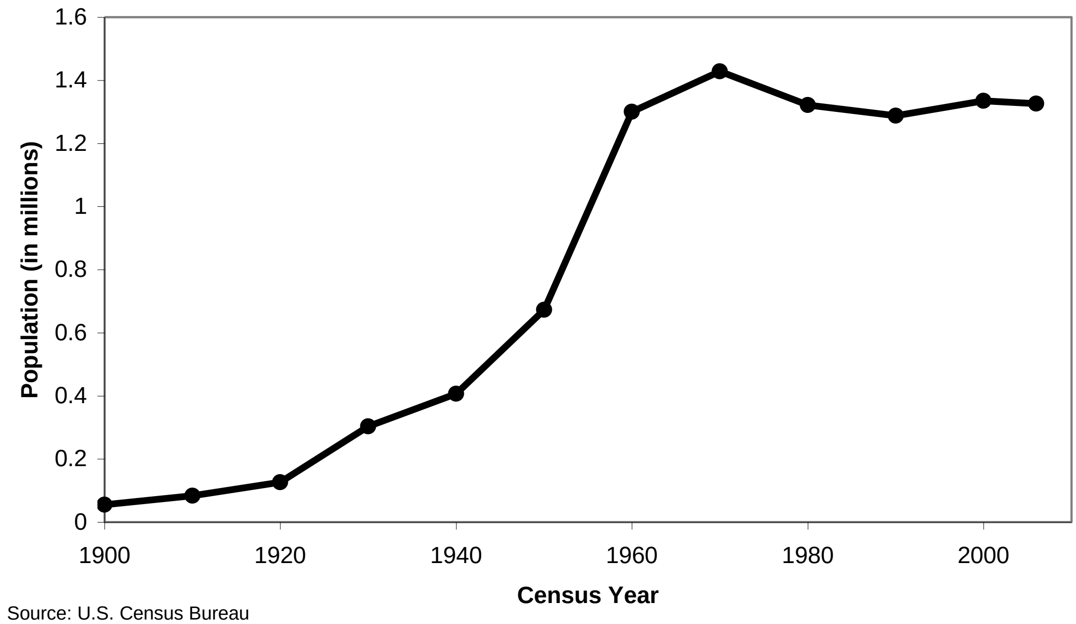


Figure 3-1. Population Trends in Nassau County

The Long Island Index 2008 Report provides an annual review of the goals of government and residents of Long Island to direct regional planning efforts. The 2007 report highlights the need for more affordable housing for young professionals, empty-nesters and retirees. The report found that a majority of current home-owners on Long Island could not afford to purchase a home in today's market. This project was and continues to be funded by the Rauch Foundation.

3.3 Recreation and Community Resources

The Oyster Bay/Cold Spring Harbor Complex provides many opportunities for recreational activities, such as fishing, swimming, and boating. The National Wildlife Refuge and North Shore Wildlife Sanctuary provide significant opportunities for nature observation. Recreational boating is an important activity in the harbor complex, with a 750-vessel mooring area in Oyster Bay Harbor managed by the Town of Oyster Bay. Freshwater fishing is popular in Mill Pond. There are also many public parks, preserves and beaches within the Oyster Bay/Cold Spring Harbor Complex, including:

- Caumsett State Park,
- Cold Spring Harbor State Park,
- Sagamore Hill National Historic site in Cove Neck,
- Tiffany Creek Preserve,
- Stillwell Woods,

- Muttontown Preserve,
- Roosevelt Memorial Park,
- Charles T. Church/Shu Swamp Nature Sanctuary,
- Village Woods Park,
- Mill Neck Preserve ,
- Centre Island Town Park,
- Beekman Beach.

A number of country clubs and golf courses exist in the watershed including the Cold Spring Harbor Country Club, Pine Hollow Country Club, Muttontown Golf and Country Club, Mill River Country Club, Brookville Country Club, Piping Rock Country Club, and Nassau Country Club.

4 Natural Resources

4.1 Geology and Soil

Long Island is formed largely of two spines of glacial moraine. Oyster Bay/Cold Spring Harbor is on the northern moraine, which directly abuts the North Shore of Long Island at points and is known as the Harbor Hill moraine. The moraine consists of gravel and loose rock left behind during the two most recent pulses of Wisconsin glaciation around 19,000 BC. The glaciers melted and receded to the north, resulting in the difference between the North Shore beaches and the South Shore beaches. The North Shore beaches are rocky from the remaining glacial debris, while the South Shore's are crisp, clear, outwash sand (Mills, 1974).

The underlying bedrock is composed of the Monmouth Group, Matawan Group and Magothy Formation of the Coastal Plain Deposits. The surficial geology in the watershed is composed of till and till moraine along the coast, which can be of variable texture (boulders to silt) and permeability. Outwash sand and gravel is present inland from the till deposits composed of coarse to fine gravel with sand. Patches of Kame deposits are present in the watershed, consisting of coarse to fine gravel and/or sand (NYS Museum, 2000).

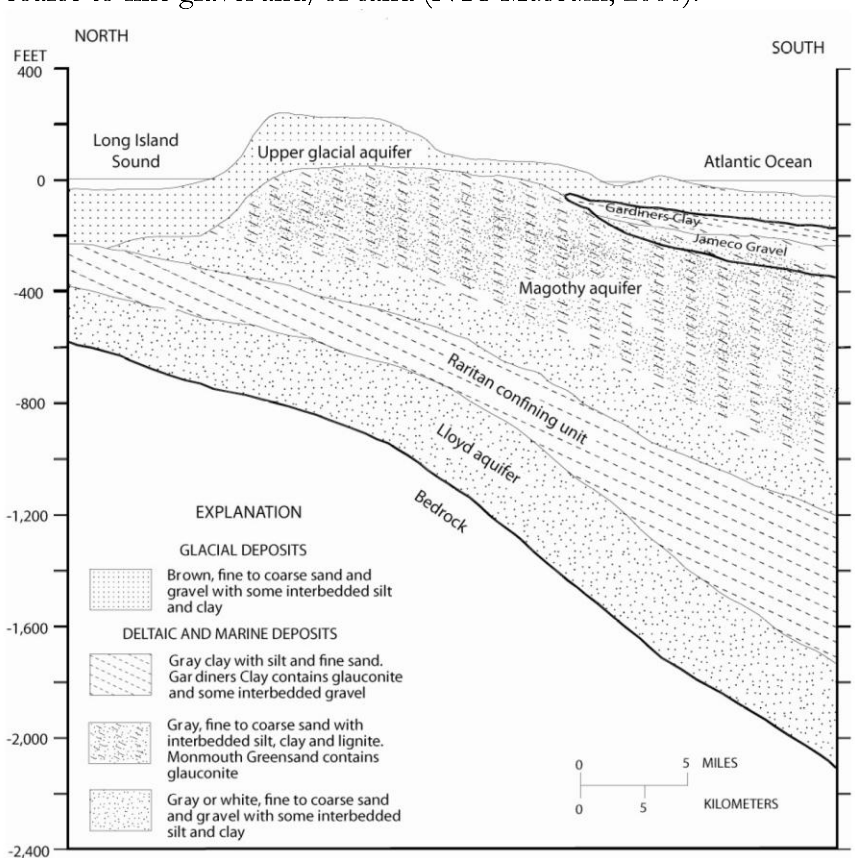


Figure 4-1. Hydrogeologic Cross Section of Long Island Near the Nassau-Suffolk County Border (McClymonds and Franke, 1972)

The regional surficial sediment distribution in Long Island Sound exhibits textural trends which are related to sea-floor geology, bathymetry, and the effects of currents. In general, gravelly sediments are dominant in easternmost Long Island Sound, where tidal currents are strong, and in areas characterized by glacial tills. Sand occurs across the east-central Sound and along most of the nearshore margins. Sand-silt-clay is predominant in Oyster Bay/Cold Spring Harbor (USGS, 2007).

The unconfined groundwater aquifer in the harbor complex watershed is the Upper Glacial Aquifer which extends from Long Island Sound south to the Atlantic Ocean (*Figure 4-1*). The unconfined aquifer is underlain in the Oyster Bay area by several deeper freshwater aquifers. Beneath the Upper Glacial Aquifer, the North Shore Aquifer is confined by the North Shore confining Raritan clay unit. The Lloyd aquifer is confined between the Raritan clay unit and the bedrock formation (Nassau DPW, 2005). Monitoring in the Oyster Bay area has detected significant saltwater intrusion into the Upper Glacial Aquifer and less extensive intrusion into the deeper confined Lloyd Aquifer (USGS, 2004).

4.2 Topography

The topography of the area within the Oyster Bay/Cold Spring Harbor Complex watershed is generally characterized by long, narrow stream valleys surrounded by gentle (1-2%) to steeply (25% or more) sloping hills that transition into broader areas of gently sloping topography *(Figure 4-2)*. Based on U.S. Geological Survey topographic mapping of the area, elevations in the southernmost, upper, portions of the watersheds are typically 200 feet above mean sea level (MSL) with some elevations as high as approximately 350 feet MSL in the Cold Spring Harbor watershed near High Hill in Huntington. Elevations near the watershed's outlets to the estuary are typically less than 10 feet MSL, with some sandy rocky bluffs of 20 to 80 feet MSL elevation adjacent to narrow beach areas (NYDEC, 2003).

4.3 Surface Hydrology

Surface hydrology on Long Island is primarily limited to small streams since the land area is relatively small, and fresh water runoff reaches the ocean without forming large rivers (Mills, 1974). This is also true of the Oyster Bay/Cold Spring Harbor Complex watershed, where the surficial hydrology is dominated by smaller headwater streams and associated impoundments.

The small streams and creeks on Long Island are primarily fed by base flow or groundwater. The distribution and timing of flows is therefore relatively stable year-round. *Figure 4-3* shows the seasonal pattern of mean monthly streamflow in Mill Neck Creek (USGS Stream Gage 01303000, at Beaver Lake 30 feet upstream from Cleft Road in Mill Neck) and Cold Spring Brook (USGS Stream Gage 01303500, at Cold Spring Fish Hatchery 270 feet upstream from State Highway 25A) for the period of record. Normalized by drainage area, the streamflow data in *Figure 4-3* are presented in units of cubic feet per second per square mile (CFSM). The highest streamflow generally occurs during March and April, while seasonal low-flows typically occur during late summer or early fall.

Figure 4-2

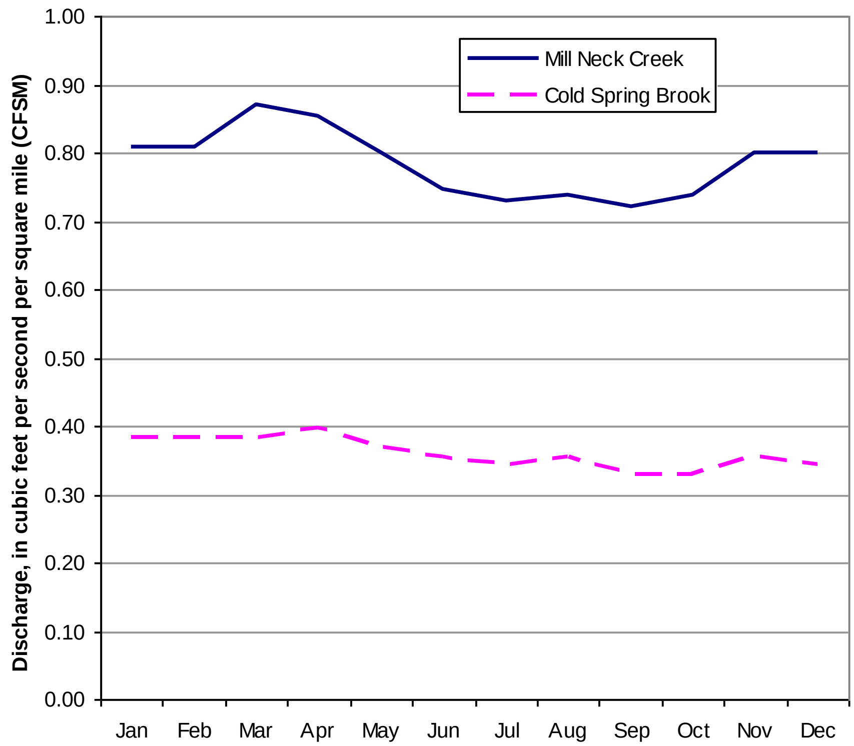


Figure 4-3. Mean Monthly Streamflow of Mill Neck Creek and Cold Spring Brook

As described in Section 2.3, the major surface hydrologic features within the harbor complex watershed are Cold Spring Brook, which feeds Cold Spring Harbor, Tiffany Creek and Mill River, which discharge to Oyster Bay Harbor, and Beaver and Kentuck Brooks, which combine at Beaver Lake before discharging into Mill Neck Creek.

4.4 Flood Hazard Areas

Floodplains, which are areas that would be impacted by floodwaters of some depth, are delineated by the Federal Emergency Management Agency 100-year and 500-year flood zones (FEMA, 1979). Much of the watershed's coastline is subject to inundation and flooding due to wave action (*Figure 4-4*). The 100-year flood zone is typically within 500 feet of the coast and includes residential areas in Bayville and the estuarine complex on the eastern side of Centre Island. Most areas of the watershed lie outside the 500-year flood zone. Portions of Beaver Brook, Mill Pond, Tiffany Creek and St. John's Pond have designated 100-year and 500-year flood zones.

Figure 4-4

4.5 Climate

Climate in the Oyster Bay/Cold Spring Harbor Complex watershed is similar to other coastal areas in the Northeast, with warm humid summers and cold winters. Climate on Long Island is influenced strongly by the ocean, which results in a relatively mild winter season compared to inland areas and helps to alleviate heat in the summer months. According to the National Oceanic and Atmospheric Administration, there are an average of 7 days between June and September when the afternoon temperature on Long Island exceeds 90 degrees, while farther inland there are 10 to 15 such days. The winter season is relatively mild, with below zero temperatures reported on only one or two days in about half the winters. Temperatures of 10 degrees below zero or colder are extremely rare and there are often extended periods during the winter when no snow cover is present. The freeze-free season is typically from late April/early May to mid- to late-October.

The area typically receives 45-50 inches of precipitation on an annual basis. The seasonal snowfall averages about 30 inches. Almost all of this snow falls between December and March. Coastal low pressure systems, Northeasters, are the principle source of this snow. These weather systems will occasionally produce a heavy snowfall. It is uncommon for the eye of a tropical storm to pass directly over Long Island. Tropical weather systems moving along the Atlantic Coast, however, are capable of producing episodes of heavy rain and strong winds in the late summer or fall.

Changes in climate are anticipated to occur over the next century. The magnitude of changes in temperature, sea level, and the timing and intensity of rainfall will depend upon future emissions of carbon dioxide and other greenhouse gases driving climate change. However, using different emissions scenarios, climate modelers have predicted the following changes to the climate in the Northeast United States as summarized below (Ashton et al., 2007; Fogarty et al., 2007; Frumhoff et al., 2007; Hayhoe et al., 2008; Kirshen et al., 2008).

Over the next several decades, temperatures are anticipated to rise 2.5-4°F in winter and 1.5-3.5°F in summer. By the end of the century, winter temperatures are predicted to rise 5-12°F and summer temperatures 3-14°F compared to current conditions. As a result, days over 90°F will be more frequent, there will be a longer growing season, less winter precipitation falling as snow and more as rain, a reduced snowpack, and an earlier spring snowmelt. In addition, regional sea surface temperatures are expected to rise 4-8°F by 2100.

The Northeast is anticipated to experience an increase in total precipitation of about 10% or 4 inches on an annual basis by the end of the century. Seasonally, winter precipitation is predicted to increase 20-30%, while summer precipitation amounts will remain relatively unchanged. In addition to increased precipitation amounts, more extreme precipitation is expected. Current model predictions include an increase in the precipitation intensity, i.e., the average amount of rain falling on a rainy day, and the number of heavy precipitation events. Precipitation intensity is predicted to increase 8-9% by mid-century and 10-15% by the end of the century. An 8% increase in the number of heavy precipitation events is expected by mid-century, with a 12-13% increase by the end of the century. The resulting hydrologic response will be higher winter and lower summer streamflow.

4.5.1 Climate Change Impacts

Climate change in the Northeastern U.S. is anticipated to result in an increase in the extent and frequency of coastal flooding, a rise in the frequency of severe storms and related damages, and sea level rise of 2-6 feet (Frumhoff et al., 2007). Increases in sea level and frequency of severe storms will result in more inundation of coastal areas, and subsequent increases in shoreline erosion and wetland loss. Inundation of low-lying areas will result in the potential for saltwater to infiltrate into freshwater surface waters and aquifers. Increased flooding and erosion has the potential to negatively impact transportation infrastructure and sewage and septic systems.

Areas of coastline most vulnerable to sea-level rise impacts have been identified by the U.S. Geological Survey (USGS) (Hammar-Klose and Thieler, 1999) through the calculation of a coastal vulnerability index (CVI). Calculation of the CVI depends on past changes in shoreline position, typical wave climates, tidal range, coastal geomorphology and sea-level history. Each region is assigned a CVI from 1 (low-risk) to 5 (high-risk). The assessment indicates a low CVI of 1 for the north shore of Long Island, in contrast to a CVI of 2 or higher for large segments of the south shore of Long Island and other coastal areas of the Northeastern U.S. (*Figure 4-5*). However, it is important to keep in mind that the CVI does not predict future shoreline location or take into account large events such as hurricanes.

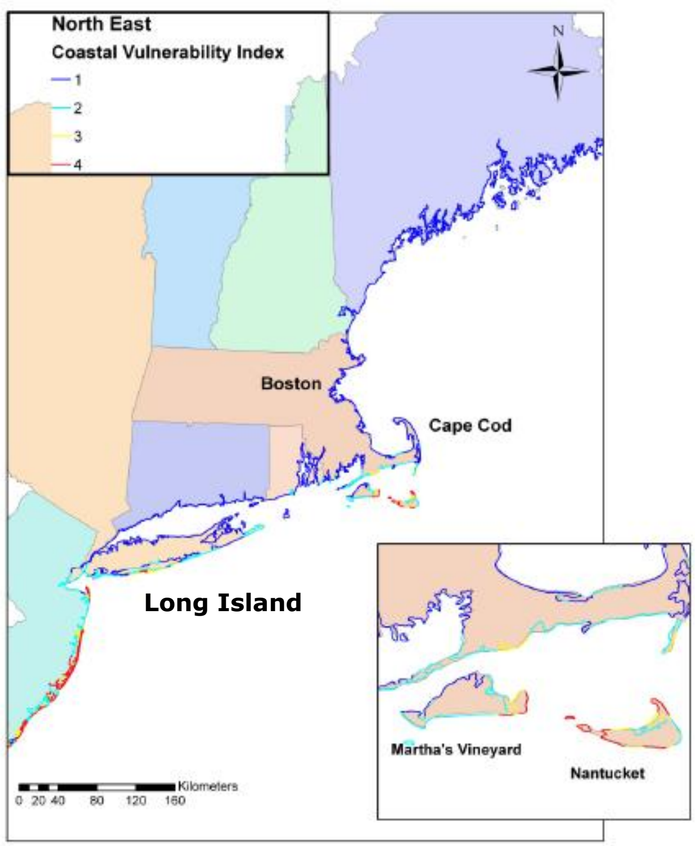


Figure 4-5. Coastal Vulnerability Index (CVI) for the Northeastern U.S.

Coastal wetlands are vulnerable to the effects of sea-level rise, increasing water temperatures, and increased nutrients. If accretion of river-borne sediment and organic matter is unable to keep pace with the combined affects of sea-level rise and land subsidence, coastal marshes will be reduced or disappear. This will impact the ecological services provided by these areas including buffering coastal areas from waves and erosion, filtering nutrients and pollutants, providing wildlife habitat, and providing nursery areas for fisheries. Because hard-clams and oysters depend on wetland-based food chains, impacts to coastal wetlands are anticipated to impact those fisheries (Frumhoff et al., 2007).

It is difficult to predict the ways in which warming of water temperatures will influence other factors that affect marine ecosystems, including nutrient dynamics, ocean circulation, and plankton production. However, commercial fish and shellfish have water temperature thresholds that define conditions suitable for reproduction, growth, and survival. Increased water temperatures over the last decade have already led to declines in lobster landings in Long Island Sound (Fogarty et al. 2007). In addition, warmer water temperatures also appear to facilitate the spread of shellfish disease, the frequency and intensity of harmful algal blooms, and the ability of invasive species to reproduce and spread (Frumhoff et al., 2007).

More geographically-specific information on the impact of climate change on Long Island is currently being developed through a collaboration of The Nature Conservancy (TNC), the National Oceanic and Atmospheric Administration (NOAA), the NASA Goddard Institute for Space Studies, Pace Law School, the University of Southern Mississippi, and the Association of State Floodplain Managers. The TNC Coastal Resilience project is intended to provide planners and other decision-makers with tools to assess reasonable future impacts of flooding from sea level rise and storms. The mapping tool developed for the project is an interactive decision support tool that explores future flooding scenarios and is available at http://maps4.msi.ucsb.edu/. Currently the online tool is only operational for the south shore of Long Island, although plans to include the north shore of Long Island are included in the project.

4.6 Wetlands

Generally, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance.

Wetlands are classified by NYSDEC as either freshwater or tidal, depending on the vegetation they support, which is a function of water salinity and inundation. Freshwater and tidal wetlands provide a multitude of functions including flood and stormwater control, pollution reduction, marine food production, wildlife habitat, recreational opportunities, open space, and aesthetic value.

In New York State, freshwater wetlands are regulated under the Freshwater Wetlands Act (under Article 24 of the Environmental Conservation Law) and are defined and mapped by NYSDEC. Freshwater wetlands are those areas of land and water that support a preponderance of characteristic wetlands plants that out-compete upland plants because of the presence of wetlands hydrology (such as prolonged flooding) or hydric (wet) soils. Freshwater wetlands commonly include marshes, swamps, bogs and fens. *Figure 4-6* depicts the extent and distribution of freshwater wetlands in the Oyster Bay/Cold Spring Harbor Complex watershed. Freshwater wetlands comprise less than 2 percent of the harbor complex watershed. The majority of these wetlands are associated with ponds along Beaver Brook, Mill River, Tiffany Creek, and Cold Spring Brook.

Tidal wetlands are regulated in New York State under the Tidal Wetland Act of 1973. Tidal wetlands are the coastal areas periodically flooded by seawater during high or spring tides or are affected by the changes in water levels caused by the tidal cycle. Salt marshes and mud flats are common types of tidal wetlands found along New York's marine shoreline. Tidal wetlands are classified by the amount of inundation during high and low tides and the type of vegetation. *Table 4-1* summarizes the categories of tidal wetlands, as designated by NYSDEC, which exist within the Oyster Bay/Cold Spring Harbor Complex.

Table 4-1. Tidal Wetland Categories

Category	Description
Coastal Shoals, Bars and Mudflats (SM)	The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, and at low tide is exposed or is covered by water to a maximum depth of approximately one foot, and is not vegetated.
Littoral Zone (LZ)	The tidal wetland zone that includes all lands under tidal waters which are not included in any other category. There shall be no LZ under waters deeper than six feet at mean low water.
Formerly Connected (FC)	The tidal wetlands zone in which normal tidal flow is restricted by man-made causes. Phragmites sp. is the dominant vegetation.
Fresh Marsh (FM)	The tidal wetland zone found primarily in the upper tidal limits of the riverine systems where significant fresh water inflow dominates the tidal zone. Species normally associated with this zone include narrow leaved cattail, Typha angustifolia; the tall brackish water cordgrass, Spartina pectinata and/or S. cynosuroides; and the more typically emergent fresh water species such as arrow arum, Peltandra; pickerel weed, Pondederia; and cutgrass, Leersia.
High Marsh (HM)	The normal upper most tidal wetland zone usually dominated by salt meadow grass, Spartina patens; and spike grass, Distichlis spicata. This zone is periodically flooded by spring and storm tides and is often vegetated by low vigor, Spartina alterniflora and Seaside lavender, Limonium carolinianum. Upper limits of this zone often include black grass, Juncus Gerardi; chairmaker's rush, Scirpus sp; marsh elder, Iva frutescens; and groundsel bush, Baccharis halimifolia.
Intertidal Marsh (IM)	The vegetated tidal wetland zone lying generally between average high and low tidal elevations in saline waters. The predominant vegetation in this zone is low marsh cordgrass, Spartina alterniflora.
Dredged Spoil (DS)	All areas of fill material.

Source: http://www.dec.ny.gov/lands/5120.html

Figure 4-6 depicts the extent and distribution of tidal wetlands in the Oyster Bay/Cold Spring Harbor Complex watershed. Approximately 1,000 acres of tidal wetlands exist within the harbor complex. Extensive areas of coastal shoals, bars, and mudflats occur along Mill Neck Creek, the western and southern shoreline of Oyster Bay Harbor, Inner Cold Spring Harbor,

Figure 4-6

and the northeast shoreline of Centre Island. Most of the shoreline in the harbor complex is fringed by vegetated (IM and HM) tidal wetlands of varying width, interrupted by man-made waterfront structures. Some of the larger areas of vegetated tidal wetlands in the harbor complex are (Cashin Associates, P.C., 2002):

- Marshes along most of the shoreline in Mill Neck Creek,
- Oak Neck Creek, a northwesterly tributary of Mill Neck Creek, which is characterized by NYSDEC as one of the largest undeveloped salt marshes remaining on the north shore of Long Island,
- The Town of Oyster Bay-owned marsh at Goose Point in Bayville,
- Centre Island Marsh, which connects to Oyster Bay,
- Marsh along the entire length of West Shore Road on Oyster Bay Harbor,
- St. John's Marsh at the head of Cold Spring Harbor.

Table 4-2 summarizes the distribution and extent of freshwater and tidal wetlands in the harbor complex subwatersheds. Freshwater wetlands account for approximately 1.7 percent of the harbor complex watershed area, with the majority of these located in the Beaver Brook, Cold Spring Brook, and Mill River subwatersheds. Tidal wetlands account for approximately 1,000 acres within the harbor complex subwatersheds and estuary. Approximately half of the acreage of tidal wetlands is within the estuary, outside of the subwatershed boundaries.

Table 4-2. Freshwater and Tidal Wetlands in the Oyster Bay/Cold Spring Harbor Complex

Subwatershed Name	Freshwater Wetland Acreage (Percent of Watershed)	Tidal Wetland Acreage	Total Wetland Acreage
Bailey Arboretum	22.8 (5.5%)	6.1	28.9
Beaver Brook	168 (3.5%)	0	168
Centre Island	0 (0%)	329.4	329.4
Cold Spring Brook	86.2 (1.8%)	0	86.2
Cold Spring Harbor	10.8 (0.4%)	169.9	180.7
Kentuck Brook	15.3 (1.0%)	0	15.3
Lloyd Neck	6.7 (0.8%)	62.6	69.3
Mill Neck Creek	0 (0.0%)	335.2	335.2
Mill River	108 (5.0%)	0	108
Oyster Bay Harbor	0 (0.0%)	169.4	169.4
Tiffany Creek	16.1 (0.9%)	0	16.1
Upper Kentuck Brook	0 (0%)	0	0
Upper White's Creek	0 (0%)	0	0
White's Creek	0 (0%)	0	0
Harbor Complex Watershed	**433.9 (1.7%)**	**1,072.6**	**1,506.5**

4.7 Fish and Wildlife Resources

Portions of the Oyster Bay/Cold Spring Harbor Complex and its watershed provide abundant and significant habitat that supports a variety of fish and wildlife. Various estuarine, palustrine, riverine, and upland areas provide habitat to finfish, shellfish, mammals, amphibians, reptiles and birds.

The most notable tracts of protected or preserved land (including submerged or tidal areas) within the estuary and watershed include:

- Oyster Bay National Wildlife Refuge,
- Charles T. Church/Shu Swamp Nature Preserve,
- Sagamore Hill National Historic Site,
- Planting Fields Arboretum,
- Muttontown Preserve,
- Bailey Arboretum,
- Stillwell Woods Park,
- Tiffany Creek Preserve.

These tracts of privately and publicly owned land provide valuable habitat or unique natural resources in an otherwise developed residential watershed. Due to the importance of these habitats, the State of New York has designated some of them as Significant Coastal Fish and Wildlife Habitats (SCFWH). According to NYSDEC, SCFWH include marshes, wetlands, mud and sandflats, beaches, rocky shores, riverine wetlands and riparian corridors, stream, bay and harbor bottoms, submerged aquatic vegetation beds, dunes, old fields, grasslands and woodlands and forests. These coastal habitats provide living and feeding areas for animals and are also economically important. Three NYSDEC-designated SCFWH areas exist in the watershed: Mill Neck Creek, Cold Spring Harbor, and Oyster Bay Harbor.

Oyster Bay Harbor and Cold Spring Harbor are hydrogeomorphically different from Mill Neck Creek, being predominantly composed of deep water estuarine habitats. Mill Neck Creek, in contrast, is predominantly composed of a tidal creek and marsh estuarine habitats. Each estuarine habitat provides unique resources for the fish and wildlife that use them. All or portions of these areas make up the majority of the Oyster Bay National Wildlife Refuge.

The Oyster Bay National Wildlife Refuge (NWR) is a 3,200-acre refuge that is the largest in the Long Island National Wildlife Refuge Complex. Oyster Bay NWR includes the northern three-quarters of Oyster Bay Harbor, the northwestern quadrant of Cold Spring Harbor (approximately 1,000 acres), and all of Mill Neck Creek. The refuge consists of bay bottom, saltmarsh, and freshwater wetlands systems. Bay bottom is the largest proportion of habitat owned and managed by the USFWS (78%). The remaining 22% consists of saltmarsh (low and high), estuarine stream bed, and unconsolidated shore habitats (10%, 9% and 3% respectively). The refuge also includes Mill Pond and its associated freshwater wetlands. The Oyster Bay NWR is well-sheltered from Long Island Sound and, as such, provides excellent winter habitat for a variety of water fowl and shorebirds. It also provides significant nursery and feeding habitat for finfish and substrate for shellfish (USFWS, 2009).

The following sections describe representative habitats and protected lands to illustrate the diverse and rich ecological communities that exist within the Oyster Bay/Cold Spring Harbor Complex and its watershed. The presence of diverse fish and wildlife habitats and species is indicative of the capacity of the harbor complex and its watershed to support these natural resources, despite the developed suburban landscape that makes up a large percentage of the watershed.

4.7.1 Estuarine Habitats

Oyster Bay/Cold Spring Harbor

The NYSDEC-designated SCFWH in Oyster Bay consists of approximately 2,500 acres of open tidal waters, mud flats, salt marshes, tidal creeks and sand islands. Depth of water at mean low tide ranges from 6 feet to 30 feet with some areas greater than 50 feet (USFWS, 2009; NYSDOS, 2005).

The designated SCFWH in Cold Spring Harbor consists of approximately 2,500 acres of open tidal waters, mud flats, salt marshes, tidal creeks and sand islands. Depth of water at mean low tide ranges from 6 feet to 20 feet with some areas as deep as 70 feet. Only a few areas of undeveloped salt marsh remain, including St. John's Marsh located at the southern end of the harbor and unnamed tidal marshes on the west shore associated with the Sagamore Hill National Historic Site (NYSDOS, 1987).

Finfish

Oyster Bay/Cold Spring Harbor and its associated lagoons, smaller embayments and tidal marshes serve as nursery and feeding habitat for various marine fish species including scup (*Stenotomus chrysops*), striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*), Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), winter flounder (*Pseudopleuronectes americanus*), and blackfish (*Tautoga onitis*). This area is also known as one of a few spawning runs for smelt (*Osmerus mordax*) on Long Island (NYSDOS, 1987).

Attempts in recent years have been made to open up fish passage throughout the watershed to anadromous fish (which spend most of their adult lives in coastal marine waters) such as river herring (*Alosa sapidissim*), sea lamprey (*Petromyzon marinus*) and sea-run brook trout and catadromous fish (which live in freshwater but spawn at sea) such as American eel (*Anguilla rostrata*). (NYSDOS, 2005; Gomez & Sullivan, undated). A fish ladder has been constructed at the downstream end of Beaver Lake to open passage to sea run trout and potentially other anadromous and catadromous fish (NYSDOS, 2005).

Fish passage feasibility studies have also been completed by the Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay to evaluate restoration of diadromous fish (which travel between salt and freshwater and include both anadromous and catadromous fish) to the Mill River and other areas of the harbor complex watershed. According to an evaluation conducted by NYSDEC, Region 1 Fisheries Bureau (Kozlowski, 2001), the fishery in the Oyster Bay/Mill River system is unusual for Nassau County (Gomez & Sullivan, undated) due to the documented presence of brown trout and brook trout.

The NYSDEC conducted electrofishing of Mill River above the pond near Glen Cove Road in December 1993 and discovered that Mill River, upstream of Mill Pond, has a naturally reproducing brown trout population. It is one of three known reproducing brown trout populations on Long Island. The NYSDEC believes this population became established from stockings of brown trout in Mill Pond, as annual stocking has occurred since 1978. NYSDEC continues to stock brown trout in Mill Pond.

The presence of brook trout in Beekman Creek is one of only two known spawning populations in Nassau County. The other exists in the Beaver Brook subwatershed, in Shu Swamp Preserve. In February 2008, for the first time, natural reproduction of brook trout in Beaver Brook was documented by NYSDEC and Long Island Trout Unlimited (Gomez & Sullivan, undated).

Brook trout are also believed to be using Mill River during various times of their life cycle. From the Mill River confluence, Beekman Creek runs upstream under the Beekman Beach parking lot and West Shore Avenue where it runs exposed for approximately 75 yards before passing beneath the LIRR Bridge. In December 1995, ten brook trout were captured in Beekman Creek ranging in size from 3.4 to 10.2 inches with at least three size classes. Brook trout have never been stocked in Beekman Creek; however, they were stocked in Mill Pond until 1977 by the NYSDEC. Brook trout were stocked in Mill River upstream of the dam in 1996 and 1997 by the Cold Spring Harbor Fish Hatchery (Gomez & Sullivan, undated).

Shellfish

Oyster Bay/Cold Spring Harbor is one of the most productive shellfish growing areas in New York State. The Frank M. Flower & Sons, Inc. shellfish company, along with more than 80 independent commercial baymen, annually harvests up to 90% of New York's oyster crop from the Oyster Bay NWR. In addition to oysters, Oyster Bay/Cold Spring Harbor produces a substantial crop of other commercial shellfish including soft clams (*Mya arenaria*), mussels, Conch (*Strombus* sp.), Razor clam (*Ensis directus*), and most notably hard clams (*Mercenaria mercenaria*).

Landing data from the NYSDEC Shellfish Division illustrates the abundant commercial value of the shellfish population in Oyster Bay/Cold Spring Harbor. The average annual landing of oysters between 2005 and 2007 was more than 25,000 bushels worth an estimated annual average of $1.6 million. By comparison, the average hard clam production from Oyster Bay/Cold Spring Harbor between 2005 and 2007 was over 61,000 bushels worth an estimated annual average of $5.5 million. *Table 4-3* summarizes annual shellfish landing data from the NYSDEC Shellfish Division from 2005, 2006 and 2007 for Oyster Bay (NYSDEC Shellfish Harvest Area NS2) (NYSDEC, 2008).

Table 4-3. Shellfish Production in Oyster Bay

Shellfish	2005		2006		2007	
	Bushels	Value*	Bushels	Value*	Bushels	Value*
Hard Clams	53,744	$5,062	58,040	$5,201	72,492	$6,489
Soft Clams	65	$5.2	169	$15	69	$6.2
Oysters	27,010	$1,812	14,879	$964	33,415	$2,239
Mussels	--	--	--	--	180	$1.8
Conch	147	$3.9	447	$8.6	855	$16.4
Razor Clams	--	--	32	$1.3	--	--

* in thousands of dollars

Overharvesting, habitat destruction, pollution, and disease reduced native oyster populations in Oyster Bay and Cold Spring Harbor to 1 to 2 percent of historic populations by the early 1960's. Wild oyster reefs have been gone so long that there is no record of where they were. To compensate for the decline of oyster populations, the only remaining commercial oyster company, Frank M. Flower & Sons, raises oysters in a hatchery and uses them to seed the underwater beds which they lease from the Town of Oyster Bay. The oyster population has been restored to the abundant levels seen in the past, and up to 90% of NY's oyster harvest comes from Oyster Bay. Construction of artificial reefs can be used to boost the commercial wild harvest of oysters by the local independent baymen as well. Those reefs could be populated with larvae generated by the annual spawning of the large number of broodstock size oysters now present in the bay.

Birds

The sheltered nature of Oyster Bay/Cold Spring Harbor provides excellent winter and breeding habitat for a variety of avian species including waterfowl; shorebirds; gulls, terns and allied species; song birds; and raptors. Over 110 species of birds have been documented in the Oyster Bay NWR and other coastal areas, (USFWS, 2006, 2009; NYDOS, 1987, 2005; Edinger et al., 2002, Conolly, 1991).

- *Waterfowl* – Numerous waterfowl use the Oyster Bay/Cold Spring Harbor area as over-winter habitat. Mid-winter aerial surveys of the embayment have documented an abundance of waterfowl, in some cases more than 20,000 individuals per survey, during peak usage. Common species include American black duck (*Anas rubripes*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), canvasback (*Aythya valisineria*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), American widgeon (*Anas Americana*), mergansers (common (*Mergus merganser*), red-breasted (*Mergus serrator*) and hooded (*Lophodytes cucullatus*)) long-tail duck (*Clangula hyemalis*), gadwall (*Anas strepera*), green-winged teal (*Anas carolinensis*), and mute swan (*Cygnus olor*)(NYDOS, 1987, 2005; USFWS, 2006). It is estimated that 85% of all the duck species using the embayment as over-winter habitat are greater scaup, bufflehead and black duck. (USFWS, 2006).

- *Shorebirds, Gulls, Terns and Allied Species* – The category of shorebirds includes cormorants, gulls, terns egrets, grebes, plovers and the like. The most common of these species in Oyster Bay/Cold Spring Harbor are double-crested cormorant (*Phalacrocorax auritus*) and gulls. The double-crested cormorant is a year-round resident, with populations peaking during breeding season (between April and October). Great cormorants also inhabit Oyster Bay/Cold Spring Harbor, however, not typically as a breeding species but as an over-winter species (USFWS, 2006, Conolly, 1991).

- *Gulls* – As in most northeastern coastal areas, gulls are very common. Most common of these include herring gull (*Larus argentatus*), great black-backed gull (*Larus marinus*), ring-billed gull (*Larus delawarensis*), laughing gull (*Leucophaeus atricilla*) and Bonaparte's gull (*Chroicocephalus philadelphia*) (SCFWH – CSH/MNC; Oyster Bay NWR). An estimated 1,500 gulls, mostly herring and great black-backed gulls, use the Oyster Bay NWR over winter. However some, such as the laughing gulls, use the NWR in the summer (USFWS, 2006; Conolly, 1991)

- *Passerine Birds* – Variable coastal habitats support a wide assemblage of passerine birds (song birds). These birds may make use of any number of habitats from beaches to tidal marshes to upland forests and will move among different habitats depending on the time of year, availability of food, and breeding status. Common passerine birds that have been observed throughout the area include, but are not limited to, mourning dove (*Zenaida macroura*), gray catbird (*Dumetella carolinensi*), northern mockingbird (*Mimus polyglottos*), northern flicker (*Colaptes auratus*), eastern kingbird (*Tyrannus tyrannus*), American robin (*Turdus migratorius*), barn swallow (*Hirundo rustica*), red-winged blackbird (*Agelaius phoeniceus*), house sparrow (*Passer domesticus*), sharp-tailed sparrow (*Ammodramus caudacutus*), and fish crow (*Corvus ossifragus*) (NPS, 2009, Conolly, 1991).

- *Raptors* – Numerous raptors have been observed in Oyster Bay/Cold Spring Harbor. These include piscivorous (i.e., fish-eating) species like wintering populations of bald eagle (*Haliaeetus leucocephalus)* and breeding populations of osprey (*Pandion haliaetus*); carnivorous species like the red-tailed hawk (*Buteo jamaicensis*) and northern harrier (*Circus cyaneus*); and scavenger species like the turkey vulture (*Cathartes aura*) (USFWS, 2006; NPS, 2009; Conolly, 1991).

- *Other Common Bird Species* – Other common shorebird, migrants and residents, have been observed in the NWR at various times of the year. These species include common loon (*Gavia immer*), red-throated loon (*Gavia stellata*), horned grebe (*Podiceps auritus*), pie-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), belted kingfisher (*Megaceryle alcyon*), great blue heron (*Ardea herodias*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violaceus*), green heron (*Butorides virescens*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), least bittern (*Ixobrychus exilis*), black-bellied plover (*Pluvialis squatarola*), dunlin (*Calidris alpina*), greater yellow legs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), least sand piper (*Calidris minutilla*), spotted sandpiper (*Actitis macularia*) (USFWS, 2006; Conolly, 1991).

Mill Neck Creek

The NYSDEC-designated SCFWH in Mill Neck Creek consists of approximately 700 acres of open tidal waters, tidal marshes and creeks, mudflats and wooded freshwater swamps. The fish and wildlife habitat areas that are associated with Mill Neck Creek include Oak Neck Creek, Bayville Brook, and Beaver Brook.

The network of tidal creeks and salt marshes that make up much of Mill Neck Creek provide a unique and valuable habitat to a variety of species. This area is composed of a combination of high salt marsh, low salt marsh, intertidal mudflat communities and sub-tidal areas. Each of these communities is a part of the larger coastal marsh ecosystem – one transitioning to another – forming a mosaic with adjacent communities.

The low salt marsh community is characterized by regular flooding of semidiurnal tides. The vegetation of the low salt marsh is a nearly monospecific stand of cordgrass (*Spartina alterniflora*). A few species of marine algae can form dense mats on the surface sediments between the cordgrass stems, including knotted wrack (*Ascophyllum nodosum*), and rockweed (*Fucus vesiculosus*). Sea lettuce (*Ulva* spp.), and hollow green weeds (*Enteromorpha* spp.) can be abundant, especially in early summer. Other plants that are present in very low numbers include glasswort (*Salicornia europaea*), salt marsh sand-spurry (*Spergularia marina*), and lesser sea blite (*Suaeda maritima*) (Edinger et al., 2002).

Animals common to these low salt marsh communities include clapper rail (*Rallus longirostris*), willet (*Catoptrophorus semipalmatus*), marsh wren (*Cistothorus palustris*), seaside sparrow (*Ammodramus maritimus*), fiddler crabs (*Uca pugilator* and *U. pugnax*) nesting along creek banks, ribbed mussel (*Geukensia dimissa*), and at high tide mummichog (*Fundulus heteroclitus*), sheepshead minnow (*Cyprinodon variegatus*), and several other small fishes that live in the tidal creeks at low tide (Edinger et al., 2002).

The high salt marsh community is characterized by less frequent flooding compared to low salt marsh communities. Typically, flooding occurs only at the spring tide; however, semidiurnal tidal fluctuations maintain regular, saturated conditions in the soil. The vegetation of the high salt marsh is dominated in many areas by either salt-meadow grass (*Spartina patens*) or a dwarf form of cordgrass (*Spartina alterniflora*); also common are large areas dominated by spikegrass (*Distichlis spicata*), black-grass (*Juncus gerardii*), and glassworts (*Salicornia* spp.) (Edinger et al., 2002).

Characteristic species of the upper high marsh (the area that grades into salt shrub or is topographically slightly higher than its surroundings) are blackgrass, switchgrass (*Panicum virgatum*), sea-lavender (*Limonium carolinianum*), seaside gerardia (*Agalinus maritima*), seaside goldenrod (*Solidago sempervirens*), and slender saltmarsh aster (*Aster tenuifolius*) (Edinger et al., 2002).

Animals characteristic to the high salt marsh include salt marsh mosquitoes (*Aedes* spp.), greenhead flies (*Tabanidae*), coffeebean snail (*Melampus bidentatus*), sharp-tailed sparrow (*Ammodramus caudacutus*), marsh wren (*Cistothorus palustris*), eastern meadowlark (*Sturnella magna*), clapper rail (*Rallus longirostris*), and American black duck (*Anas rubripes*).

4.7.2 Riverine and Palustrine Habitats

Representative areas of riverine and palustrine habitats in the Oyster Bay/Cold Spring Harbor Complex are described below.

Charles T. Church/Shu Swamp Nature Preserve

The Charles T. Church/Shu Swamp Nature Preserve (Shu Swamp) is located in the Beaver Brook subwatershed immediately upstream of Beaver Lake. This 60-acre preserve is dominated by a forested wetland system set in the heavy clay soils of the Mill Neck Creek valley. The wetland system is dominated by trees, specifically red maple (Acer rubrum), tulip tree (*Liriodendron tulipifera*) and black tupelo (*Nyssa sylvatica*) and an understory of primarily sweet pepperbush.

Red maple-black gum swamps are hardwood swamps that occur in poorly drained depressions. Hummock-hollow microtopography is usually evident in these wetlands. Other characteristic shrubs of this wetland type are highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), fetterbush (*Leucothoe racemosa*), dangleberry (*Gaylussacia frondosa*), and on the Atlantic coastal plain inkberry (*Ilex glabra*). Vines such as greenbrier (*Smilax rotundifolia*), sawbrier (*Smilax glauca*), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*) are present at low amounts in the understory. The herbaceous layer is not particularly diverse, characterized by cinnamon fern (*Osmunda cinnamomea*), skunk cabbage (*Symplocarpus foetidus*). The nonvascular layer may include some *Sphagnum* species (Edinger et al., 2002).

Given the hummock-hollow microtopography of the swamp, small pockets of breeding amphibian pools provide habitat for species such as wood frog (*Rana sylvatica*), spring peeper (*Pseudacris crucifer*), northern red-back salamander (*Plethodon glutinosa*) and possibly spotted salamander (*Ambystoma maculatum*).

Common bird species that may inhabit Shu Swamp include American robin *Turdus migratorius*, hermit thrush (*Catharus guttatus*), veery *Catharus fuscescens*, grey catbird (*Dumetella carolinensis*), and wood duck *(Aix sponsa)*. Common mammals may include Virginia opossum (*Didelphis virginiana*), short-tailed shrew (*Blarina brevicauda*), little brown myotis (*Myotis lucifugus*), eastern cottontail (*Sylvilagus floridanus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), mink (*Neovison vison*)/ Recent observations indicate that river otter (*Lontra canadensis*) may also have begun populating local waterbodies such as Shu Swamp (Rather, 2008).

Muttontown Preserve

Muttontown preserve is a 550-are parcel located in the upper reaches of the Mill River subwatershed. Nassau County's largest nature preserve, this tract of land consists of fields, moist woodlands, and kettle-hole ponds.

The dominant vegetation community type in Muttontown Preserve is a coastal oak-hickory forest. These types of forests are co-dominated by several species of oaks (*Quercus* spp.) and hickory (*Carya* spp.) and are typically found in dry well-drained, loamy sand of knolls, upper slopes, or slopes of glacial moraines. The forest is usually co-dominated by two or more species of oaks, usually white oak (*Q. alba*), black oak (*Quercus velutina*) and chestnut oak (*Q. montana*). Scarlet oak (*Quercus coccinea*) is also a common associate. Mixed with the oaks, usually at moderate densities, are one or more of the following hickories: pignut (*Carya glabra*), mockernut (*C. tomentosa*), and sweet pignut (*C. ovalis*) (Edinger et al., 2002).

Characteristic animals include eastern towhee (*Pipilo erythrophthalamus*), vireos (*Vireo* spp.), woodpeckers (Edinger et al., 2002). Muttontown Preserve is also notable for having several kettle-hole ponds. In addition, there are an estimated eight to ten vernal pools. These habitats offer both breeding and refuge for several common species of amphibians including green frog (*Rana clamitans*), American toad (*Bufo americanus*) wood frog, spring peepers, and spotted salamanders. Tiger salamanders (*Ambystoma tigrinum*) have also been documented at the site; however, the local populations appears to have been locally extirpated.

Sagamore Hill National Historic Site

Sagamore Hill National Historic Site is located on the western shore of Cold Spring Harbor. One of Sagamore Hill's greatest natural resource values lies in the high number of varied habitat types located in close proximity to each other. From oak-tulip forests, to open fields, to ponds, to salt marshes, the park offers a wide variety of habitat types that support a diverse assemblage of plants and animal species. The following account was provided by the National Park Service for the Sagamore Hill National Historic Site.

Birds

Though a small park, Sagamore Hill contains a range of vegetation types and habitats that support a wider variety of bird species. Most notably, mature forest, salt marsh, and beach habitats on the eastern portion of the site offer excellent natural habitat. Notable species found here include the winter wren (*Troglodytes troglodytes*), great crested flycatcher (*Myiarchus crinitus*), yellow-billed cuckoo (*Coccyzus americanus*), and ruby-crowned kinglet (*Regulus calendula*).

Reptiles & Amphibians

Reptiles and amphibians can be found in nearly all of Sagamore Hill's vegetative communities, from dry upland forests to salt marshes. Many of the amphibian and reptile species of the park exhibit complex life-cycles that require complex habitat mosaics for reproduction and over-wintering. Species such as wood frogs and spotted salamanders (a locally uncommon species) spend only a short time within the park's ponds during the breeding season and utilize adjacent forested upland for the remainder of the year. Aquatic species, such as painted and snapping turtles, likewise depend upon well-drained upland forests and fields for nesting.

Terrestrial species such as the eastern red-backed salamander, common garter snake, and box turtle extensively utilize Sagamore Hill's mixed deciduous forests, with the box turtle in particular depending upon large, roadless patches. Heron and Woodpile ponds constitute the only freshwater wetland sites within the park, but they exhibit the highest species diversity of amphibians and reptiles. These sites are critical for obligate vernal-pool breeders, such as wood frogs, spotted salamanders, spring peepers, and grey treefrogs.

The northern diamondback terrapin, though the most abundant reptile at Sagamore Hill, is found exclusively within the park's estuarine habitats. These turtles are found primarily in Eel Creek and Cold Spring Harbor and nest on the adjacent beach. Though small, the maritime complex at Sagamore Hill is a vital part of the larger harbor complex, which supports one of the larger diamondback terrapin populations in the state.

Insects, Spiders, Centipedes, Millipedes

According to a recent odonate survey of Sagamore Hill, the site hosts at least twenty-one species of dragonflies and damselflies, which utilize a variety of habitats within the park.

Heron Pond, located in the eastern forest, had one of the highest species diversities for odonates in the entire park, with six species of dragonflies and two species of damselflies recorded at the site. These species included the park's only recorded Twelve-spotted skimmer and Slender spread-wings. Three dragonflies and one damselfly were also recorded at the Woodpile Pond just north of the parking area. Two fields within the park also displayed high species abundance, with at least 10 species being found in each. These included one rare species, the Comet Darner (*Anax Longipes*).

Five species of dragonflies have also been recorded within the estuarine complex at the eastern edge of the park. These include the only Seaside dragonlet recorded at Sagamore Hill, as well as Wandering and Spot-winged gliders.

4.7.3 Threatened and Endangered Species

The NYSDEC Natural Heritage Program was consulted regarding rare or state-listed animals and plants, significant communities and other significant habitats within the Oyster Bay/Cold Spring Harbor Complex watershed. A query of the Natural Heritage Program database was generated on January 27, 2009 and a response, dated February 6, 2009, was received from NYSDEC Natural Heritage Program listing rare species and ecological communities.

The NYSDEC Natural Heritage Program database shows, based on recent observation and documentation (1980 to present), that there are 6 rare or state-listed animal species and 16 rare or state-listed plant species within (in whole or in part) the Oyster Bay/Cold Spring Harbor Complex watershed. Animal species include one species of amphibian, four species of birds and one species of butterfly. In addition, six significant natural communities were identified within the watershed.

The NYSDEC Natural Heritage Program database also provided historic records of plants and animals, located in the vicinity of the watershed, which have not been documented since 1979. One rare or state-listed animal species and eight rare or state-listed plant species have historically been identified within the harbor complex watershed.

The location of these species and the information provided by the NYSDEC Natural Heritage Program is considered sensitive. It is strongly recommended that the information provided should not be disseminated to the public without permission from the Natural Heritage Program. For this reason, details regarding the exact species and communities have not been appended to this report.

5 Water Quality

5.1 Water Quality Classifications, Standards, and Impairments

All waters in New York State are assigned a classification indicating their best uses including drinking water source, swimming, boating, fishing and shellfishing. Letter classes such as A, B, C, and D are assigned to fresh waters and two-letter classifications beginning with S are assigned to saline (marine) waters. Water quality classifications for New York surface waters are found at 6 NYCRR Part 701, and classifications for surface waters in the Oyster Bay/Cold Spring Harbor Complex are summarized in *Table 5-1*.

Table 5-1. Selected Surface Water Quality Classifications

Classification	Description
A	The best usages of Class A waters are: a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
B	The best usages of Class B waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
C	The best usage of Class C waters is fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
SA	The best usages of Class SA waters are shellfishing for market purposes, primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
SB	The best usages of Class SB waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
SC	The best usage of Class SC waters is fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Note: Complete description of classifications at http://www.dec.ny.gov/chemical/23853.html.

Figure 5-1 shows the water quality classifications assigned to fresh and marine waters in the Oyster Bay/Cold Spring Harbor Complex and its watershed. All freshwaters in the watershed are Class C. Class SA, SB, and SC marine waters are located in the Oyster Bay/Cold Spring Harbor Complex, with SA designations assigned to the open water areas and many nearshore areas. Exceptions are the Frost Creek, Mill Pond, Beaver Brook, and Fresh Pond areas where saline waters have an SC classification (*Figure 5-1*).

Numeric and narrative water quality standards for New York waters are found at 6 NYCRR Part 703. The narrative standards for surface water classifications A, B, C, SA, SB, and SC are shown in *Table 5-2*. Numeric standards for these surface water classifications for pH, dissolved oxygen (DO), dissolved solids, total coliform, and fecal coliform are provided in *Table 5-3*.

Figure 5-1

Table 5-2. Narrative Water Quality Standards

Parameter	Classes	Standard
Taste-, color-, and odor-producing, toxic and other deleterious substances	A, B, C, SA, SB, SC	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	A, B, C, SA, SB, SC	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	A, B, C, SA, SB, SC	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	AA, A, B, C,SA, SB, SC	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	None in any amounts.
Phosphorus and nitrogen	A, B, C,SA, SB, SC	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Thermal discharges	AA, A, B, C, SA, SB, SC	Details in 6 NYCRR Part 704.
Flow	A, B, C	No alteration that will impair the waters for their best usages.

Table 5-3. Numeric Water Quality Standards

Parameter	Classes	Standard
pH	A, B, C	Shall not be less than 6.5 nor more than 8.5.
	SA, SB, SC	The normal range shall not be extended by more than one-tenth (0.1) of a pH unit.
Dissolved oxygen (DO)	A, B, C	For trout spawning waters (TS), the DO concentration shall not be less than 7.0 mg/L from other than natural conditions. For trout waters (T), the minimum daily average shall not be less than 6.0 mg/L, and at no time shall the concentration be less than 5.0 mg/L. For nontrout waters, the minimum daily average shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L.
	SA, SB, SC	Chronic: Shall not be less than a daily average of 4.8 mg/L* Remark: *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., $\sum_{i=1}^{n} \frac{t_i(actual)}{t_i(allowed)} < 1.0$ The DO concentration shall not fall below the acute standard of 3.0 mg/L at any time.

Table 5-3. Numeric Water Quality Standards

Parameter	Classes	Standard
	SA, SB, SC	Acute: Shall not be less than 3.0 mg/L at any time.
Dissolved Solids	A, B, C	Shall be kept as low as practicable to maintain the best usage of waters but in no case shall it exceed 500 mg/L.
Total Coliforms (number per 100 ml)	A, B, C, D, SB, SC	The monthly median value and more than 20 percent of the samples, from a minimum of five examinations, shall not exceed 2,400 and 5,000, respectively.
	SA	The median most probable number (MPN) value in any series of representative samples shall not be in excess of 70.
Fecal Coliforms (number per 100 ml)	A, B, C, SB, SC	The monthly geometric mean, from a minimum of five examinations, shall not exceed 200

Assessments of water quality are typically based on comparisons with numeric and narrative criteria for various pollutants or water characteristics (e.g., color or dissolved oxygen) and determination of impairment. Waters that are unable to support the uses for which they are designated (e.g., primary or secondary contact recreation, fishing, water supply, habitat, etc.) are said to be impaired. Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987, Public Law 100-4 and regulations for Water Quality Planning and Management found at 40 CFR 130 require each state to identify waters not meeting water quality standards for any given pollutant applicable to the water's designated uses, i.e., classification. The NYSDEC develops the 303(d) list for New York waters.

The 2008 303(d) list references Mill Neck Creek and its tidal tributaries, Cold Spring Harbor and its tidal tributaries, and Oyster Bay Harbor as impaired due to pathogens from urban and stormwater runoff and, in the case of Mill Neck Creek, municipal discharges are also identified as a source of impairment. As reflected by these impairments, water quality issues in the Oyster Bay/Cold Spring Harbor Complex have focused on elevated pathogen levels, which impact shellfish harvesting in the estuary. Shellfish, such as oysters and clams, are filter feeders, meaning they filter the water around them to feed on microscopic organisms. If the water column contains pathogenic bacteria and viruses, they can be retained in the shellfish and pose a health threat if the oysters or clams are eaten raw or partially cooked.

Although identified as impaired, these waters are no longer on the 303(d) list because, in response to these impairments, the NYSDEC has developed Total Daily Maximum Loads (TMDL) for pathogens for the impaired waters in the Oyster Bay/Cold Spring Harbor complex. A TMDL is required for each pollutant violating or causing a violation of water quality standards for each impaired water body. A TMDL determines the maximum amount or load of a pollutant from both point and non-point sources that a water body can receive and continue to meet applicable water quality standards. In 2003, a TMDL for Oyster Bay Harbor and Mill Neck Creek and its tidal tributaries was developed (NYSDEC et al., 2003). In 2007, Cold Spring Harbor was included in the New York Shellfish Pathogen TMDL (NYSDEC et al., 2007).

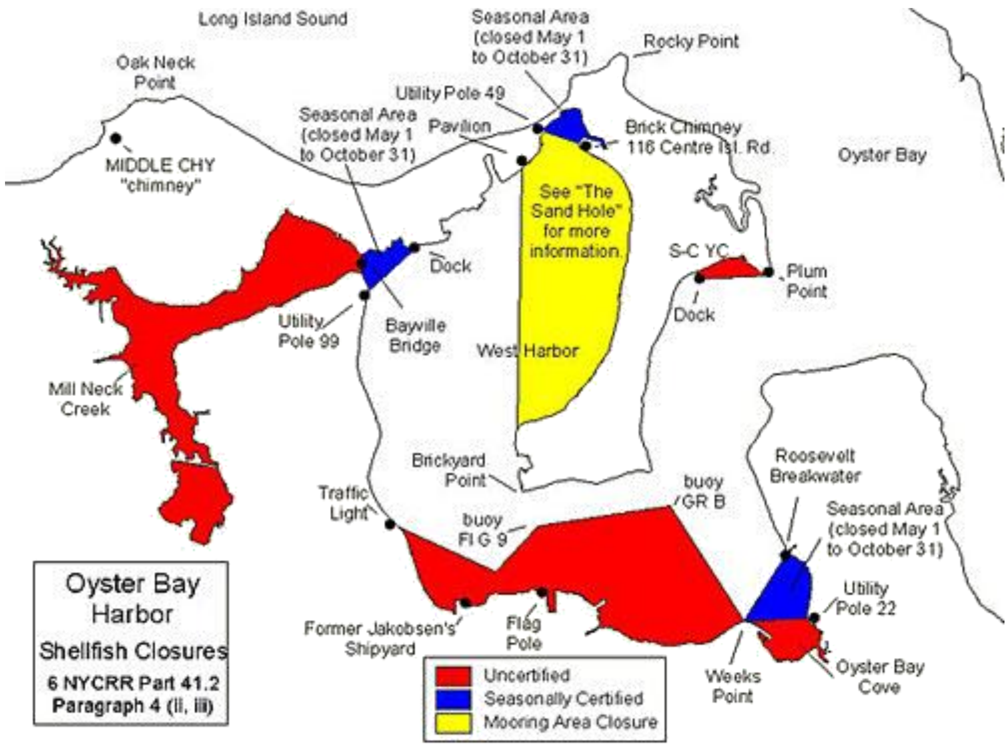
5.2 History of Water Quality Issues

The TMDL for Oyster Bay Harbor and Mill Neck Creek (NYSDEC, 2003) summarized the water quality issues and identified potential sources of pathogens by conducting a shoreline survey and investigation of point and non-point sources of pollutants. The following were identified as pathogen sources:

- Centralized wastewater discharges (Oyster Bay wastewater treatment plant, Seawanhaka Corinthian Yacht Club, The Birches),
- Domestic waste disposal using cesspools,
- Stormwater discharges,
- Freshwater streams,
- Boats/marinas/mooring areas,
- Wildlife and waterfowl.

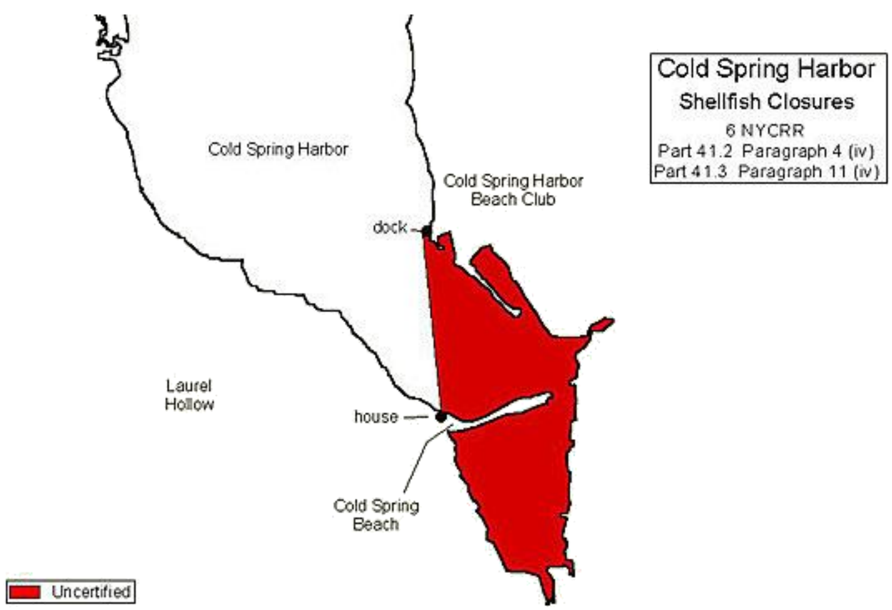
The impact of these point and non-point sources varies spatially throughout the harbor complex. *Figures 5-2 and 5-3* show the areas in the harbor complex subject to shellfish harvesting closures. Uncertified areas are those that fail to meet the water quality standards for shellfishing listed in *Table 5-3*. Conditionally certified harvesting areas are those that marginally fail to meet the certified shellfish harvesting area criteria and may be operated during certain times of the year under certain rainfall conditions. Areas around the wastewater treatment plant outfalls, marinas, and boat mooring areas are subject to administrative closures for shellfishing. Although these areas may meet the water quality standard for coliform, the administrative closures are necessary in the event of a wastewater treatment plant malfunction, and they provide a buffer between pathogen sources and nearby certified shellfish harvesting areas.

The New York Shellfish Pathogen TMDL (NYSDEC et al., 2007) provided a generic identification of pollution sources likely to affect pathogen concentrations in Cold Spring Harbor. These included agricultural sources, marine vessels/marinas, urban/residential sources including pet waste, waterfowl, beach wrack, and marine sediment resuspension.



Source: http://www.dec.ny.gov/regs/4014.html

Figure 5-2. Oyster Bay Harbor and Mill Neck Creek Shellfish Closure Areas



Source: http://www.dec.ny.gov/regs/4014.html

Figure 5-3. Cold Spring Harbor Shellfish Closure Areas

In addition to these broader analyses of water quality, there have been specific studies of water quality in locations in the estuary complex where chronic water quality problems exist. Over the past several years, the Friends of the Bay water quality monitoring program (See Section 5.1.3) has identified elevated concentrations of pathogens and nutrients in the area near Beekman Beach. This area is near the discharge of the Mill River to Oyster Bay Harbor. In 2007, the Town of Oyster Bay's *Mill River Watershed Study and Public Stewardship Program* report summarized the nearly 30 years of investigations into water quality in the Mill River watershed. Beginning with a 1977 study, high coliform levels were noted in the Mill River outflow and the need for reduced dumping and dog wastes and sediment removal from Mill Pond were identified as measures to improve water quality. The 1995 *Oyster Bay/Cold Spring Harbor Complex Stormwater Management/Coastal Water Qualty Improvement Program (SM/WQIP) Report* identified stormwater outfalls along the shoreline and recommended general measures to improve stormwater quality. A study of the Mill Pond outflow in 2001 (Cashin Associates, P.C., 2001) identified the need to address wet-weather flows from the pond to reduce pathogen loading to Oyster Bay Harbor and suggested dredging or drawdown in anticipation of significant rainfall events to reduce loading from Mill Pond.

In 2004-2005, three rounds of dry-weather sampling at three locations in the Mill River watershed were conducted and are presented in the *Mill River Watershed Study and Public Stewardship Program* report. Based on the three samples, the report concluded that:

- Fecal and total coliform levels were consistent with typical results for similar waters under dry weather conditions.
- Elevated nitrate levels found on the South Side of Glen Cove Road are likely due to leachate from on-site wastewater disposal systems.
- Elevated phosphate levels and total dissolved solids from samples collected at a tributary near the Town Highway Yard may be due to runoff from the Yard.
- Despite the presence of golf course lands, arboretum grounds and cultivated areas, the samples did not exceed the detection limit for the herbicide atrazine, indicating it is unlikely to be a concern in the Mill River watershed.

5.3 Friends of the Bay Water Quality Monitoring Program

Friends of the Bay's ongoing water quality monitoring program in the Oyster Bay/Cold Spring Harbor Complex was developed in cooperation with the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the NYSDEC, local governments, and other volunteer monitoring groups around Long Island Sound. Under the ongoing monitoring program, every Monday morning from April through October, data is collected on water quality and ambient conditions at 19 sites throughout the harbor complex. Since 2007, Friends of the Bay has also collected quarterly water quality data at 10 stream and outfall monitoring locations within the watershed. Sampling in the estuary and the watershed is conducted consistent with the Standard Operating Procedures and Quality Assurance Project Plans (QAPPs) that were approved by the EPA in 2006 and 2007 for the open water and stream and outfall monitoring, respectively.

5.3.1 Open Water Body Monitoring

Figure 5-4 shows the 19 monitoring locations in the Oyster Bay/Cold Spring Harbor Complex. During the 28-week annual monitoring season, the parameters measured by Friends of the Bay including:

- Bacteria - fecal coliform (since 2000) and enterococci (since 2004),
- Nutrients - ammonia, nitrate/nitrite, total Kjeldahl nitrogen, total phosphorus,
- Salinity,
- Water clarity - Secchi disk depth.

In addition to sample collection for these parameter, several environmental conditions are noted including the time the sample was collected; qualitative description of rainfall in the previous 24 hours; tidal stage on a scale of 1-4; air temperature; wind direction and speed; wave height (subjective, on a scale of 0-5); weather conditions (on a predetermined 1-6 scale); water color (subjective color, e.g. yellow-brown); cloud cover (0-5 scale); and any unusual conditions (i.e., odors, fish kills, debris).

5.3.2 Stream and Outfall Monitoring

In 2007, Friends of the Bay began collecting stream and outfall data from 10 major discharges into the estuary four times a year to complement the open water body monitoring program. The objectives of the stream and outfall monitoring program are to establish current baseline water quality conditions in the watershed, identify water quality impacts from potential point and non-point pollution sources, develop a water quality database to guide environmental decision-making, and measure the progress toward meeting water quality goals in the watershed.

The monitoring locations (*Figure 5-4*) include streams, ponds, an untreated sewage discharge, and a 'rotating' outfall that changes in an effort to identify other pollutant sources, based on a set of standard criteria. Samples are collected four times per year, with two of these monitoring events to occur following a period without precipitation ("dry weather" events), and the remaining two during precipitation events ("wet weather" events). The dry weather events are used to characterize background constituent inputs and potential dry weather issues such as illicit discharges, while the wet weather events provide information on pollutant concentrations and loadings associated with precipitation runoff.

Samples are analyzed for a variety of biological, chemical, and physical parameters including:

- Bacteria - fecal coliform and escherichia coli (E. coli),
- Nutrients - ammonia, nitrate/nitrite, total Kjeldahl nitrogen, total phosphorus,
- Chemical oxygen demand,
- Turbidity,
- Dissolved oxygen and temperature,
- Hardness,
- pH,
- Metals - lead, copper, zinc.

Figure 5-4

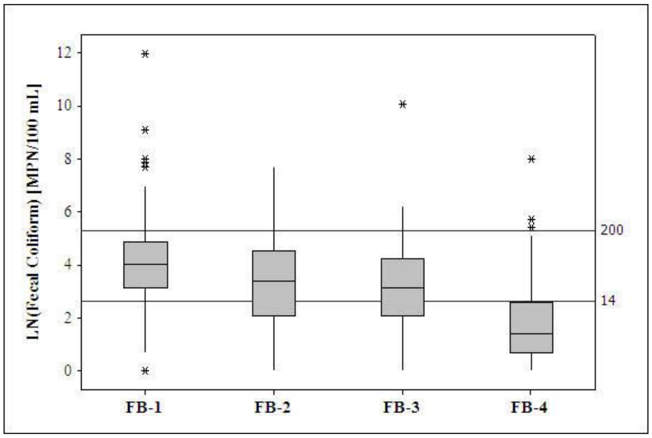
5.3.3 Water Quality Trends

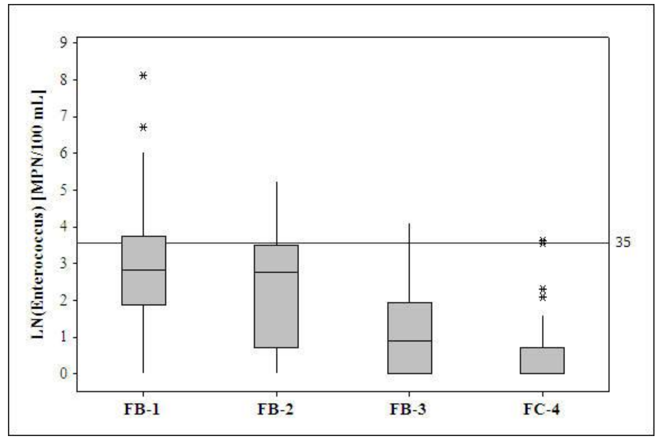
Results of the Friends of the Bay water quality monitoring from 1999 to 2008 have been documented in a series of annual reports. A 2008 summary report (Fuss & O'Neill, 2008) evaluated spatial and temporal trends in the water quality data generated through the 2006 monitoring season. The goals of the comprehensive analysis were to identify how water quality in the Oyster Bay/Cold Spring Harbor Complex has changed and the progress that is being made as a result of management efforts to address water quality problems in the estuary. The evaluation consisted of graphical and statistical analysis of the data, including non-parametric tests for trends in the bacteria and nutrient data collected from 2000 to 2006.

Based on the results of this evaluation, fecal coliform concentrations appear to be decreasing at many locations, and there is no indication of an increasing trend in fecal coliform concentrations at any of the 19 monitoring locations. These findings were made through visual analysis of the boxplots and confirmed by the trend analysis. Only two years of enterococci data were available for the analysis. Two key observations that emerged are: (1) in some locations the two indicator organisms sampled appeared to trend in different directions, with decreases in fecal coliform and increases in enterococci observed at the same monitoring locations (e.g., FB-13 and FB-15), and (2) where trends were present, there was an increase in enterococci. Given, that the enterococci data set is of limited duration compared to the fecal coliform data period of record, the identification of a trend in the enterococci concentrations at some locations should be viewed with caution and should be revisited with additional years of data. This result supports the need for on-going enterococci monitoring. Use of this indicator organism is encouraged because it is found exclusively in the intestinal tracts of warm-blooded animals, while coliform bacteria can originate from other sources including plant material, and because it is typically considered a more reliable indicator of health risk for contact recreation in marine waters (USEPA, 1986).

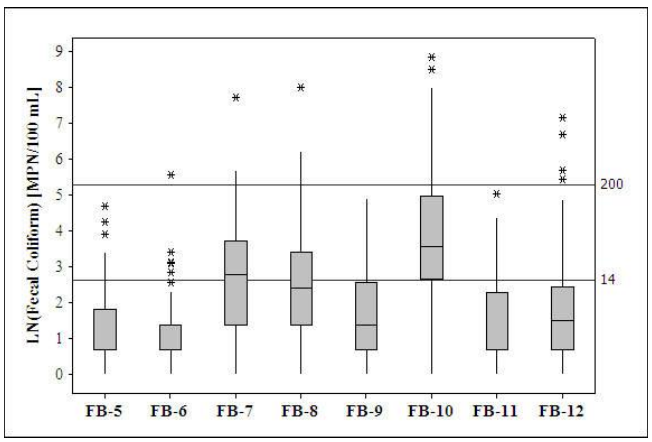
There are also spatial trends in microbial water quality. Generally, monitoring locations in the southern part of Oyster Bay Harbor (FB-7, FB-8, FB-10), the southern part of Cold Spring Harbor (FB-1 and FB-2), and landward in Mill Neck Creek (FB-15 and FB-17) exhibit consistently higher bacteria values, as shown in the boxplots in *Figure 5-5*, which summarize the data at each station for the entire period of record evaluated. In these locations, point and non-point sources are likely contributors to in-harbor water quality. This finding is also supported by the observed relationships with rainfall and tides. At many of the monitoring locations, there is a correlation between bacteria concentrations and/or nitrogen species concentrations and precipitation on the day of or day prior to sampling. Examination of indicator organism concentrations at various phases of the tidal cycle shows the influence of landside sources on water quality. In both Cold Spring Harbor and Oyster Bay Harbor, there are higher concentrations of bacteria at low tide, when there is less dilution from the incoming tide and in-harbor water quality is more strongly influenced by inputs from runoff and streams discharging to the estuary.

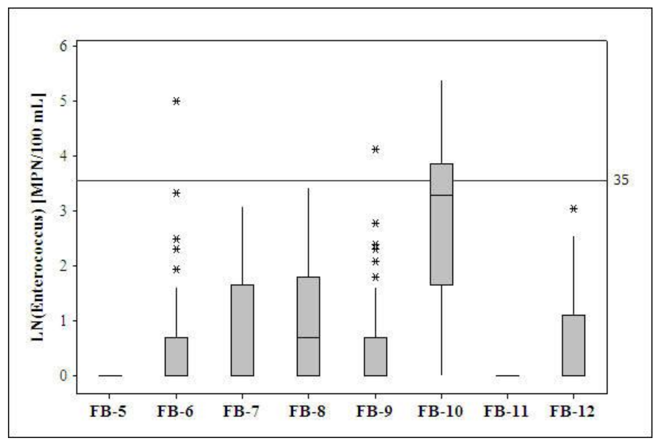
Cold Spring Harbor



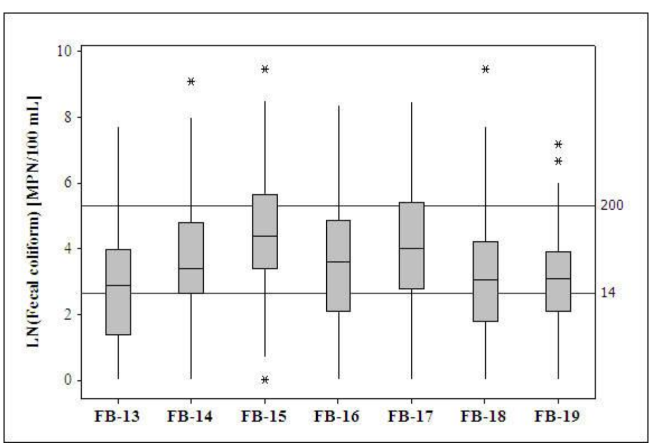


Oyster Bay Harbor





Mill Neck Creek



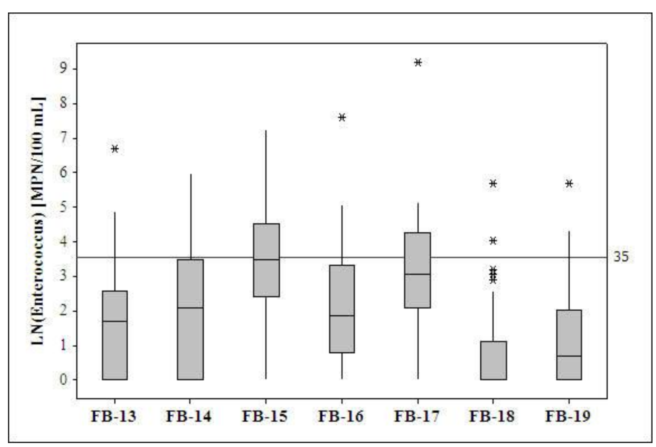


Figure 5-5. Indicator Bacteria Concentrations

The results of multi-year monitoring shows that in the Oyster Bay/Cold Spring Harbor Complex (1) there are correlations between nutrients and precipitation and (2) while the concentrations of ammonia show no trends or are decreasing, TKN and therefore organic nitrogen levels are increasing at some locations in the estuary. For example, in Oyster Bay Harbor, at FB-5, FB-6, FB-7, and FB-9, there is a decline in ammonia over the period of record, but there is an increasing trend in TKN, the result of increased organic nitrogen. This may reflect the input of organic nitrogen from sources such as runoff or atmospheric deposition or from sources within the estuary such as phytoplankton. Bronk et al. (1994) report that an estimated 25-41% of inorganic nitrogen (i.e., ammonia and nitrate/nitrite) taken up by phytoplankton is released and dissolved organic nitrogen. Since phytoplankton utilize ammonia, the decreased ammonia and increased TKN may reflect increased phytoplankton within the estuary system. In addition, sediment can act as both a source and sink of organic nitrogen.

The influence of the tides and precipitation should be considered in any temporal comparison of monitoring stations, as a direct comparison under different tidal/precipitation conditions requires adjustment of the data for these influences. Additional understanding of in-harbor water quality and the factors that influence water quality could be gained from targeted monitoring under clearly defined wet or dry weather conditions. Such sampling would both provide a snapshot of water quality under specific conditions and could be added to the long term water quality database.

The statistical analysis generally indicates that monitoring locations near the shore show higher concentrations of nutrients and bacteria, which suggests the influence of freshwater sources. Location FB-10 consistently exhibited lower water quality compared with other locations in the estuary. This has been noted in prior annual water quality reports, and the multi-year analysis demonstrates that this location is clearly impacted by a localized pollution source. This site is located near the outflow of Mill Pond and the Mill River, which supports a substantial population of waterfowl, and Beekman Creek, which flows under West Shore Road and the Beekman Beach parking lot and eventually discharges to the Mill River and Oyster Bay Harbor. It is suspected that the outflow of Mill Pond and the Mill River, including Beekman Creek, is contributing to elevated levels of bacteria and nutrients at FB-10.

5.4 Other Water Quality Monitoring

5.4.1 Long Island Sound Study – Sound Health 2008

The Long Island Sound Study (LISS) is a cooperative effort involving researchers, regulators, user groups and other concerned organizations and individuals. The LISS report *Sound Health 2008* provides information on water quality, the abundance of animal and plant life in the Sound, and trends in land use along the shore. The LISS divides Long Island sound into three (3) basins: Western, Central, and Eastern. The Oyster Bay/Cold Spring Harbor Complex discharges to the Western Basin. The *Sound Health 2008* report uses three indices to rate basin conditions: water quality, sediment quality, and benthic quality. The Western Basin, with greater population density and weaker currents, is the most stressed of the three basins (LISS, 2008)

5.4.2 Shellfish Growing Area Sanitary Surveys

The NYSDEC conducts shoreline surveys of shellfish growing areas (SGAs) at least every 10 years to identify pollution sources that may be affecting SGAs. The Oyster Bay/Cold Spring Harbor Complex is divided into two SGAs, one consisting of Mill Neck Creek and Oyster Bay Harbor (SGA #47) and the other consisting of Cold Spring Harbor (SGA #48).

SGA #47 is approximately 5,040 acres. Of that area, approximately 785 acres are uncertified for shellfish harvesting and an additional 75 acres are seasonally certified (*Figure 5-6*). There are approximately 17 miles of shoreline within SGA #47, and NYSDEC maintains 42 sampling stations within the SGA. Thirty-eight (36) are located in Oyster Bay Harbor and seven (7) are located in Mill Neck Creek. A shoreline survey was completed in May 2002 and updated in 2003. *Table 5-4* summarizes the findings of the survey. The survey concluded that water quality is primarily affected by nonpoint source runoff. Waterfowl, wastewater treatment plant discharges, and improperly treated septic wastes from recreational vessels were identified as secondary pollution sources.

The total area of SGA #48 (Cold Spring Harbor) is approximately 4,640 acres with an uncertified area of approximately 190 acres located at the southern end of the harbor (*Figure 5-6*). Twenty (20) sampling stations are monitored by NYSDEC in SGA #48 (*Figure 5-6*). The shoreline in SGA #48 is over 9 miles, and surveys of the shoreline for potential pollution sources were conducted in 1988 and 2001. *Table 5-5* summarizes the findings of the survey. The sanitary survey found that the primary source of bacterial loading in Cold Spring Harbor is non-point source runoff and that this source is primarily concentrated a the southern end of the Harbor near the intersection of Routes 25A and 108 and from the stormwater drainage system serving the Village of Cold Spring Harbor. Waterfowl and discharges from recreational vessels were determined to be insignificant.

5.4.3 Nassau County Department of Public Health Beach Monitoring

Each beach season, samples for bacteria testing are collected by the Nassau County Department of Health (NCDH) with assistance from the Town of Oyster Bay at four active beaches in the Oyster Bay/Cold Spring Harbor Complex: Laurel Hollow Beach, Theodore Roosevelt Beach, West Harbor Beach, and Centre Island Bay Beach (Wendolovske, pers. comm., 2009). Samples are also collected at Beekman Beach, although the beach is no longer an approved public bathing beach. On average, samples are collected twice a week with additional sampling conducted in the event of a closure. These bacteria samples are analyzed at the NCDH laboratory, currently for fecal coliform and enterococci, in conformance with beach closure standards that were implemented in 2004. In addition to beach closings based on

Figure 5-6

bacteria sample results, NCDH instituted pre-emptive or administrative beach closings following rain events that exceed a threshold level and duration of precipitation. During the 2008 beach season, that threshold was ½ inch of rain or more. In 2008, the beaches in the harbor complex were closed pre-emptively for nine days due to rain events. The beach closings occurred on 6/15, 7/24, 7/28, 8/6, 8/8, 8/12, 8/15, 8/16, and 8/31, based on a threshold of ½-inch of precipitation over a 24-hour period (Wendolevske, pers. comm., 2009).

5.4.4 Nassau County Groundwater Monitoring

The Nassau County Department of Public Works has been monitoring groundwater quality and quantity in the County since the 1930s. Currently, the County monitors a network of 5,000 monitoring wells for groundwater quality, water elevations, and potentiometric head in the deeper aquifers (Nassau County DPW, 2005). There are several monitoring wells located in the Oyster Bay/Cold Spring Harbor Complex watershed used to monitor water levels in the Upper Glacial, Lloyd, and Magothy aquifers as well as volatile organic compounds (VOCs), pesticides, perchlorate, the gasoline additive methyl tertiary butyl ether (MBTE), and pharmaceuticals.

The 2005 report entitled *Nassau County Groundwater Monitoring Program 2000-2003 With Historical Information* (Nassua County DPW, 2005) concluded that raw groundwater quality throughout the County is improving due to the installation of sanitary sewers and the implementation and enforcement of regulatory programs governing the use, storage and disposal of hazardous substances and that annual water demand has been increasing in recent years. Saltwater intrusion is present in the watershed, as the monitoring wells illustrate saltwater intrusion has occurred at localized areas in Bayville and in Centre Island. As a result of the saltwater intrusion, portions of the Lloyd, North Shore, and Upper Glacial aquifers have become unusable for public water supply purposes. Saltwater intrusion along the north shore of Long Island is driven by groundwater withdrawal from public supply wells located near the shoreline.

MTBE was detected at levels of 2 to 10 parts per billion (ppb) in a monitoring well in the Upper Glacial aquifer located in the Mill Neck Creek watershed during the period 1995-1999. It was not detected at monitoring wells within the watershed during 2000-2003. This is consistent with the larger finding by the Nassau County DPW that there is not widespread MBTE contamination in the County's groundwater. There were no detectable levels of pesticides or perchlorate in monitoring wells within the watershed sampled in 2001-2003, and no detectable levels of pharmaceuticals in monitoring wells within the watershed sampled in 2002-2003. Although VOCs were detected at levels of >5 to 10 ppb in 1985-1987 in monitoring wells located in Cove Neck in the Oyster Bay Harbor subwatershed, concentrations of Total VOCs in monitoring wells in the Upper Glacial, Lloyd, and North Shore Aquifers within the watershed during 2000-2003 were at concentrations ranging from below detection limit to 5 ppb. This finding is consistent with the general conclusion that raw water quality in Nassau County is improving with respect to VOCs (Nassau County DPW, 2005).

5.4.5 Subwatershed Illicit Discharge Detection and Hot Spot Investigations

As part of their compliance with the National Pollution Discharge Elimination System (NPDES) Phase II requirements and as part of a stormwater runoff impact analysis, Nassau County initiated illicit discharge detection and elimination surveys in the Oyster Bay/Cold Spring Harbor Complex watershed in 2006, and six have been completed to date (Bailey Arboretum, Francis Pond, Kentuck Brook, Mill River, Tiffany Creek, Whites Creek). One goal of the investigations was to identify "hot spots" or illicit discharges. Hot spots are land uses that are known to have a high potential for pollutant discharge. Illicit discharges are locations were unpermitted discharges outfall into the stream. The investigations found potential hot spots and/or illicit discharges in the Mill River and Whites Creek subwatersheds. In the Mill River subwatershed, the Town of Oyster Bay Highway Yard on Lake Avenue, a golf course along Mill River Road, and commercial businesses on State Route 25a were identified as having the potential to be hot spots or illicit discharges (Cashin Associates, P.C., 2007). Numerous potential hot spots were also identified in the Whites Creek subwatershed. These included a petroleum bulk station, railroad car terminal/storage yard, multiple auto repair and service stations, boat storage and repair shops, gas stations, and parking lots (Cashin Associates, P.C., 2007).

Table 5-4. Sampling Stations and Pollution Sources in Oyster Bay Harbor, SGA #47

Station Number	Location & Pollution Source(s) Monitored A = Actual P = Potential	Type(s) of Pollution Source(s) PT = Point NP = Non-Point
1	On closure line, near buoy C "19" in channel to boat ramp. Effects of runoff from boat ramp and outflow from Mill Pond at Beekman Beach **A & P**	Indirect, NP
1A	Near shore (Beekman Beach) effect of outflow from Mill Pond, west of former Jakobsen Shipyard **A & P**	Direct, PT (Mill Pond outflow) Indirect, NP (runoff to/waterfowl in Mill Pond)
2	Near buoy C "15" off Brickyard Point, general water quality in certified area SW section of OB Hbr. **P**	Indirect, NP
3	Near shore, outflow from unnamed cove, north of Brickyard Point; runoff from residential property **P**	Indirect, NP
4	Near shore, off long dock at just north of Cleft Road. Effect of non-point runoff from West Shore Road **P**	Indirect, NP (runoff)
5	Near shore, effects of non-point runoff from West Shore Road **P**	Indirect, NP
6	Off shore, mid-harbor. General water quality in the certified area of West Harbor **P**	Indirect, NP
7	Near shore, off the NW point of Centre Island peninsula, runoff from residential property **P**	Indirect, NP
8	Off shore, mid-harbor. General water quality in the certified area of West Harbor **P**	Indirect, NP
9	On south end of seasonal closure line outside Mill Neck Creek. Effects of outflow from M N Crk **A & P**	Direct, PT (Mill Neck Creek mouth)/ Indirect, NP (runoff into M N Creek)
10	In seasonal closure, effects of drainage from wetlands south of West Harbor Road and effects of outflow from Mill Neck Creek **A & P**	Direct PT (wetlands runoff & Mill Neck Creek)/ Indirect, NP (runoff into wetlands & Mill Neck Creek)
11	Off shore, effects of outflow from Mill Neck Creek and potential effects of cesspool at Mill Neck Rod & Gun Club **P**	Indirect, NP

Table 5-4. Sampling Stations and Pollution Sources in Oyster Bay Harbor, SGA #47

Station Number	Location & Pollution Source(s) Monitored A = Actual P = Potential	Type(s) of Pollution Source(s) PT = Point NP = Non-Point
12	Off shore, mid-harbor. General water quality in the certified area of West Harbor. Potential effects of large # of occupied boats summer weekends **P**	Direct, NP (summer boat discharges) Indirect, NP (rest of the year)
13	Near shore, off Town of Oyster Bay Centre Island Beach. Potential effects of bathers, runoff; and, large number of occupied boats summer weekends **P**	Indirect, NP
13A	Near shore, north end of West Harbor at mouth of private canal on Centre Island. Potential effects of large # of occupied boats summer weekends **P**	Indirect, NP Direct, NP (summer boat discharges)
14	Near shore, off long dock for a residence on Centre Island. Potential effects of large # of occupied boats summer weekends **P**	Direct, NP (summer boat discharges) Indirect, NP (rest of year)
15	Near shore, near "split rock" on beach. Potential effects of large # of occupied boats summer weekends **P**	Direct, NP (summer boat discharges) Indirect, NP (rest of year)
16	Near buoy N Red "12" south of Brickyard Point, middle of east-west boat channel and just north of closed area around STP outfall & boat moorings **P**	Indirect, NP
17	Off shore, in uncertified area around closed area around STP outfall & boat moorings (summer) **A & P**	Indirect, PT (STP outfall) and NP (runoff from Oyster Bay village)
18	Near buoy N Red "8" south of Brickyard Point, middle of east-west boat channel and just north of closed area around STP outfall & boat moorings **P**	Indirect, PT (STP outfall) and NP (runoff from Oyster Bay village)
19	Near buoy Red N "6" southeast of Moses Point **P**	Indirect, NP
20	Near buoy JB "B" south of Moses Point, just north of closed area around STP outfall & boat moorings **A&P**	Indirect, PT (STP outfall) and NP (runoff from Oyster Bay village)
21	Near buoy Red N "4" in commercial channel to fuel depot & marinas. Within the uncertified area around STP outfall & boat moorings **A & P**	Direct, PT (STP outfall) and Indirect, NP runoff from village
22	Near shore, near buoy C "7" in commercial channel to fuel depot & marinas. Within the uncertified area around STP outfall & boat moorings **A & P**	Direct, PT (STP outfall) and Indirect, NP runoff from village
	Near shore at STP outfall site. Effects of STP outfall and stormwater runoff from Whites Creek and village business district, end of South Street **A & P**	Direct, PT (STP outfall) and Indirect, NP runoff from village
23	Near shore, off long fixed dock at a residence east of Steamboat Landing Road. Within uncertified area around STP outfall & boat moorings. Potential effects of runoff from road end. **P**	Indirect, NP (runoff from road end)
24	Off shore, along closure line at east side of the uncertified area around STP outfall & moorings. Potential effects of discharges from occupied boats in summer weekend anchoring area **P**	Indirect, NP & Direct, NP (boat discharges, summer months)
25	Off Roosevelt Breakwater (stone jetty) northeast side of Oyster Bay Cove. Along the seasonal closure line. Potential effects of discharges from occupied boats (summer months) & runoff into OB Cove **A & P**	Indirect, NP & Direct, NP (boat discharges)
26	Near shore, off small boat house on Cove Neck **P**	Indirect, NP
27	Near shore, off large estate property on Cove Neck **P**	Indirect, NP
28	Near shore, at Cove Point. General water quality in the certified area. **P**	Indirect, NP

Table 5-4. Sampling Stations and Pollution Sources in Oyster Bay Harbor, SGA #47

Station Number	Location & Pollution Source(s) Monitored A = Actual P = Potential	Type(s) of Pollution Source(s) PT = Point NP = Non-Point
29	Off shore, near buoy Green "5" between Cove Point and Plum Point. General water quality in the certified area. P	Indirect, NP
30	Near shore, at buoy Red N "4' east of Plum Point. General water quality in outer Oyster Bay Harbor P	Indirect, NP
31	Off long dock at Sewanhaka-Corinthian YC, on closure line for sewage outfall from YC. A & P	Direct, PT (sewage outfall) & Indirect (boats in S-C YC mooring area)
32	Near shore off long dock for residences on Centre Island. Potential effects of discharges from occupied yacht/sailboats in S-C YC anchorage P	Indirect, NP (boats in YC mooring area)
33	Near shore, off small group of residences along shoreline (Morgan Place & Roosevelt Drive). Potential effects of cesspools & road runoff P	Indirect, NP
C-1	Near shore at Weeks Point, along west end of seasonal closure line. Potential effects of runoff to Oyster Bay Cove & discharges from occupied boats in/outside OB Cove. (summer months) P	Indirect, NP
	Same as Sta. #25. Sampled as C-2 when evaluating w/q in Oyster Bay Cove for Conditional program P	Indirect, NP & Direct, NP (boat discharges)
C-3	Near shore in seasonally (November - April) certified area in Oyster Bay Cove. Potential effects of runoff from Cove Neck Road. P	Indirect, NP (runoff)
C-4	Near shore in the uncertified portion of Oyster Bay Cove, quite shallow. Potential effects of road runoff and discharge from Tiffany Creek. A & P	Indirect, NP (runoff)
C-5	Tiffany Creek at Cove Neck Road. Assess w/q in Tiffany Crk. when establishing conditional programs in OB Cove. Station not used in many yrs. A & P	Direct, PT (NP runoff into Creek)

Table 5-5. Sampling Stations and Pollution Sources in Cold Spring Harbor, SGA #48

Station Number	Location & Pollution Source(s) Monitored A = Actual P = Potential	Type(s) of Pollution Source(s) PT = Point NP = Non-Point
1	Near shore, at Cooper Bluff; general water quality in outer harbor area, land runoff below bluff P	Indirect, NP
2	Off shore, mid-harbor; general water quality in outer harbor area P	Indirect
3	Near shore, off West Neck Beach pavilion; potential effects of septic systems serving beaches, bathers P	Indirect, NP
3.1	Outflow from Smugglers Cove, runoff into Cove P	Indirect, PT (outflow from Cove)/NP land runoff into cove
4	Off shore, mid-harbor; general water quality in outer harbor area P	Indirect
5	Mouth of unnamed inlet at private residence P	Direct from inlet, NP
6	Off shore, mid-harbor; general water quality in outer harbor area P	Indirect
7	Near shore, runoff P	Indirect, NP
8	Near shore, near rock jetty, runoff P	Indirect, NP
9	Off shore, mid-harbor; general water quality in souther	Indirect

Table 5-5. Sampling Stations and Pollution Sources in Cold Spring Harbor, SGA #48

Station Number	Location & Pollution Source(s) Monitored A = Actual P = Potential	Type(s) of Pollution Source(s) PT = Point NP = Non-Point
	portion or Cold Spring Harbor **P**	
10	General water quality near Harbor mouth **P**	Indirect, NP
11	Near mouth of marina boat basin, in uncertified area potential effects of boats & outflow from inner Cold Spring Harbor uncertified area **A & P**	Indirect, NP; Direct (boats) NP
12	Just east of south end of closure line, in uncertified area. Off white house on CSH Labs property. Potential effects of outflow from inner CSH uncertified area **A & P**	Indirect, NP
13	Off eastern tip of sand spit, north of boat ramp. Effects of runoff from ramp and Route 25A, boats and marina in inner harbor uncertified area **A & P**	Direct, NP
13.1	In uncertified cove north of station 13, effects of outflow from ponds at Spring Road and runoff from Cold Spring Harbor village roads **A & P**	Direct, PT (pond outflow); NP (runoff from roads)
14	West of Town fishing dock, within boat mooring area potential effects of runoff, marina and boats **A & P**	Direct, PT (boats); Indirect, NP (runoff)
15	Near shore, former discharge from small STP serving CSH Labs. Discharge ceased 1992. Station monitors w/q effects of runoff and freshwater inflow from ponds south of Route 25A, near hatchery	Indirect, NP (runoff)
21	Near fixed navigation aid , general water quality in outer harbor area **P**	Indirect
22	Near buoy Red N "2", general water quality in outer harbor area **P**	Indirect
23	Near buoy Gong "1" , general water quality in outer harbor area, near boundary with SGA #34, **P**	Indirect

6 Watershed Modifications

6.1 Dams and Impoundments

There are several small dams and impoundments in the Oyster Bay/Cold Spring Harbor Complex watershed, which are used primarily for recreational purposes. According to the NYSDEC Dam Safety Regulations, a dam's hazard classification is based on the height of the dam, its maximum impoundment capacity, physical characteristics of the dam site, and location of downstream facilities. *Figure 6-1* shows the location and hazard classification of each of the eight dams within the watershed; all dams are a rated a low hazard. Mill Pond Dam is owned by the Nassau County Department of Public Works and the others are privately owned. Mill Pond Dam creates an approximately 6-acre impoundment. The lands beneath the impoundment are part of the Oyster Bay National Wildlife Refuge.

In addition to recreational opportunities, these impoundments also provide aquatic and wildlife habitat. Some of the dams, as well as culverts and other obstructions, are potential barriers to fish passage. As described in Section 4.7 of this report, the Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay recently completed fish passage feasibility studies to evaluate restoration of diadromous fish to the Mill River and other areas of the harbor complex watershed by installing fish ladders or removing Mill Pond Dam and other obstructions.

6.2 Water Supply

Groundwater aquifers supply drinking water to all of Long Island. Long Island's drinking water system was designated as the nation's first Sole Source Aquifer. To protect these groundwater aquifers, the state designated nine Special Groundwater Protection Areas (SGPAs), as defined in Article 55 of the NYS Environmental Conservation Law. The Oyster Bay SGPA is one of two such state-designated aquifer recharge areas in Nassau County. The Town of Oyster Bay has an Aquifer Protection Overlay District (APO) in addition to the SGPA, adopted in 2004, which affords added protection to groundwater resources.

The Town of Huntington contains portions of two SPGAs, only one of which (West Hills/Melville in the western part of the Town) is located within the Oyster Bay/Cold Spring Harbor Complex watershed. Most of the Town of Huntington's public water supply wells are located outside of SPGAs. Unlike the Town of Oyster Bay, Huntington has not enacted aquifer protection overlay district regulations.

Public water is supplied within the Oyster Bay/Cold Spring Harbor Complex watershed by the Jericho Water District, Village of Bayville, City of Glen Cove, Oyster Bay Water District, Locust Valley Water District and several private wells on Cove Neck and Centre Island. In Suffolk County, there are eleven wells that service the watershed within the Village of Lloyd Harbor, West Hills, Cold Spring Harbor and Huntington. *Figure 6-2* shows the locations of public water supply wells and the approximate limits of SGPAs within the watershed.

Figure 6-1

Figure 6-2

6.3 Wastewater

Oyster Bay Hamlet and portions of the Unincorporated Villages of Upper Brookville are served by sanitary sewers that transport sanitary waste to the Oyster Bay District Sewage Treatment Plant (OBDSTP). The treatment plant is located in Oyster Bay Hamlet and discharges treated effluent to Oyster Bay Harbor east of the Mill River outlet. The treatment plant operates under a State Pollution Discharge Elimination System permit with a maximum treatment capacity of 1.8 million gallons per day (MGD). The plant currently averages 1.25 MGD. The OBDSTP serves an area (*Figure 6-3*) of approximately 975 acres, with approximately 20 miles of sewer lines and 2,000 individual service connections (Ryan & Ryan PR, Inc., 1999). All facilities within the sewer service area must be connected to public sanitary sewers, and existing on-site sewage disposal systems, such as septic tanks or cesspools, must be properly abandoned according to the Nassau County Department of Public Works and Department of Health guidelines (Cashin Associates, P.C., 2007).

The OBDSTP has been in service since 1926 and has been upgraded several times. The most recent upgrade occurred in 2006 to provide advanced treatment for nitrogen removal. Nitrogen has been identified as the primary pollutant causing low dissolved oxygen conditions, or hypoxia, occurring throughout much of Long Island Sound's bottom waters each summer. Wastewater treatment plants that discharge directly to the Sound or into inland surface waters that reach the Sound are a significant contributor of nitrogen. To address this water quality problem, NYSDEC imposed limits to reduce nitrogen discharged from the 12 municipal treatment plants located on the north shore of Long Island. NYSDEC issued a revised discharge permit that required the OBDSTP to reduce nitrogen discharged to Oyster Bay from the treatment plant by 63.8 percent in three 5-year increments by August 2014. According to the Friends of the Bay 2007 and 2008 Annual Water Quality Report, the OBDSTP's new advanced treatment facility is already achieving the 2014 nitrogen limits imposed by NYSDEC permit. The upgrade has reduced the daily nitrogen discharged by as much as 75%.

Sanitary sewers in the southeastern portion of the watershed collect and convey waste to wastewater treatment plants on the South Shore of Long Island operated by the Nassau County Department of Public Works.

A second wastewater treatment plant in the harbor complex watershed is located west of Plum Point on Centre Island. This privately-owned plant, Seawanhaka STP, operates primarily in the summer months to process waste during the boating season. *Table 6-1* identifies the OBDSTP and the Seawanhaka STP, as well as other facilities with NYSDEC State Pollution Discharge Elimination System (SPDES) permits in the Oyster Bay/Cold Spring Harbor Complex watershed. *Figure 6-4* also depicts the locations of these facilities within the watershed.

Figure 6-3

Table 6-1. Facilities in the Oyster Bay Watershed with SPDES Permits

Facility	Town	Facility Type
Commander Terminal	Oyster Bay	Petroleum Bulk Station and Terminal
Mill-Max Manufacturing Corp.	Oyster Bay	Electronic Connector Manufacturing
MTA LIRR Oyster Bay Yard	Oyster Bay	Railroad
Oyster Bay Water Pollution Control Plant	Oyster Bay	Sewerage System
Seawanhaka-Corinthian Yacht Club Property	Oyster Bay (Centre Island)	Sports and Recreation Club
County Parkland	Huntington	--
Cold Spring Harbor Terminal*	Cold Spring Harbor	Petroleum Bulk Station and Terminal

Source: EPA Water Permit Compliance System (PCS) database and NYSDEC. SPDES: New York State Pollutant Discharge Elimination System
* Although still listed in the database, the Cold Spring Harbor Terminal bulk storage tanks have been removed.

The Birches (also known as Continental Villas) is a residential subdivision located on the west side of Oak Neck Creek, in the Locust Valley area. This subdivision historically operated its own sewage treatment system, which suffered chronic problems due to cesspool overflows and inadequate treatment of waste, impacting low-lying wetlands and the adjacent creek. In an attempt to address these issues, a contact chlorine treatment system was installed which disinfects the wastewater by adding chlorine prior to discharging to Oak Neck Creek. The treatment system did not fully address the problem, as elevated coliform bacteria concentrations in the harbor persisted near this location. Failing and/or low-functioning individual on-site sewage disposal systems located in this area are also believed to have contributed to these chronic problems. A groundbreaking occurred in April 2009 for long-awaited upgrades to sewer and water infrastructure to connect the homes in the Birches residential subdivision to the Glen Cove sewage treatment plant. This project will eliminate chronic cesspool overflows to Mill Neck Creek.

In October 2008, the Oyster Bay/Cold Spring Harbor Complex was declared a federal No-Discharge Zone (NDZ) for vessel sewage, regulated under Section 312 of the Clean Water Act. The designation prohibits the discharge of sewage (whether treated or untreated) from vessels, providing an additional level of protection to address water quality issues associated with sewage contamination in marine waters.

The remainder of the Oyster Bay/Cold Spring Harbor Complex watershed is served by individual on-site sewage disposal systems, including cesspools and septic tank systems. Cesspools were the most common method of on-site sewage disposal until about 1973, when the local development regulations were modified to require the use of sanitary sewers. Cesspools are essentially underground chambers with perforated walls through which wastewater leaches into the soil. Cesspools receive untreated sanitary waste, including both liquid and solid materials, and are therefore are susceptible to clogging. Septic tanks are typically

Figure 6-4

installed prior to a cesspool in order to settle out the heavier solids before entering the leaching system and prolong the life of the system. Further treatment of wastewater occurs in the soil below the leaching system, the effectiveness of which is strongly influenced by groundwater and soil conditions.

Cesspools and septic systems are a potential source of pollution, including nitrogen, pathogens, and other contaminants, to surface waters and groundwater as a result of system failure (inadequately treating sewage or by creating potential for direct or indirect contact between sewage and the public) or malfunction (typically a slow loss of function that is difficult to detect). Since a large portion of the watershed was developed prior to 1973, failure or malfunction of cesspools and septic systems is believed to be a significant source of pollution to surface water and groundwater.

6.3 Stormwater Infrastructure

The stormwater collection and drainage system within the harbor complex watershed consists of drainage infrastructure operated and maintained by the watershed municipalities, including the Town of Oyster Bay, the Town of Huntington, the associated villages, and Nassau and Suffolk Counties. Nassau and Suffolk County are responsible for the drainage infrastructure associated with county roadways. All of these municipal entities are regulated small Municipal Separate Storm Sewer Systems (MS4s) under the NYSDEC State Pollution Discharge Elimination System Phase II stormwater program.

Stormwater within the watershed is discharged to surface waters and to groundwater. A large portion of the watershed drains to surrounding surface waters. The stormwater drainage systems in selected areas of the watershed are described in the stormwater runoff impact analysis subwatershed reports prepared on behalf of Nassau County (Cashin Associates, P.C., October 2007) and in the Stormwater Management/Coastal Water Quality Improvement component of the Oyster Bay/Cold Spring Harbor Complex Harbor Management Plan (Cashin Associates, P.C., 2002). Outfall surveys performed by Nassau County and the Town of Oyster Bay to meet Phase II stormwater program requirements identified stormwater outfalls throughout the watershed, including numerous stormwater outfalls that discharge directly to the harbor complex (*Figure 6-4*). Note that information regarding stormwater outfalls was unavailable from the Town of Huntington as of the preparation of this report.

Artificial infiltration of stormwater runoff by use of basins or sumps has been practiced on Long Island since the 1930s to recharge collected stormwater back to the groundwater system. In the 1950s, Nassau and Suffolk Counties adopted regulations requiring stormwater to be retained and infiltrated onsite. Subsequently, the use of drywells, recharge basins, and drainage reserve areas became common practice to retain and infiltrate stormwater runoff from roadways in residential, commercial, and industrial areas. Recharge basins are most prevalent in eastern Nassau County and western Suffolk County. Most of these facilities have overflow structures that direct stormwater resulting from extreme rainfall events to either other recharge basins or to drainage facilities that ultimately discharge to surface waters. *Figure 6-4* shows the existing recharge basins within the Nassau County portion of the harbor complex watershed (note that information regarding recharge basins in the portion of the watershed within Suffolk County was unavailable as of the preparation of this report). Overall, there are approximately 70 recharge basins in the watershed in Nassau County. According to the Nassau County Storm Water Management Program, nearly half of the land area of Nassau County is serviced by recharge basins (Nassau County DPW, 2003).

Since much of the watershed was developed prior to the adoption of stormwater quality regulatory requirements, most of the existing drainage infrastructure that does not discharge to recharge basins consists of traditional storm drains/catch basin and storm pipes that discharge directly to surface waters without treatment, other than detention to maintain peak rates of discharge. As described in Section 7.1.4, uncontrolled stormwater runoff from impervious surfaces is a significant source of potential impacts to surface waters within the harbor complex watershed, groundwater supplies, and the water quality of the harbor complex itself. Through their Phase II stormwater management programs and other planning initiatives, the watershed municipal entities, including Nassau and Suffolk Counties, have developed and implemented a variety of Best Management Practices to address stormwater quality and quantity issues associated with land development and redevelopment projects. The municipalities have also begun to address historical development and nonpoint source pollution impacts in the watershed by identifying potential sites for stormwater retrofits. However, stormwater runoff continues to be a significant threat to the water quality and overall health of the Oyster Bay/Cold Spring Harbor Complex and its watershed.

6.4 Other Regulated Sites

Historical and current industrial and commercial activities within the harbor complex watershed pose a potential threat to surface waters and groundwater supplies. Illegal waste disposal, improper use and disposal of chemicals such as used oil, pesticides, and herbicides, and chemical spills are potential sources of contaminants from industrial and commercial facilities. As summarized in *Table 6-2* and shown in *Figure 6-5*, several hazardous waste generators and other regulated sites are located within the watershed. These facilities are generally located in the more densely developed commercial and industrial areas of the Towns of Oyster Bay and Huntington, primarily in the central and southeastern portions of the watershed.

Table 6-2. Regulated Sites

Site Types	Number of Sites in OB/CSH Watershed		
	Oyster Bay	Huntington	Glen Cove
Hazardous Waste Generators	94	27	0
Air Emissions	19	4	0
Remediation Sites	3	0	0

Source: EPA RCRAInfo (EPA and State Treatment, Storage, Disposal facilities), Air Facility System (AFS), and Superfund National Priorities List (NPL).

There are three NYSDEC-regulated remediation sites located within the watershed, all within the Town of Oyster Bay. The Bayville Village Cleaners, located in the western portion of the watershed, is being remediated under the NYSDEC Voluntary Cleanup Program.

Figure 6-5

The Mill Neck Marina located on Mill Neck Creek (northern portion of the watershed). The site is designated by the NYSDEC as a Class 2 site, meaning that the disposal of hazardous waste has been confirmed and the presence of such hazardous waste or its components or breakdown products represent a significant threat to the environment.

The third site is the former Jakobsen Shipyard, which is a six-acre site bordered on the north by Oyster Bay Harbor and in close proximity to Beekman Beach and Theodore Roosevelt Memorial Park on the west and east respectively. This State Superfund site was once highly contaminated with metals and other pollutants, but has been remediated and has been partially redeveloped as a passive waterfront park owned jointly by the Town and the State.

7 Land Use and Land Cover

The type and distribution of land use and land cover within a watershed has a direct impact on nonpoint sources of pollution and water quality. This section describes the current and potential future land use and land cover patterns in the harbor complex watershed, and the implications for water quality.

7.1 Current Conditions

7.1.1 Land Use

Figure 7-1 depicts general land use patterns in the Oyster Bay/Cold Spring Harbor Complex watershed. The land use information in *Figure 7-1* is a combination of parcel-based land use GIS data provided by the Town of Oyster Bay and land use derived from the Town of Huntington's Comprehensive Plan July 2008 Draft (Town of Huntington, 2008). Land use categories and associated acreage within the watershed are provided in *Table 7-1*.

The watershed's predominant land use (approximately 64%) is low-density residential. Approximately 10.3% of the watershed is considered open space, including conservation land and public parks. Land classifies as "open space" in the Town of Huntington consists of both undeveloped land and recreational parks. Land classified as "vacant" by the Town of Oyster Bay accounts for approximately 4.8% of the watershed area. The vacant land in Oyster Bay is a mixture of undeveloped parcels and forested areas. Transportation land use, including local and county roads and highways, comprises approximately 7% of the watershed land area.

Table 7-1. Watershed Land Use

Land Use Category	Acres	Percent of Watershed
Agriculture	96	0.4%
Commercial	368	1.5%
Industrial	16	0.1%
Residential	15949	63.9%
Transportation (3, 4)	1756	7.0%
Public Services (1)	131	0.5%
Recreation And Entertainment (1)	964	3.9%
Vacant Land (1,5)	1206	4.8%
Wild, Conservation Lands and Public Parks (1)	1490	6.0%
Community Services (1)	1911	7.7%
Institutional (2)	5	0.0%
Open Space (2)	1064	4.3%
Utilities (2)	9	0.0%
Water (2)	12	0.0%

Notes: (1) Category for Town of Oyster Bay land use only.
(2) Category for Town of Huntington land use only.
(3) Transportation land use for in the Town of Huntington was estimated by buffering roads included in the Census 2000 Tiger Road file.
(4) Transportation land use in the Town of Oyster Bay was estimated as the area between parcels bordered by roads.
(5) Some parcels in the Town of Oyster Bay were unclassified and determined to be vacant land based on aerial orthophotography.

Figure 7-1

Commercial land use accounts for less than 2% of the watershed area, with the majority of the commercial areas concentrated in Oyster Bay Hamlet and along the Route 106/Pine Hollow Road/South Street corridor. Other isolated commercial areas are located along Forest Avenue in Locust Valley, in Laurel Hollow near the head of Cold Spring Harbor, along Main Street in Cold Spring Harbor, and along Jericho Turnpike in Woodbury and West Hills. Current and former industrial land use account for a small percentage of the watershed area (0.1%) and are located primarily along the Oyster Bay waterfront and Oyster Bay Hamlet.

7.1.2 Zoning

Figure 7-2 depicts the generalized existing zoning in the Oyster Bay/Cold Spring Harbor Complex watershed, which is based on a compilation of zoning districts and designations established by the various municipal entities in the watershed. The specific zoning districts across the watershed are highly variable because they are defined at the village or town level. For this reason, the village-defined zoning designations were grouped into the generalized zoning designations shown in *Figure 7-2*, including business, recreation, industrial, office, multi-family residential, and single-family residential. The pattern of existing zoning largely reflects the existing pattern of residential, commercial, office, and industrial uses. The majority of the harbor complex watershed is zoned single-family residential. *Figure 7-3* depicts the minimum lot size required in each residential zoning district based on the village-specific zoning. Minimum residential lot sizes vary from less than a quarter acre to over 5 acres.

7.1.3 Land Cover

Figure 7-4 depicts the generalized land cover in the harbor complex watershed. The data shown in Figure 7-4 are land cover types derived from 2002 Landsat satellite imagery with ground resolution of 30 meters. The land cover data in the watershed are summarized into eleven categories (*Table 7-2*). These ten categories are those used in the Connecticut Land Cover Map Series and are described following the table (University of Connecticut Center for Land Use Education and Research).

Figure 7-2

Figure 7-3

FUSS & O'NEILL

Figure 7-4

Table 7-2. Watershed Land Cover

Land Cover Type	1985 Acres	1985 Percent of Watershed	2002 Acres	2002 Percent of Watershed	Relative Change in Percent of Watershed (%)[1]	Relative Change in Acreage (%)[2]
Deciduous Forest	9,500	39.0	9,068	37.2	-1.8	-5
Developed	7,175	29.5	7,455	30.6	1.1	4
Turf/Grass	3,439	14.1	3,661	15.0	0.9	6
Coniferous Forest	2,039	8.4	1,999	8.2	-0.2	-2
Other Grasses	561	2.3	683	2.8	0.5	22
Agriculture	559	2.3	524	2.2	-0.1	-6
Water	450	1.8	465	1.9	0.1	3
Barren	274	1.1	142	0.6	-0.5	-48
Tidal Wetland	250	1.0	247	1.0	0.0	-1
Forested Wetland	101	0.4	102	0.4	0.0	2
Non-forested Wetland	8	< 1	10	< 1	--	--

[1]Calculation = % land cover 2002 - % land cover 1985
[2]Calculation = (acres land cover 2002 - acres land cover 1985) / acres land cover 1985
Source: University of Connecticut's Center for Land Use Education and Research (CLEAR)

- Barren – Mostly non-agricultural areas free from vegetation, such as sand, sand and gravel operations, bare exposed rock, mines, and quarries. Also includes some urban areas where the composition of construction materials spectrally resembles more natural materials. Also includes some bare soil agricultural fields.

- Coniferous Forest – Includes Southern New England mixed softwood forests. May include isolated low density residential areas.

- Deciduous Forest – Includes Southern New England mixed hardwood forests. Also includes scrub areas characterized by patches of dense woody vegetation. May include isolated low density residential areas.

- Developed – High density built-up areas typically associated with commercial, industrial and residential activities and transportation routes. These areas contain a significant amount of impervious surfaces, roofs, roads, and other concrete and asphalt surfaces.

- Forested Wetland – Includes areas depicted as wetland, but with forested cover. Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.

- Non-forested Wetland – Includes areas that predominantly are wet throughout most of the year and that have a detectable vegetative cover (therefore not open water). Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.

- Other Grasses and Agriculture – Includes non-maintained grassy areas commonly found along transportation routes and other developed areas and also agricultural fields used for both crop production and pasture.

- Turf & Grass – A compound category of undifferentiated maintained grasses associated mostly with developed areas. This class contains cultivated lawns typical of residential neighborhoods, parks, cemeteries, golf courses, turf farms, and other maintained grassy areas. Also includes some agricultural fields due to similar spectral reflectance properties.

- Utility – Includes utility rights-of-way. This category was manually digitized on-screen from rights-of-way visible in the Landsat satellite imagery. The class was digitized within the deciduous and coniferous categories only.

- Water – Open water bodies and watercourses with relatively deep water.

A comparison of watershed land cover data between 1985 and 2002 (*Table 7-2*) shows a minor increase in watershed development during this period (4% increase in developed cover types) and a corresponding loss of coniferous (2% decrease) and deciduous forest (5% decrease). There was a significant percentage loss of barren land cover and percentage increase in other grasses; however these land cover categories comprise a very small percentage of the watershed area and could reflect construction or agricultural activity at the time the satellite data was obtained.

The harbor complex watershed is characterized by roughly equal amounts of forested land cover and developed land cover. These land cover types are described below.

Forest Cover

Approximately 45% of the watershed consists of deciduous and coniferous forest cover, which is associated with open space and wooded portions of low-density residential properties. *Table 7-3* compares the total acres and percent forest cover by subwatershed. The percent forest cover in each subwatershed ranges from approximately 15% in the White's Creek subwatershed to approximately 65% in the Tiffany Creek subwatershed.

Based on literature threshold values documented in several studies (CLEAR, 2007), watershed forest cover of 65% or greater is typically associated with a healthy aquatic invertebrate community. Only one of the fourteen subwatersheds, Tiffany Creek, meets or exceeds this threshold value of 65%. Based on a recommendation of the American Forests organization, 40% forest cover is a reasonable threshold goal for urban areas. Although the harbor complex watershed, as a whole, is above this threshold value, several of the subwatersheds, Centre Island (31%), Cold Spring Brook (37%), Kentuck Brook (39%), Mill Neck Creek (30%), and Upper White's Creek (33%), are below this threshold, with White's Creek significantly below the threshold at approximately 15%.

Table 7-3. Forest Cover – Oyster Bay Watershed

Subwatershed Name	Forest Cover in Subwatershed (acres)	Percent Forest Cover in Subwatershed	Developable Forest Cover in Subwatershed (acres)	Percent of Forest Cover that is Developable
Bailey Arboretum	310	61%	25	8%
Beaver Brook	2,157	46%	97	4%
Centre Island	243	31%	39	16%
Cold Spring Brook	1,745	37%	122	7%
Cold Spring Harbor	1,460	50%	25	2%
Kentuck Brook	567	39%	40	7%
Lloyd Neck	463	54%	0	0%
Mill Neck Creek	295	30%	9	3%
Mill River	1,207	58%	141	12%
Oyster Bay Harbor	777	48%	128	16%
Tiffany Creek	1,189	65%	77	6%
Upper Kentuck Brook	188	43%	0	0%
Upper White's Creek	424	33%	4	1%
White's Creek	42	15%	8	19%
Harbor Complex Watershed	**11,067**	**45%**	**25**	**8%**

Developed Areas

Developed land cover, characterized by significant amounts of impervious surfaces such as roofs, roads, and other concrete and asphalt surfaces, accounts for approximately 30% of the harbor complex watershed. When considered together with the turf/grass land cover category (primarily cultivated lawns typical of residential neighborhoods, parks, cemeteries, golf courses, turf farms, and other maintained grassy areas), approximately 46% of the watershed area consists of developed land cover types. The percentage of developed land cover (not including turf/grass) in each subwatershed ranges from approximately 17% in the Lloyd Neck and Bailey Arboretum subwatersheds to approximately 66% in the White's Creek subwatershed.

Table 7-4. Developed Land Cover by Subwatershed

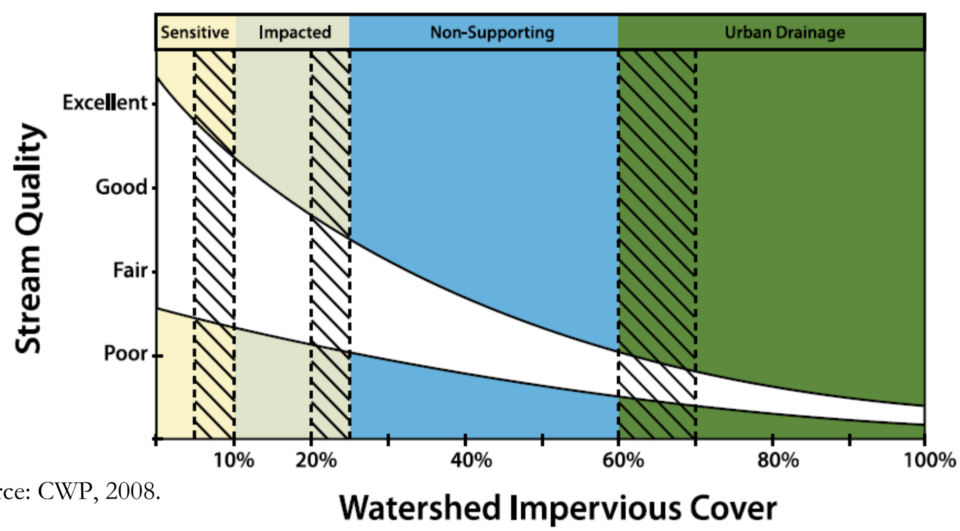
Subwatershed Name	Developed Land Cover in Subwatershed (acres)	Percent Developed Land Cover in Subwatershed (%)
Bailey Arboretum	85	17
Beaver Brook	1,064	23
Centre Island	198	25
Cold Spring Brook	1,815	39
Cold Spring Harbor	797	27
Kentuck Brook	598	41
Lloyd Neck	144	17
Mill Neck Creek	407	42
Mill River	541	26
Oyster Bay Harbor	515	32
Tiffany Creek	464	25
Upper Kentuck Brook	148	34
Upper White's Creek	496	39
White's Creek	184	66
Harbor Complex Watershed	**7,455**	**30**

7.1.4 Impervious Cover

Impervious cover has emerged as a measurable, integrating concept used to assess the overall condition of a watershed. Numerous studies have documented the cumulative effects of urbanization on stream and watershed ecology (Center for Watershed Protection, 2003; Schueler et al., 1992; Schueler, 1994; Schueler, 1995; Booth and Reinelt, 1993, Arnold and Gibbons, 1996; Brant, 1999; Shaver and Maxted, 1996). Research has also demonstrated similar effects of urbanization and watershed impervious cover on downstream receiving waters such as lakes, reservoirs, estuaries, and coastal areas.

The correlation between watershed impervious cover and stream indicators is due to the relationship between impervious cover and stormwater runoff, since streams and receiving water bodies are directly influenced by stormwater quantity and quality. Although well-defined imperviousness thresholds are difficult to recommend, research has generally shown that when impervious cover in a watershed reaches between 10 and 25 percent, ecological stress becomes clearly apparent. Between 25 and 60 percent, stream stability is reduced, habitat is lost, water quality becomes degraded, and biological diversity decreases (NRDC, 1999). Watershed imperviousness in excess of 60 percent is generally indicative of watersheds with significant urban drainage. *Figure 7-5* illustrates this effect. These research findings have been integrated into a general watershed planning model known as the Impervious Cover Model (ICM) (CWP, 2003).

Figure 7-5 also demonstrates the wide variability in stream response found in less-urban watersheds at lower levels of impervious cover (generally less than 10 percent). Stream quality at lower range of impervious cover is generally influenced more by other watershed metrics, such as forest cover, road density, extent of riparian vegetative cover, and cropping practices. Less variability exists in the stream quality at higher levels of impervious cover because most streams in highly impervious, urban watersheds exhibit fair or poor stream health conditions, regardless of other conditions (CWP, 2008).



Source: CWP, 2008.

Figure 7-5. Conceptual Model Illustrating Relationship Between Watershed Impervious Cover and Stream Quality

A GIS-based impervious cover analysis was performed for the harbor complex watershed, with assistance from the Center for Landuse Education and Research (CLEAR) at the University of Connecticut (Wilson, 2008). The satellite-derived land cover data described previously were used in the analysis. The sub-pixel classification method extracts impervious surface data directly from 2002 Landsat imagery to estimate the amount of impervious surface within each 30 meter pixel. The percent imperviousness by basin was calculated using the subwatershed GIS layer described previously. *Figure 7-6* graphically summarizes the results of this analysis.

The overall imperviousness of the harbor complex watershed is estimated at approximately 12.3% (*Table 7-5*), which slightly exceeds the 10% threshold in the ICM where ecological stress and stream impacts become apparent. As shown in *Figure 7-6*, impervious cover is generally highest (30% to 70%) in the urbanized areas of Oyster Bay Hamlet and the Villages of Glen Cove, Bayville, Locust Valley, West Hills and the southern portion of Woodbury. Impervious cover in most of the residential areas of the watershed generally ranges from less than 10 percent up to 30%.

Figure 7-7 and *Table 7-5* summarize estimates of impervious cover by subwatershed. Most of the subwatersheds fall into the "impacted" category (impervious cover between 10 and 25%) according to the ICM. Several of the subwatersheds have significantly less than 10% impervious cover, including the Bailey Arboretum and Lloyd Neck subwatersheds. The White's Creek subwatershed has the highest impervious cover (43.3%), which is consistent with the high-density development in Oyster Bay Hamlet and indicative of degraded stream conditions according to the ICM.

Table 7-5. Existing Subwatershed Impervious Cover

Subwatershed	Percent Impervious Cover
Bailey Arboretum	4.6%
Beaver Brook	8.0%
Centre Island	10.0%
Cold Spring Brook	16.4%
Cold Spring Harbor	9.6%
Kentuck Brook	18.5%
Lloyd Neck	4.4%
Mill Neck Creek	19.1%
Mill River	10.5%
Oyster Bay Harbor	14.1%
Tiffany Creek	8.6%
Upper Kentuck Brook	11.9%
Upper White's Creek	15.8%
White's Creek	43.3%
Harbor Complex Watershed	**12.3%**

The results of this analysis provide an initial diagnosis of potential stream and receiving water quality within the watershed study area. The analysis method and ICM are based on several assumptions and caveats, which limits its application to screening-level evaluations. Some of the assumptions of the ICM include:

Figure 7-6

FUSS & O'NEILL

Figure 7-7

- Requires accurate estimates of percent impervious cover, which is defined as the total amount of impervious cover over a subwatershed area. The resolution of the land cover data used in the evaluation is relatively coarse, although sufficient for screening analysis.

- Predicts potential rather than actual stream quality.

- Does not predict the precise score of an individual stream quality indicator but rather predicts the average behavior of a group of indicators over a range of impervious cover.

- The 10 and 25 % thresholds are approximate transitions rather than sharp breakpoints.

- Does not currently predict the impact of watershed best management practices (treatment or non-structural controls).

- Does not consider the geographic distribution of the impervious cover relative to the streams and receiving waters. Effective impervious cover (impervious cover that is hydraulically connected to the drainage system) has been recommended as a better metric, although determining effective impervious cover requires extensive and often subjective judgment as to whether it is connected or not.

- Impervious cover is a more robust and reliable indicator of overall stream quality beyond the 10 percent threshold. The influence of impervious cover on stream quality is relatively weak compared to other potential watershed factors such as percent forest cover, riparian community, historical land use, soils, agriculture, etc. for impervious cover less than 10 percent.

7.1.5 Open Space

Open space areas were identified based on a review of land use information provided by the Town of Oyster Bay and Town of Huntington, review of aerial photographs, and through coordination with Friends of the Bay. Approximately 10% of the harbor complex watershed consists of protected open space that is primarily conservation land and public parks (*Figure 7-8*). This land is protected against future development. In addition, recreational open space (golf courses, beaches, and private institutional open space) accounts for another 5% to 10% of the watershed area (*Figure 7-1*). Future development of these parcels is unlikely, unless their continued use becomes threatened. Additional privately held natural open space exists on already subdivided parcels and large estates.

Nassau County has identified open space, parks, stormwater systems and brownfields that are recommended for acquisition or restoration funding in the report *The 2006 Nassau County Environmental Program: Recommended Properties and Projects* (Nassau County, 2006). The open space acquisition recommendations total 52 acres in the harbor complex watershed and include the Humes Property and Smithers Property in Mill Neck, the Held Property and Schwab Property in Oyster Bay Cove, and Woodbury Hills in Woodbury.

Figur 7-8

In February 2008, the Nassau County Legislature acquired most of the 31-acre Smithers Estate in Mill Neck for open space preservation. This important acquisition creates a continuous preserve all the way to the Oyster Bay National Wildlife Refuge, helping to protect water quality and the health of the Oyster Bay/Cold Spring Harbor estuary system. The Smithers Estate is within a state-designated Special Groundwater Protection Area (SGPA) and contains two ponds, as well as many of the fresh-water springs that supply Shu Swamp, Beaver Dam, Mill Neck Creek and Oyster Bay. The NYSDEC has documented 74 species of birds breeding in the area, including migratory birds. It also provides critical habitat for numerous fish species, such as Brook Trout and the American Brook Lamprey.

The NYSDEC *2006 New York State Open Space Conservation Plan* identifies several properties in the Oyster Bay/Cold Spring Harbor Complex watershed that are priorities for future acquisition to protect water quality, fish and wildlife habitat, and water-based industry, and provide increased opportunities for public access to Long Island Sound. The *DRAFT 2009 New York State Open Space Conservation Plan* updates the 2006 priority list and includes:

- *Sagamore Hill Additions* – 19 parcels totaling 358 acres, flanking Sagamore Hill National Park on the Cove Neck peninsula in the Town of Oyster Bay. Most parcels front either Oyster Bay or Cold Spring Harbor.

- *Shu Swamp Natural Area* – 9 parcels totaling 80 acres on either side of Shu Swamp Preserve in the Town of Oyster Bay. The area is a Class I freshwater wetland within the Oyster Bay SGPA. Home to endangered brook trout, brook lamprey and water otter as well as several unusual or regionally rare plant species.

- *Oyster Bay Mill Pond Area* – One 6-acre parcel fronting Oyster Bay Mill Pond, an 8-acre stream-fed pond within the boundaries of the Oyster Bay National Wildlife Refuge that flows directly into Oyster Bay Harbor.

- *Oyster Bay Harbor Area* – 36 parcels totaling 294 acres surrounding Oyster Bay Harbor, home to New York State's largest oyster fishing area. This popular area provides outstanding recreational opportunities and includes a large concentration of both saltwater and freshwater wetlands.

The *DRAFT 2009 New York State Open Space Conservation Plan* also identifies acquisition of parcels along trail corridors and greenways associated with the Long Island Trail & Greenway System to provide non-motorized travel corridors for people and wildlife, and to link recreational, natural and cultural attractions. In the Oyster Bay/Cold Spring Harbor Complex watershed, the primary trail and greenway acquisition priorities include:

- *Muttontown Preserve Trail System* – 11 parcels totaling 295 acres adjoining the Muttontown Preserve. This popular horse and foot trail system is heavily used and is threatened with fragmentation. It is located in the Oyster Bay SGPA and contains rare plants, tiger salamanders, and glacial kettle-hole ponds.

Finally, the *DRAFT 2009 New York State Open Space Conservation Plan* identifies acquisition of vacant land within SGPAs identified in the 1992 Long Island Comprehensive Special Groundwater Protection Area Plan. The protection of land within SGPA boundaries is directly linked to the long term health of Long Island's drinking water supply. In the Oyster Bay/Cold Spring Harbor Complex watershed, the primary acquisition priorities include:

- *Route 25A Heritage Area* – 16 parcels totaling 231 acres along Route 25A in the State-designated Long Island North Shore Heritage Area and the Oyster Bay SGPA. Parcels will preserve the history of Long Island's rural past while protecting drinking water for its future.

- *Planting Fields Arboretum Additions* – 21 parcels totaling 606 acres near or adjoining Planting Fields Arboretum State Historic Park in the Oyster Bay SGPA.

- *Tiffany Creek Preserve* – 18 parcels totaling 221 acres in the Oyster Bay SGPA. Two water district wells are located in project area, as well as spring fed ponds and streams, old growth woods, migratory songbirds, several turtle species and tiger salamanders.

7.2 Future Conditions

7.2.1 Watershed Buildout Analysis

A watershed buildout analysis was conducted to estimate future potential land use and impervious cover conditions in the watershed as a result of maximum development allowed by current zoning.

Land Use

Existing undeveloped land that could be developed in the future (i.e. "developable" land) is shown in *Figure 7-9*. Land designated as "Potential New Development" in *Figure 7-9* includes parcels in the Town of Oyster Bay that are designated as "Vacant Land." There is little vacant land remaining in the Town of Huntington, and no significant vacant parcels in the Huntington portion of the watershed. Areas identified as protected open space, as well as areas identified as having "Recreation and Entertainment" land use, were excluded from the analysis. Isolated fragments of land or parcels less than ¼-acre in size were also excluded. Potentially developable parcels were verified by Friends of the Bay using local knowledge of parcels that are unlikely to be developed and land designated as protected open space. The developable land in the watershed is primarily forested.

As indicated in *Table 7-6*, the harbor complex watershed is largely built-out. There are relatively few vacant, undeveloped parcels that are not either protected open space or recreational open space that is likely to be developed in the future. Overall, less than 3% of the watershed area has the potential for new development. The actual amount of land in the watershed that is subject to future development is likely even less since development on these parcels would be restricted by wetlands, steep slopes, and other physical factors, as well as maximum lot coverage, setbacks, and other zoning constraints. Most significant future development will most likely occur as infill or redevelopment.

Figur 7-9

Table 7-6. Potential Developable Land

Subwatershed Name	Potential New Development (acres)	New Development Percent of Subwatershed
Bailey Arboretum	25	4.8%
Beaver Brook	97	2.0%
Centre Island	39	5.1%
Cold Spring Brook	3	0.0%
Cold Spring Harbor	25	0.8%
Kentuck Brook	40	2.6%
Lloyd Neck	0	0.0%
Mill Neck Creek	9	0.9%
Mill River	141	6.5%
Oyster Bay Harbor	128	7.9%
Tiffany Creek	77	4.0%
Upper Kentuck Brook	0	0.0%
Upper White's Creek	4	0.3%
White's Creek	8	2.7%
Harbor Complex Watershed	**596**	**2.4%**

Impervious Cover

The watershed buildout analysis was used in conjunction with the existing conditions impervious cover analysis (Section 7.1.4) to estimate future impervious cover in the harbor complex watershed. For this analysis, impervious cover was included as a parameter in the pollutant loading model described in Section 8.1. Each urban land use type was assigned an impervious cover coefficient based on literature values (see Table 2 in *Appendix A*). Land use data for both existing and buildout conditions were then entered into the model to determine the change in impervious cover for each subwatershed. The predicted change in impervious cover was then added to the existing impervious cover estimates described in Section 7.1.3 to estimate future impervious cover.

Table 7-7 presents estimates of existing and future impervious cover by subwatershed. The shaded cells in the table highlight the subwatersheds in which future impervious cover is predicted to approach or exceed the "impacted" (10%) threshold value as described by the Impervious Cover Model.

Table 7-7. Percent Impervious Cover – Existing and Future Conditions

Subwatershed	Existing Percent Impervious Cover	Future Percent Impervious Cover	Percent Change ($IC^{future}-IC^{existing}$)
Bailey Arboretum	4.6%	6.9%	2.3%
Beaver Brook	8.0%	8.7%	0.7%
Centre Island	10.0%	12.1%	2.1%
Cold Spring Brook	16.4%	16.4%	0.0%
Cold Spring Harbor	9.6%	10.0%	0.4%
Kentuck Brook	18.5%	20.0%	1.5%
Lloyd Neck	4.4%	4.4%	0.0%
Mill Neck Creek	19.1%	19.6%	0.5%
Mill River	10.5%	13.4%	2.9%
Oyster Bay Harbor	14.1%	17.6%	3.5%
Tiffany Creek	8.6%	10.4%	1.8%

Table 7-7. Percent Impervious Cover – Existing and Future Conditions

Upper Kentuck Brook	11.9%	11.9%	0.0%
Upper White's Creek	15.8%	16.0%	0.2%
White's Creek	43.3%	45.3%	2.0%
Harbor Complex Watershed	**12.3%**	**13.6%**	**1.3%**

Based on this analysis, the impervious cover in the overall harbor complex watershed is predicted to increase from 12.3% to 13.6%, but remain well below the ICM non-supporting threshold of 25%. The Cold Spring Harbor and Tiffany Creek subwatersheds are predicted to increase from slightly less than 10% impervious cover to meet or slightly exceed the 10% threshold where ecological impacts become apparent (see *Figure 7-5*). The largest relative change in impervious cover is predicted in the Oyster Bay Harbor subwatershed, where imperviousness could increase from approximately 14.1% to 17.6%.

Another useful metric was developed by Goetz et al. (2003) for the Chesapeake Bay region, which combines subwatershed impervious cover and tree cover within the 100-foot riparian area along streams and other watercourses. The harbor complex subwatersheds were analyzed with regard to the combined impervious cover/riparian zone metric, which is summarized in the following matrix by Goetz et al. (2003).

Stream Health	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Riparian Zone
Excellent	< = 6%	>=65%
Good	6-10%	60-65%
Fair	10-25%	40-60%
Poor	> 25%	<40%

Natural vegetation was determined using the CLEAR land cover data and included the deciduous forest, coniferous forest, forested wetland, and non-forested wetland categories. A 100-foot riparian area was considered on both sides of mapped streams and around Beaver Pond, Mill Pond, and St. John's Pond. The following table presents the results from the combined impervious cover/riparian zone metric. Centre Island, Cold Spring Harbor, Lloyd Neck, Mill Neck Creek, Oyster Bay Harbor, Upper Kentuck Brook, and Upper White's Creek are not included in the table since these subwatersheds do not contain well-defined, mapped streams.

Table 7-8. Existing Impervious Cover/Riparian Zone Metric

Subwatershed	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Riparian Zone
Bailey Arboretum	4.6%	63%
Beaver Brook	8.0%	61%
Cold Spring Brook	16.4%	82%
Kentuck Brook	18.5%	62%
Mill River	10.5%	62%
Tiffany Creek	8.6%	71%
White's Creek	43.3%	30%

Overall, most of the harbor complex subwatersheds evaluated are currently categorized as "good" to "excellent" based on the riparian zone metric published by Goetz et al. (2003). White's Creek falls into the "poor" category, with approximately 30% natural vegetation in the 100-foot stream buffer. The segment of the stream in the subwatershed is approximately 360 feet long and the Oyster Bay Sewage Treatment Plant is on the western bank of the stream, with a forested area along the western bank. Future conditions were not evaluated since there is no significant undeveloped land within the 100-foot riparian zone.

8 Pollutant Loading

A pollutant loading model was developed using the land use/land cover data described in Section 7.0. The model was used to compare existing nonpoint source (NPS) pollutant loads from the watershed to projected future pollutant loads that would occur under a watershed buildout scenario. It is important to note that the results of this screening-level analysis are intended for the purposes of comparing existing and future conditions and not to predict future water quality. This section summarizes the methods and results of the analysis, which are presented in greater detail in *Appendix A*.

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.0, was used for this analysis. This model was developed for US EPA by Tetra Tech in EPA Region 5 and has since been modified for use in other areas. The model calculates watershed pollutant loads for sediment and nutrients based on land use-related pollutant sources, including urban runoff, septic system failures, stream bank erosion, and agricultural activities. The model also allows simulation of best management practices (BMPs) and Low Impact Development (LID) techniques to reduce pollutant loads.

Data obtained as part of the Land Use/Land Cover analysis presented in Section 7.0 were used to generate model inputs. Several other model parameters were specified for each pollutant and subwatershed, including:

- Event Mean Concentrations (EMCs), which are literature values for the mean concentration of a pollutant in stormwater runoff for each land use, and
- Curve Number (CN), which is a measure of the runoff potential of the land surface and is a function of soil type, cover condition, and slope.

The model was applied to each subwatershed to estimate annual pollutant loads under existing and future land use scenarios, as described in Section 7.0. The existing and future pollutant loads were compared to assess anticipated changes in loads for each subwatershed. The area draining to existing recharge basins (see *Figure 6-4* for areas in the watershed that currently drain to a recharge basin) was excluded from the pollutant loading analysis since the recharge basins effectively infiltrate and provide treatment for the water quality volume, thereby eliminating pollutant loads to surface waters. The recharge basin drainage areas were determined based on mapping available from the Nassau County subwatershed stormwater management reports, where available, and the Nassau County Department of Public Works.

Because the study subwatersheds vary in size, pollutant loads were also evaluated in terms of loading rates (i.e., pollutant loads per acre of land area, as shown in *Table 8-1*). A higher loading rate indicates relatively greater pollutant sources per unit area, which suggests that implementation of best management practices (BMPs) in these areas would be more effective in reducing pollutant loads. The results in *Table 8-1* indicate that pollutant loading rates are relatively uniform across many of the subwatersheds. The highest loading rates for nitrogen, phosphorus and sediment are associated with the White's Creek, Mill Neck Creek, Centre Island, and Cold Spring Harbor subwatersheds.

As discussed previously, pollutant loads and loading rates are also correlated with the amount of area within a subwatershed that is served by recharge basins. For example, the Kentuck Brook and Tiffany Creek subwatersheds are characterized by high density residential, commercial, and institutional land use, but a large percentage of the stormwater runoff from these subwatersheds is captured and infiltrated in recharge basins (65% and 31% respectively). Consequently, these subwatersheds have lower pollutant loading rates than the Mill Neck Creek and Cold Spring Harbor subwatersheds, for example, in which little or none of the drainage area is currently served by recharge basins.

Table 8-1. Existing Pollutant Loads and Loading Rates

Subwatershed	% Area to Recharge Basins	N	P	Sediment	N	P	Sediment
		lb/yr	lb/yr	ton/yr	lb/ac-yr	lb/ac-yr	ton/ac-yr
Cold Spring Brook (4,851 ac)	39%	17,479	3,113	324	3.6	0.6	0.07
Cold Spring Harbor (2,953 ac)	0%	16,476	2,834	314	5.6	1.0	0.11
Beaver Brook (4,862 ac)	31%	14,789	2,677	269	3.0	0.6	0.06
Oyster Bay Harbor (1,612 ac)	2%	8,769	1,494	173	5.4	0.9	0.11
Mill Neck Creek (968 ac)	5%	8,491	1,765	132	8.8	1.8	0.14
Mill River (2,175 ac)	17%	7,796	1,494	140	3.6	0.7	0.06
Tiffany Creek (1,923 ac)	31%	7,670	1,386	137	4.0	0.7	0.07
Kentuck Brook (1,538 ac)	65%	5,942	1,483	71	3.9	1.0	0.05
Centre Island (762 ac)	0%	4,307	799	78	5.7	1.0	0.10
Lloyd Neck (894 ac)	0%	3,661	697	69	4.1	0.8	0.08
Bailey Arboretum (527 ac)	5%	2,929	504	53	5.6	1.0	0.10
White's Creek (292 ac)	0%	2,814	436	61	9.6	1.5	0.21
Upper White's Creek (1,317 ac)	100%	1,155	452	0	0.9	0.3	0.00
Upper Kentuck Brook (451 ac)	100%	295	115	0	0.7	0.3	0.00

- *White's Creek* – Although the White's Creek subwatersheds is the smallest in the study area, it is characterized by the dense residential and highest percent composition of commercial (18.4%) and industrial (2.2%) land uses in the watershed. For comparison, the next highest percentage of commercial land use is Cold Spring Brook with only 3.8% of the total subwatershed area. Transportation and other land uses are in comparable proportions to other subwatersheds in Oyster Bay. White's Creek does not contain any recharge basins, and is therefore characterized by high pollutant loading rates.

- *Mill Neck Creek* – Mill Neck Creek is characterized by both relatively high total pollutant loads and pollutant loading rates due to a high proportion of dense residential land use (42.8%). Other land uses are similar to other subwatershed areas. A major factor contributing the high pollutant loading rates in this subwatershed is that only 2 recharge basins are present in the watershed, with only 5% of the total area treated through recharge basins.

- *Centre Island* – Centre Island is characterized by rural residential land uses and no recharge basins within the subwatershed. The high loading rates for nitrogen and phosphorus are due to the septic systems.

- *Cold Spring Harbor and Oyster Bay Harbvor* – Cold Spring Harbor and Oyster Bay Harbor are moderately-sized subwatersheds in which stormwater is conveyed to the harbor complex through stormwater collection systems and overland flow. These coastal areas are heavily developed, and only very small portions of these subwatersheds are served by recharge basins. Consequently, existing pollutant loads and loading rates for these subwatersheds are relatively high.

Table 8-2 presents the results of the future pollutant loading analysis under the watershed buildout scenario described in Section 7. Results are shown in terms of increase in pollutant loading rate (the mass of pollutants discharged per contributing acre of land on an annual basis) and percent increase in pollutant load (based on the total pollutant discharge from each of the subwatersheds).

Table 8-2. Projected Future Pollutant Loading Rates and Load Increases

Subwatershed	Projected Future Loading Rate			Projected Load Increase		
	N	P	Sediment	N	P	Sediment
	lb/ac-yr	lb/ac-yr	lb/ac-yr	lb/yr	lb/yr	ton/yr
Bailey Arboretum (527 ac)	5.8	0.99	0.107	5%	4%	6%
Beaver Brook (4,862 ac)	3.1	0.56	0.057	3%	2%	3%
Centre Island (762 ac)	5.9	1.09	0.109	5%	4%	6%
Cold Spring Brook 4,851 ac)	3.6	0.64	0.067	0%	0%	0%
Cold Spring Harbor (2,953 ac)	5.6	0.97	0.107	1%	1%	1%
Kentuck Brook (1,538 ac)	4.1	0.99	0.051	5%	3%	9%
Lloyd Neck (894 ac)	4.1	0.78	0.077	0%	0%	0%
Mill Neck Creek (968 ac)	8.8	1.83	0.137	1%	0%	1%
Mill River (2,175 ac)	3.9	0.73	0.072	10%	7%	11%
Oyster Bay Harbor (1,612 ac)	5.9	0.99	0.117	8%	7%	9%
Tiffany Creek (1,923 ac)	4.2	0.75	0.076	6%	4%	7%
Upper Kentuck Brook (451 ac)	0.7	0.26	0.000	0%	0%	0%
Upper White's Creek (1,317 ac)	0.9	0.34	0.000	0%	0%	0%
White's Creek (292 ac)	9.9	1.53	0.214	3%	3%	3%

Several of the subwatersheds are predicted to experience significantly higher increases in pollutant loads and loading rates under a watershed buildout scenario. These include Tiffany Creek, Mill River, Oyster Bay Harbor, and Kentuck Brook watersheds. The build-out conditions of the Mill River and Oyster Bay Harbor subwatersheds are projected to result in greater than 5% increase in pollutant loading rates for nitrogen, phosphorus and sediment loads. The increase in urban land use with a corresponding decrease in forest, with a proportion of the new urban land is likely to consist of new residential and industrial development. The increase in pollutant loads is the future is relatively small across the watershed because there is little opportunity for redevelopment in existing residential areas and for development in forested or vacant areas.

9 Comparative Subwatershed Analysis

A Comparative Subwatershed Analysis was performed for the Oyster Bay/Cold Spring Harbor subwatersheds to identify the subwatersheds with the greatest restoration potential. Subwatershed "metrics" were used to conduct this analysis. Metrics are numeric values that characterize the relative restoration potential of a subwatershed. The results of this analysis are used to prioritize field assessment efforts in future phases of this study and to guide plan recommendations.

The analysis involves a screening level evaluation of selected subwatershed metrics that are derived by analyzing available GIS layers and other subwatershed data sources. The basic approach used to conduct the Comparative Subwatershed Analysis consisted of:

1. Delineation of subwatershed boundaries and review of available metric data.
2. Selection and calculation of metrics that best describe subwatershed restoration potential.
3. Developing weighting and scoring rules to assign points to each metric.
4. Computing aggregate scores and developing initial subwatershed rankings.

Subwatersheds with higher aggregate "restoration potential" scores are more likely to have been impacted and have greater potential for restoration to improve upon existing conditions. This approach enables watershed planners to allocate limited resources on subwatershed where restoration and conservation efforts have the greatest chances of success. The subwatersheds used in this analysis are those identified in Section 5.1 of this document.

9.1 Analysis Methods and Results

The metrics for the Comparative Subwatershed Analysis are presented in *Table 9-1*. Ten metrics were evaluated for each subwatershed and points were assigned for the relative restoration potential indicated by the metric. All metrics were scored between 1 and 10, with 1 indicating the lowest potential for restoration and 10 indicating the highest potential for restoration. The scores for each of the 10 metrics were then added to arrive at a composite score for each subwatershed. The total number of points possible for each subwatershed is 100.

The results of the Comparative Subwatershed Analysis are summarized in *Table 9-2*. The restoration potential scores ranged from 20 to 54 points out of a possible 100. The highlighting identifies subwatersheds with high (orange), moderate (yellow), and low (green) restoration potential in the harbor complex watershed.

Table 9-1. Comparative Subwatershed Analysis Restoration Potential Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Restoration Potential When	Metric Points
1. Existing Impervious Cover	% impervious cover in subwatershed	Current impervious cover is low, suggesting range of possible sites for storage retrofits and stream repairs	<10% = 10pts; 10 to 25% = 7 pts; 26 to 40 = 5 pts; 41 to 60% = 3 pts; > 60% = 1 pts
2. Forest Cover	% forest cover in subwatershed	Forest cover is low, suggesting potential for upland and riparian reforestation	<20% = 10 pts; 21 to 30% = 7 pts; 31 to 40% = 5 pts 41 to 60% = 3 pts, >60 % = 1 pt
3. Recharge Basin Drainage Area	% drainage area	Recharge basin drainage area is low, subwatersheds with smaller proportion of area served by recharge basins are better candidates for stormwater retrofits	One pt for each 10% below 100%
4. Publicly-owned land	% of subwatershed that is publicly owned	Public land ownership is high, providing range of potential sites for restoration practices	Award 1 pt for each 2.5% of subwatershed in public ownership (up to 10 pts)
5. Residential Land	% of subwatershed residential land use	residential land is high, suggests strong feasibility for neighborhood source control, on-site retrofits and upland forestry	Award 1 pt for each 10% residential land use
6. Industrial & Commercial Land	% of subwatershed that is industrial or commercial land	Industrial/Commercial land is high, suggesting potential for source controls, discharge prevention, and on-site retrofits	Award 1 pt for each 2% of subwatershed classified as industrial or commercial
7. Wetland Area	% of subwatershed that is tidal or freshwater wetlands	Wetland cover is high, suggesting potential for wetland and riparian restoration	Award 1 pt for each 4% of subwatershed area
8. Stream Density	Stream miles / square mile	Stream density is high, suggesting greater feasibility of stream corridor restoration practices	Award 1 pt for each 0.1-mile of stream/sq mi (up to 10 pts)
9 Regulated Site Density	Regulated sites / sq mi. (incl. RCRA, AFS, CERCLIS)	Regulated site density is high, suggests strong potential to implement source controls, discharge prevention and on-site retrofits	0 to 1 sites/sq. mi. = 1 pt; 1 to 2 = 3 pts; 2 to 5 = 5 pts; 5 to 10 = 7 pts; > 10 = 10 pts
10. Developed Areas with Septic	Density (septic systems/acre)	Density of septic systems is high, suggesting greater potential for improvements through septic system upgrades or new sewers	Award 1 pt for each 0.2 septic system per acre in subwatershed

Table 9-2. Results of Comparative Subwatershed Analysis

Subwatershed	1. Current Impervious Cover	2. Forest Cover	3. Recharge Basin Collection Area	4. Publicly-Owned Land	5. Residential Land	6. Industrial & Commercial Land	7. Wetland Area	8. Stream Density	9. Regulated Sites Density	10. Developed Areas Served by Septic	Total
Mill Neck Creek	7	7	10	3	7	0	8	0	3	9	**54**
Bailey Arboretum	10	1	10	4	7	0	1	10	5	2	**50**
Mill River	7	3	8	10	5	1	1	8	5	2	**50**
Cold Spring Brook	7	5	6	10	5	2	1	3	7	3	**49**
White's Creek	3	10	10	1	4	10	0	1	10	0	**49**
Centre Island	7	5	10	5	6	0	10	0	1	2	**46**
Cold Spring Harbor	10	3	10	6	5	1	2	0	5	2	**43**
Lloyd Neck	10	3	10	9	7	0	2	0	0	2	**43**
Oyster Bay Harbor	7	3	10	3	6	1	3	0	7	1	**41**
Kentuck Brook	7	5	3	4	6	1	0	3	5	6	**40**
Beaver Brook	10	3	6	3	6	0	1	3	1	1	**34**
Tiffany Creek	10	1	6	5	6	0	0	4	0	1	**33**
Upper White's Creek	7	5	0	4	6	1	0	0	5	3	**31**
Upper Kentuck Brook	7	3	0	0	8	0	0	0	0	2	**20**

As shown in *Table 9-2*, the following subwatersheds have the highest restoration potential based on the Comparative Subwatershed Analysis scoring system:

- *Mill Neck Creek* – The Mill Neck Creek subwatershed is ranked highest for the wetland and septic system-related metrics. The area of Bayville is densely developed and contains a significant number of on-site septic systems, offering ample opportunities for residential-related retrofits and restoration projects to address pollutant sources. The Mill Neck Creek subwatershed also has a high proportion of tidal wetlands, which provides opportunities for wetland restoration/preservation.

- *Bailey Arboretum* – The Bailey Arboretum subwatershed drains to Mill Neck Creek through a small tributary. The subwatershed is characterized by high impervious cover and residential development. Only 5% of the subwatershed area is served by existing recharge basins, providing opportunities for new stormwater controls.

- *Mill River* – The Mill River subwatershed contains a relatively high percentage of publicly-owned land, including large portions of the Muttontown Preserve and Planting Fields. The Mill River also has a relatively high stream density, suggesting greater feasibility for stream corridor restoration practices.

- *Cold Spring Brook* – The Cold Spring Brook subwatershed ranked favorably for restoration potential in terms of recharge basin density, publicly-owned land, existing impervious cover, and regulated sites. This subwatershed has a relatively low impervious cover, indicating a greater range of potential restoration sites for stormwater retrofits, stream repairs, reforestation, and source control practices. The relatively high density of regulated sites in this watershed, including permitted stormwater dischargers, provides opportunities for source controls, discharge prevention, and on-site retrofits.

- *White's Creek* – The White's Creek subwatershed is a small drainage area characterized by high density residential development, as well as commercial and industrial uses with low forest cover. The subwatershed has a relatively high density of regulated sites, primarily located along South Street. White's Creek is, in effect, hydraulically separated from Upper White's Creek, as Upper White's Creek is almost entirely served by recharge basins. Unlike Upper White's Creek, the White's Creek subwatershed does not contain existing recharge basins, and therefore offers good potential for future stormwater retrofits.

9.2 Subwatersheds Recommended for Field Assessments

The Comparative Subwatershed Analysis results suggest that the subwatersheds identified in the previous section should be the focus of subsequent field assessments. However, a number of previous studies and stream/outfall assessments have already been performed by Nassau County in several of these priority subwatersheds, including Bailey Arboretum, Mill River, and White's Creek, in addition to subwatersheds with lower restoration potential including Beaver Brook (also named Francis Pond), Kentuck Brook, and Tiffany Creek. Subsequent field assessments should focus on those priority subwatersheds where previous studies and field assessments have not yet been performed, thereby providing new information and avoiding duplication of previous work. The results of the field assessments conducted in support of this watershed planning study will be combined with the findings of previous stream/outfall assessments to guide the overall watershed management plan recommendations.

The following subwatersheds are therefore recommended for detailed field assessments (*Figure 9-1*), potentially including stream corridor assessments and restoration inventories (for those areas where a defined stream channel exists), neighborhood source assessments, hotspot site investigations, and street and storm drain assessments:

- Cold Spring Brook,
- Cold Spring Harbor,
- Oyster Bay Harbor,

Figure 9-1

- Mill Neck Creek,
- Centre Island,
- Lloyd Neck.

Limited upland assessments focusing on neighborhoods, hotspots, and streets/storm drains (rather than the stream corridor and stormwater outfalls along the stream corridor) are also recommended in selected areas of those subwatersheds that were previously studied by Nassau County. Detailed field assessments are not recommended for the Upper White's Creek or Upper Kentuck Brook subwatersheds since these areas are self-contained (i.e., the areas drain to existing recharge basins).

10 Watershed Field Assessments

Field inventories were performed by Fuss & O'Neill during summer 2009 to further assess existing watershed conditions and potential sources of pollution. The field inventories are a screening level tool for locating potential pollutant sources and environmental problems in a watershed along with possible locations where restoration opportunities and mitigation measures can be implemented. Similar field inventories were conducted by Cashin Associates in 2007 as part of a series of stormwater investigation reports developed for Nassau County in the Bailey Arboretum, Kentuck Brook, Francis Pond (Beaver Brook), Mill River, White's Creek, and Tiffany Creek subwatersheds. The 2007 field inventories primarily focused on the stream corridors and did not include upland assessments. However, retrofit opportunities were identified in the subwatersheds where field inventories were conducted. The field inventories conducted by Fuss & O'Neill during the summer of 2009 focused on subwatersheds that were not previously investigated, and were prioritized based on the Comparative Subwatershed Analysis presented in Section 9 of this report. This section integrates the findings of both the 2007 and 2009 subwatershed field assessments.

The stream corridor assessment procedure used in this study is adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection's Unified Stream Assessment (USA) method (CWP, 2005). Upland areas and activities that may impact stream quality were also assessed using methods adapted from the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance (USSR) techniques (CWP, 2005). The upland assessments included inventories of selected representative residential neighborhoods, streets and storm drainage systems, and land uses with higher potential pollutant loads (i.e., "hotspot" land uses). Field assessment efforts were targeted on stream segments and upland areas with the greatest potential for direct impacts to streams and the harbor complex. These areas were identified through aerial and land use mapping. To the extent possible, efforts were also focused on publicly-owned land, which typically offers greater opportunities for retrofits and mitigation projects as opposed to privately-owned land. Potential retrofit opportunities were identified during the upland assessments, and preliminary sketches of structural retrofits were documented for use in the Watershed Action Plan.

During the field inventories, crews assessed approximately 1.2 miles of stream corridors, eight potential hotspot locations, nine representative residential neighborhoods, and a number of streets and storm drainage systems associated with the residential neighborhoods and hotspot land uses. Field inventory nomenclature used throughout this report is summarized in *Table 10-1*. Copies of completed field assessment forms are provided in *Appendix B*. Photographs of specific or representative pollutant sources and problem areas are included throughout this document for illustrative purposes. All of the photographs taken during the field inventories are included on a CD in *Appendix B*.

Table 10-1. Field Inventory Nomenclature

Bailey Arboretum	BAI
Beaver Brook	BEA
Centre Island	CTR
Cold Spring Brook	CSB
Cold Spring Harbor	CSH

Table 10-1. Field Inventory Nomenclature

Kentuck Brook	KBR
Lloyd Neck	LNK
Mill Neck Creek	MNC
Mill River	MRV
Oyster Bay Harbor	OBH
Tiffany Creek	TFY
White's Creek	WCR
Reach Level Assessment	RCH
Channel Modification	CM
Severe Bank Erosion	ER
Impacted Buffer	IB
Stormwater Outfall	OT
Stream Crossing	SC
Trash & Debris	TB
Utilities	UT
Hotspot Investigation	HSI
Neighborhood Site Assessment	NSA
Streets and Storm Drains	SSD
Retrofit Reconnaissance Inventory	RRI

10.1 Summary of Findings

A variety of conditions and issues were identified during the 2007 and 2009 subwatershed field assessments. Key findings, including some common issues throughout the watershed, are described below. These findings, along with other information presented in this baseline assessment report, will help guide the recommendations of the watershed management plan for the harbor complex.

- Overall in-stream habitat in the assessed reaches was mixed. Some of the assessed reaches have high quality habitat, with riparian cover, good floodplain connection, varied substrate, and significant stream shading (e.g., Bailey Arboretum, Kentuck Brook, and the middle segments of Cold Spring Brook). In other segments, even within the same subwatershed, in-stream habitat is marginal to poor due to bank erosion, buffer encroachment, trash and debris, lack of shading, and in-stream sedimentation (much of White's Creek, portions of Mill River, and the lower reach of Cold Spring Brook). However, many of the stream reaches assessed appear to be either supporting biological communities (fish, frogs, birds, etc.) or sufficient to support such communities.

- Many potential barriers to fish passage were observed throughout the watershed, including perched culverts, culverts with very shallow flow, and natural and manmade dams. The impacts of these obstructions on fish passage and the feasibility of fish barrier removal efforts in the harbor complex watershed are currently being investigated through a study led by the Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay.

- Segments of some streams in the watershed are buried in underground conduits, resulting from historical development and past storm drainage practices. These stream reaches offer potential opportunities for daylighting and stream restoration to enhance aquatic and wildlife habitat, improve aesthetics, and provide educational opportunities. Potential candidates for daylighting include segments of White's Creek and Beekman Creek.

- Stream buffer encroachments are prevalent along stream corridors in or near areas of residential, commercial, and industrial development and roads. Residential lawns and some commercial lawns extend down to the banks of the stream in many areas, particularly in residential back yards. Yard waste such as grass clippings, leaves, and brush and waste materials were also common occurrences in and near these areas where easy access exists to the streams. Education, signage, stream buffer regulations, and stream cleanups are potential approaches for improving buffer management.

- Residential roofs appear to contribute significant quantities of stormwater runoff to the storm drainage system, particularly in residential neighborhoods with smaller yards and lots with a high percentage of impervious cover. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

- Lawn-care maintenance practices in residential areas are typically high. Manicured lawns are common in residential areas, suggesting the prevalent use of fertilizer and other lawn care products, as well as permanent irrigation systems. Opportunities exist to educate the public about the impacts of lawn care practices on the water quality of the harbor complex and to encourage the use of residential lawn care best management practices, with the objective of reducing excess fertilizer runoff and the overall quantity of runoff from residential lawns.

- Parking lots associated with existing commercial development, municipal and institutional land uses, and commuter parking areas are potential candidates for stormwater retrofits to reduce site runoff and improve water quality through the use of bioretention, water quality swales, buffer strips/level spreaders, and other small-scale Low Impact Development (LID) and green infrastructure approaches. Candidate stormwater retrofit sites exist in virtually all of the assessed subwatersheds but are most prevalent in Mill River, Tiffany Creek, White's Creek, Mill Neck Creek, and Oyster Bay Harbor.

- The field assessments identified many areas in the watershed where storm drains are stenciled or watershed stewardship signage exists. Storm drain stenciling and/or stewardship signage could be expanded to other areas of the watershed, targeting commercial areas such as the Pine Hollow Shopping Complex and additional residential subdivisions including those along Harbor Road in Huntington and along Hernan Avenue in Bayville. Interpretive educational signage is also recommended in key public areas of the watershed.

- Stormwater recharge basins are prevalent in many areas of the watershed. Recharge basins are designed to capture and infiltrate stormwater, thereby replenishing groundwater aquifers and reducing the quantity of runoff that is discharged directly to surface receiving waters. Drainage areas that are served by existing recharge basin are believed to be self-contained by infiltrating their entire design volume. However, several of the basins maintained by Nassau County and the Town of Oyster Bay are overgrown and have a large amount of accumulated sediment and/or standing water, and a few are completely full. Their performance may be compromised as a result of the accumulated sediment and reduced storage volume and infiltration capacity. Routine sediment removal and other maintenance measures are recommended for the recharge basins.

- Most of the developed areas surveyed have inadequate stormwater quality controls. Many of the residential developments were constructed prior to the advent of modern stormwater quality regulations and design requirements. Therefore, most of the development observed in the watershed employs traditional curb and gutter storm drainage collection systems with little, if any, stormwater management beyond water quality inlets and detention basins for peak flow control.

- Stormwater runoff from areas that are not served by recharge basins generally receives little or no treatment prior to discharge. Such discharges are a source of sediment, pathogens, nutrients, and other pollutants to the receiving streams and the harbor complex. Opportunities exist for stormwater retrofits at roadway stormwater outfalls throughout the watershed. A number of roadway outfall retrofit candidates were identified in the Bailey Arboretum, Beaver Brook, Kentuck Brook, Mill River, and White's Creek.

- Roosevelt Memorial Park is one of the few areas in the watershed where Low Impact Development (LID) design practices were observed. The stormwater management features that were incorporated into this redevelopment project exemplify the type of stormwater controls that could be promoted throughout the watershed. Local LID demonstration sites are a valuable tool for public education and promoting the widespread use of such practices. The incorporation of LID into town and county projects, parks, and municipal buildings can also serve as a proactive model for private development. Opportunities also exist for incorporating LID practices into existing roadway upgrades and retrofit projects (i.e., "green streets") to promote stormwater infiltration, streetscape improvements, and traffic calming.

- Relatively isolated areas of moderate to severe streambank erosion were observed along Beaver Brook, Mill River, Cold Spring Brook, Tiffany Brook, and White's Creek. Most of these areas are located at or downstream of stormwater outfalls in developed areas of the watershed. Access to some of these areas is limited; therefore, potential candidate sites for bank stabilization projects should be evaluated further for overall feasibility.

- Hotspot land uses and facilities were observed throughout the watershed, including several commercial shopping centers, the Town of Oyster Bay highway yard, the LIRR Maintenance Yard, Commander Oil Terminal, and municipal parking lots. Many of these facilities discharge stormwater directly to receiving waters with no treatment or attenuation. Pollution prevention and source controls are often lacking or nonexistent at these facilities.

The following sections present a more detailed discussion of the stream corridor and upland assessment methods and findings.

10.2 Stream Corridor Assessment

Stream corridors along Cold Spring Brook were assessed by Fuss & O'Neill during August 24 through 27, 2009 using methods adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection's Unified Stream Assessment (USA) (CWP, 2005). Stream assessments were not performed on other priority subwatersheds since similar assessments were recently performed in these subwatersheds in 2007.

The method used for the 2009 stream assessments is a continuous stream walk method that identifies and evaluates the following impact conditions:

- Outfalls (OT), including stormwater and other manmade point discharges;
- Severe Bank Erosion (ER), such as bank sloughing, active widening, and incision;
- Impacted Buffer (IB), which is a narrowing or lack of natural vegetation;
- Utilities in the stream corridor (UT), such as leaking or exposed pipes;
- Trash and Debris (TR), such as drums, yard waste, and other illegal dumping;
- Stream Crossings (SC), which are hard objects, whether natural or artificial, that restrict or constrain the flow of water. These may include bridges, culverts, dams, and falls;
- Channel Modification (CM), where the stream bottom, banks, or direction have been modified;
- Miscellaneous (MI), other impacts or features not otherwise covered; and
- Reach Level Assessment (RCH), the average characteristics of each reach.

The stream assessment method also includes a semi-quantitative scoring system as part of the reach level assessment to evaluate the overall condition of the stream, riparian buffer, and floodplain, based on a consideration of in-stream habitat, vegetative protection, bank erosion, floodplain connection, vegetated buffer width, floodplain vegetation and habitat, and floodplain encroachment.

Stream assessments were performed by Cashin Associates in 2007 for the Nassau County Stormwater Management Program for the Bailey Arboretum, Francis Pond (Beaver Brook), Kentuck Brook, Mill River, Tiffany Creek and White's Creek subwatersheds. These subwatershed stormwater runoff impact investigations were performed to assess subwatershed conditions and identify stormwater retrofit opportunities to improve water quality. The 2007 stream assessments were performed using the Center for Watershed Protection's USA methods.

Six stream reaches were evaluated by Fuss & O'Neill in 2009 and 14 as part of the Nassau County subwatershed stormwater runoff impact investigations in 2007. *Table 10-2* summarizes the number of reach level assessments that were performed and the number of impact conditions that were identified. Stream assessments were not performed along Upper Kentuck Brook and Upper White's Creek since these subwatersheds drain to existing recharge basins.

Table 10-2. Number of Reach Level Assessments Performed and Impact Conditions Identified

Subwatershed [1]	RCH	CM	ER	MI	IB	OT	SC	TR	UT
Bailey Arboretum	1	-	-	-	-	5	-	-	-
Beaver Brook	3	-	-	1	-	16	-	-	-
Cold Spring Brook [2]	6	3	-	-	1	7	10	3	-
Kentuck Brook	1	-	-	1	-	13	-	-	-
Mill River	5	1	1	3	1	21	13	-	1
Tiffany Creek	2	-	-	2	-	7	-	-	-
White's Creek	2	1	-	-	2	6	4	1	-

[1]Subwatersheds without a well-defined stream are not included in the table.
[2]Field surveys conducted by Fuss & O'Neill in 2009; streams associated with the other subwatersheds listed in the table were conducted in 2007 by Nassau County.

10.2.1 2009 Stream Assessments

The primary objective of the 2009 stream assessments of Cold Spring Brook was to quantify the overall condition of stream corridors in Cold Spring Brook and identify opportunities for stream restoration, stormwater retrofits, land preservation, and other stewardship recommendations.

Reach level assessment scores were assigned by field crews based upon the overall condition of the stream, stream buffer, and floodplain. A subjective determination of eight criteria is assessed on a scale of 0 to 20; 0 relating to poor conditions and 20 being optimal conditions. The total of these scores provides a quantitative index of overall stream health and condition. The maximum possible number of points that would be assigned for a fully optimal stream reach is 160 points. *Table 10-3* summarizes the total scores and associated ranks for the assessed stream reaches along Cold Spring Brook.

Table 10-3. Cold Spring Brook Overall Stream Reach Scores

Reach	Instream Habitat Score	Buffer Zone and Floodplain Score	Total Score	Rank
CSB-01	54	38	92	4
CSB-02	68	67	135	1
CSB-03	70	72	142	2
CSB-04	46	48	94	3
CSB-05	38	20	58	6
CSB-06	42	43	85	5

As depicted in the photographs in *Figure 10-1*, CSB-03 is the highest rated stream reach due to a wide vegetative buffer, adequate riparian cover, and good instream habitat. In contrast, CSB-05 has the lowest total score due to channel modification along the entire reach, the lack of canopy cover, poor instream habitat due to uniform channel properties, and limited stream buffer due to the proximity of Harbor Road.

Figure 10-1. Photographs of Cold Spring Brook Stream Reaches

The following sections summarize the major issues identified during the 2009 stream assessment of Cold Spring Brook. Specific locations are identified according to the stream reach and impact condition IDs described previously. Identification of "right" and "left" stream banks is from the observer's perspective facing downstream. Stream reaches were assigned a subwatershed abbreviation followed by a two-digit numerical identifier. Reaches were generally numbered sequentially from downstream to upstream. A reach was considered to be a stream segment with relatively consistent geomorphology and surrounding land use, and generally less than one-half mile in length. Features noted at reach junctions (e.g., culvert crossings) were associated with the downstream reach. Impact conditions within each reach were numbered sequentially with an abbreviation followed by a two-digit number. For example, the second stream crossing in a reach would have the identifier SC-02.

Cold Spring Brook

Cold Spring Brook originates in a forested area northeast of the Cold Spring Harbor MTA commuter train station parking lot and flows in a northerly direction generally parallel to Harbor Road, eventually discharging downstream of the Route 25A overpass into Cold Spring Harbor. Franklin Pond and St. John's Pond are large ponds inline with the stream channel created by man-made impoundments. Cold Spring Brook is divided into six stream reaches, labeled CSB-01 through CSB-06 (*Figure 1; Appendix B*). All six reaches were assessed on August 24, 2009. The reaches are described beginning at the mouth of the stream and moving upstream to the headwaters.

CSB-01
Stream reach CSB-01 begins in a tidal marsh at the mouth of Cold Spring Brook and continues upstream under Route 25A, past the Cold Spring Harbor Fish Hatchery, and ends at the St. John's Pond dam.

- RCH – The overall stream conditions are suboptimal due to a lack of stable in-stream habitat, protective vegetation and some evidence of non-native vegetation in the upland areas. There is suboptimal connection to the floodplain in the upper portion of the reach due to the area of impacted buffer caused by a deck, a large pool downstream of the St. John's Pond dam spillway, and other impacts on the fish hatchery property. The overall buffer and floodplain condition is marginal due to a narrow vegetated buffer of approximately 15 feet on the left bank and slightly wider on the right bank, possibly 40 feet or greater. The floodplain is highly impacted in the vicinity of the Route 25A overpass. The floodplain vegetation is dominated by shrub and wetland plants. The tidal wetlands downstream of the Route 25A stream crossing are minimally impacted.

- OT – There are six outfalls along this reach. The first, OT-01, is a circular, 24-inch diameter concrete pipe embedded in the concrete abutment wall associated with the St. John's Pond dam. The pipe had a small dry-weather flow and some orange staining, although is likely caused by iron in the groundwater and is therefore not recommended for further investigation or retrofit. OT-02 and OT-03 are twin 6-inch metal pipes on the left bank, possibly associated with stormwater drainage from the fish hatchery property. The pipes are in fair condition, with some chips and cracking. OT-04 is a 14-inch circular clay pipe on the left bank discharging water from the fish hatchery, with moderate dry-weather flow. The discharge is clear and does not have a detectable odor. OT-05 and OT-06 are 18-inch concrete pipes located near the Route 25A overpass, one on the left bank and the other on the right bank, and are associated with stormwater outfalls from the roadway. A substantial dry-weather discharge was observed. However, the source could not be determined in the field and further investigation should be conducted to determine the source.

- SC – There are three stream crossings along the reach. SC-01 is the St. John's Pond dam at the upstream end of the reach. This dam is approximately 15 feet wide and 20 feet high and is a physical barrier to fish passage. Downstream of the dam is a plunge pool that collects and slows the water from the dam spillway. A concrete broad-crested weir approximately 2 feet in height (SC-02) was constructed approximately 25 feet downstream of the spillway to create the plunge pool. SC-03 is a twin box culvert beneath the Route 25A overpass. Each culvert is approximately 12 feet wide, 6 feet deep, and has a concrete bottom. The flow in both culverts was shallow (approximately 3 inches deep), which may impede fish passage under low-flow conditions.


SC-03 is a twin box culvert beneath Route 25A along reach CSB-01.

- IB – One area of impacted buffer is present on the left bank where a deck of approximately 15 feet in length was installed on the fish hatchery property. The deck was constructed to overhang the stream by approximately 2 to 4 feet.


Impacted buffer along reach CBS-01 near the Cold Spring Fish Hatchery property.

CSB-02

Stream reach CSB-02 begins at the outlet structure of the Franklin Pond dam and continues downstream to the inlet to St. John's Pond. A portion of the reach is within the Nature Conservancy's Franklin Pond Preserve, and the remaining portions are on private lands.

- RCH – The stream reach is of high quality and is characterized by wide stream buffers, a connected floodplain as evidenced by a large adjacent are of wetland seeps, and extensive canopy cover. The stream reach has optimal instream habitat characterized by submerged logs, shaded areas, large woody debris in the channel, and over 90% of the streambank shaded by native trees. The vegetated buffer width exceeds 50 feet along the main stream channel with little evidence of human impacts. The floodplain area is characterized by a mixture of wetland species and mature forest species.

Reach CSB-02 is a high quality segment, characterized by optimal instream habitat, vegetated buffer, and floodplain connectivity.

- SC – The Franklin Pond dam is the only stream crossing along this reach. The dam is approximately 15 feet wide and the spillway cascades approximately 15 feet from the pond elevation to a downstream pool prior to entering the main stream channel. The dam is a physical barrier to fish passage, although it is an unlikely candidate for removal due to the presence of the St. John's Pond dam downstream and the recreational benefits that Franklin Pond provides.

CSB-03

Stream reach CSB-03 begins at a footbridge that crosses the stream connecting a walking trail adjacent to Harbor Road to the downstream area at the inlet to Franklin Pond, which is primarily a braided channel that flows through a wetland complex.

- RCH – The stream reach flows adjacent to Harbor Road and is generally of optimal quality, with sand and gravel channel substrate and a mostly-shaded stream canopy. There is some evidence of stream widening and sediment deposition, which is consistent with the upstream development. The overall stream conditions are optimal with the exception of instream habitat, which is suboptimal due to lack of woody debris, undercut banks, or non-uniform channel substrate. The streambanks are stable and there is adequate floodplain connectivity along this reach. The vegetated buffer width is greater than 50 feet and there is little evidence of human impacts.

- SC – There are two stream crossings along this reach. SC-01 is a private driveway crossing at 428 Harbor Road constructed of wood beams, concrete and a paved surface. The crossing does not impact potential fish passage or have a large impact on the channel dynamics since the crossing has an open bottom and a natural substrate. The second stream crossing, SC-02, is located at the upstream end of the reach and is a footbridge associated with a trail system through the adjacent wooded area. Consistent with the construction of SC-01, the bottom substrate was left intact, and the footbridge has minimal impact on fish passage.

- TR – Although the reach habitat, stream buffers and floodplain are in optimal condition, the reach is characterized by areas of trash (bottles, cups, and various other household trash) in the stream and on the banks. The relatively minor amount of trash observed could be collected by volunteers with trash bags. This reach is a potential candidate for s stream cleanup.

Evidence of household trash and debris, which was typical along CSB-03.

CSB-04

Stream reach CSB-04 begins at the footbridge stream crossing and continues upstream to a gabion wall constructed across the stream channel for stabilization. The stream channel divides into two channels for approximately 100 feet, although the characteristics of the two channels are similar and are therefore considered part of the same reach.

- RCH – The reach is characterized by sand and gravel substrate, some floating aquatic plants, approximately 50% stream shading, and evidence of active channel dynamics, including downcutting, headcutting, sediment deposition and channelization. The overall instream habitat and buffer and floodplain characteristics are lower compared to stream reaches downstream (CSB-03, CSB-02, and CSB-01). The instream habitat ranges from marginal to suboptimal due to limited vegetative protection, non-native and invasive vegetation growing over the stream channel, and active bank erosion and stream channel dynamics. The vegetative buffer is wider on the left bank and narrower on the right bank. The floodplain habitat is marginal due to a lack of plant species diversity on the streambanks.

- SC – There is one stream crossing along reach SC-01, consisting of a gabion wall constructed across the stream channel at the upstream end of the reach. The gabion wall is approximately 2 feet tall, 6 feet long and 20 feet wide and spans the entire stream channel and banks. The gabion wall appears to have been constructed to prevent active headcutting at the location. Although the headcutting is no longer occurring, a pool exists downstream of the wall and shows signs of active downcutting.

Gabion wall along reach CSB-04

- TR – There are two areas of trash in the stream channel and on the streambanks along this reach. TR-01 is a fallen wire fence that was previously a property marker which is approximately 4 to 5 feet tall and greater than 200 feet long. The second is a trash dumping area (TR-02) consisting of traffic cones and household trash.

CSB-05

This reach is almost entirely channelized and flows from the base of the Cold Spring Harbor MTA parking lot, beneath Woodbury Road and continues along Harbor Road in a channelized roadside ditch, ending at the gabion wall structure, which marks the downstream end of a channelized stream segment.

- RCH – This reach is characterized by cobble and gravel channel substrate reinforced by wire mesh, creating a channelized stream bottom. The channel is a uniform 6 foot width with 4 foot vertical bank walls. Due to the uniform properties of the channel and the roadside location, the instream habitat and vegetative protection are marginal. There is little evidence of bank erosion since gabion walls are securing the banks. There is an approximately 15-foot buffer between the roadway and the channel. The channel has been disconnected from the floodplain by creating vertical retaining walls that serve as the banks of the stream, and the floodplain characteristics are generally marginal to poor.

- CM – The entire channel reach has been modified and can be subdivided into three distinct channel segments, CM-01, CM-02, and CM-03. CM-01 extends from the gabion wall on the downstream end of the reach to an upstream culvert. This segment is approximately 200 feet long, and wire mesh has been placed on the bottom of the stream channel and approximately 10 feet up both banks for stabilization. The bottom width of the stream at this location is approximately 6 feet. CM-02 is a stream segment that is entirely contained in an underground concrete box culvert that conveys the stream beneath Harbor Road. The culvert is approximately 3 feet tall, with an approximately 12-feet wide concrete bottom. CM-03 begins at the upstream end of the culvert where the stream is daylighted and runs to the upstream end of the stream reach, across Woodbury Road. CM-03 is also characterized by a modified channel, with wire mesh used for stabilizing the channel bottom and vertical gabion walls for bank stabilization. The stream channel along this segment is approximately 8 feet wide and is greater than 500 feet long, flowing adjacent to Harbor Road.

Reach CSB-05(CM-03) consists of a modified stream channel with gabion wall banks.

- OT – One outfall, OT-01, is present along this reach, which conveys flow from a mulched area and discharges inside the culvert along CM-02. Although the outfall is approximately 8 feet in diameter, no dry weather flow was observed.

This arched culvert, OT-01, discharges to the box culvert that conveys Cold Spring Brook beneath Harbor Road.

- SC – There are three stream crossings along this reach. SC-01 and SC-02 are box culvert driveway crossings providing access to residences at 511 and 523 Harbor Road. SC-03 is a diagonal road crossing beneath Woodbury Road. At the intersection of Harbor Road and Woodbury Road, the stream flows from a catch basin on the west side of the street with an outlet pipe heading east. The pipe is believed to be connected to the inlet pipe on the opposite side of Woodbury Road, although the connection could not be field verified.

CSB-06
Stream reach CBS-06 is located at the headwaters of Cold Spring Brook. The brook originates in a forested wetland northeast of the MTA railway tracks and parking lot. The stream flows from its headwaters to the inlet structure adjacent to Woodbury Road.

- RCH – The reach is characterized by a sand substrate with some sediment deposition observed. The instream habitat, buffer and floodplain are generally suboptimal to marginal due to the small channel width and impacts from the railway tracks and nearby parking lot.

10.2.2 2007 Stream Assessments

The following sections briefly summarize the findings of the 2007 stream assessments performed by Cashin Associates for the Nassau County Stormwater Management Program. Stream assessments were performed for Bailey Arboretum, Francis Pond (Beaver Brook), Kentuck Brook, Mill River, Tiffany Creek, and White's Creek. The details of these assessments are provided in the Stormwater Runoff Impact Analysis and Candidate Site Assessment Reports that are cited in *Section 1.3* of this report.

The 2007 stream assessment results presented in the Stormwater Runoff Impact Analysis and Candidate Site Assessment Reports were compared based on the number of outfalls, hotspot locations, road crossings, inadequate buffers, trash accumulation locations, etc. in each subwatershed. *Table 10-4* presents an overall score for each subwatershed based upon the quantitative results from the 2007 stream assessments. The subwatersheds in *Table 10-4* are listed in order of decreasing pollution potential (relative high pollution ranking to low pollution ranking). It is important to note that the 2007 stream assessment results should not be compared directly with the 2009 stream assessment results for Cold Spring Brook due to differences in the assessment methods and field personnel used in each study. However, the scores presented in *Table 10-4* are useful for comparing the relative pollution potential of the subwatersheds that were assessed in 2007.

Table 10-4. 2007 Stream Assessment Results Summary

Subwatershed	Pollution Potential Score[1]
White's Creek	86
Mill River	51
Tiffany Creek	35
Beaver Brook	26
Kentuck Brook	25
Bailey Arboretum	18

[1]Pollution potential score calculated from the quantitative stream assessment results presented in the 2007 Stormwater Runoff Impact Analysis and Candidate Site Assessment Report for each subwatershed.

Bailey Arboretum

The overall stream condition was assessed to fall in the suboptimal to optimal range due to the inadequate vegetated buffers in the arboretum. The overall buffer and floodplain condition was assessed as being within the suboptimal to optimal range due to minor floodplain encroachment and a narrow vegetated buffer width (Cashin Associates, P.C., 2007).

The Bailey Arboretum subwatershed is in optimal condition for most of the subwatershed but the drainage infrastructure system carries road runoff directly into the creek and the buffer impacts within the Bailey Arboretum property offer opportunities to improve the subwatershed further. A number of stormwater retrofits were recommended to address pollutant loads associated with the existing drainage system in the Bailey Arboretum subwatershed. In addition, the 2007 study report recommended non-structural measures including increased street sweeping, public education on garden fertilizer and chemical use and disposal, public education on the importance of buffers between cultivated lawns and waterbodies, and public education on the importance of vegetative cover to prevent soil erosion (Cashin Associates, P.C., 2007).

Beaver Brook (Francis Pond)

Three reaches were assessed in the Beaver Brook (Francis Pond) subwatershed. The first reach (103-1) encompasses all of Beaver Lake. The second reach (103-2) extends from Beaver Lake south to the intersection of Frost Mill Road and Beaverbrook Road. The third reach (103-3) extends south from Frost Mill Road and to the headwaters in the vicinity of Valley Road, including Lower Francis Pond, Upper Francis Pond, and two small branches extending south and southwest from Upper Francis Pond (Cashin Associates, P.C., 2007).

The overall stream condition for reach 103-1 was assessed to be within the suboptimal to optimal range because of its favorable in-stream habitat and floodplain connection. The overall buffer and floodplain condition was assessed to be within the poor to marginal range due to significant floodplain encroachment and inadequate floodplain vegetation due to various land development such as cultivated residential yards, roadways, horse grazing and an ice skating facility (Cashin Associates, P.C., 2007).

The overall stream condition for reach 103-2 was assessed to be within the optimal range due to the well maintained area in Shu Swamp Preserve and ideal vegetative protection. The overall buffer and floodplain condition was assessed to be within the optimal range due to little or no floodplain encroachment and adequate vegetated buffer width (Cashin Associates, P.C., 2007).

The overall stream condition for reach 103-3 was assessed in the optimal range due to ideal in-stream habitats and vegetative protection. The overall buffer and floodplain condition was assessed in the optimal range also due to little or no floodplain encroachment and ideal floodplain vegetation (Cashin Associates, P.C., 2007).

The area of the subwatershed that actually contributes surface runoff to waterbodies has been reduced by the installation of upgradient recharge basins and other drainage infrastructure that contain the storm runoff volume from roads and subdivisions. The drainage systems that discharge to waterbodies include two piped drainage systems that outfall to the west side of Shu Swamp and numerous individual catch basins and leaching structures located along the subwatershed roads, several of which have outfalls to waterbodies. Stormwater retrofits were recommended at several outfalls at the ice skating facility at the eastern end of Kaintuck Lane, an outfall located on the west side of Shu Swamp, concrete swales that contribute runoff to Upper Francis Pond, and catch basin inserts in several catch basin systems located on Chicken Valley Road, Glen Cove Oyster Bay Road, and Oyster Bay Road that outfall to Upper Francis Pond. The 2007 study report also recommends implementing non-structural measures similar to those recommended for the Bailey Arboretum subwatershed (Cashin Associates, P.C., 2007).

Kentuck Brook

The overall stream condition was assessed as being within the optimal range due to its ideal in-stream habitat and vegetative protection. The overall buffer and floodplain condition was assessed as being within the suboptimal to optimal range due to some buffer and floodplain encroachment from man-made structures (Cashin Associates, P.C., 2007).

The Kentuck Brook subwatershed is in optimal condition for most of the subwatershed but at the lower limit there are limited areas of buffer and floodplain encroachment and several outfalls that contribute road runoff to the brook (Cashin Associates, P.C., 2007).

The area of the subwatershed that actually contributes surface runoff to waterbodies has been reduced by the installation of upgradient recharge basins and other drainage infrastructure that contain the storm runoff volume from roads and subdivisions. The main areas of the subwatershed that contribute runoff to Kentuck Brook include the residential area in the northeastern section of the subwatershed and area roads including Oyster Bay Road and adjacent residential roads. Stormwater retrofits were recommended for a swale that carries road runoff from Kaintuck Lane, at outfalls associated with the high-density residential neighborhood located north of the railroad tracks including Valley Avenue and Maple Avenue, and at selected outfalls along Oyster Bay Road. Similar non-structural measures were also recommended for this subwatershed (Cashin Associates, P.C., 2007).

Mill River

The following stream reaches were assessed in the Mill River subwatershed:

- Reach 101-1: Muttontown Preserve to NYS Route 25A
- Reach 101-2: NYS Route 25A north to north side of small ponds
- Reach 101-3: Ponds north to Remsen Lane – pipe and roadside channel
- Reach 101-4: Remsen Lane north to Mohawk Drive – roadside channel
- Reach 101-5: Mohawk Drive north to Main Street -natural river channel and Mill Pond

Reach 101-1 has optimal overall stream conditions and optimal overall buffer and floodplain conditions. The overall stream condition for reach 101-2 was assessed to be in the optimal range with a suboptimal vegetative protection assessment of the right bank due to the adjacent roadway. Consequently, the overall buffer and floodplain conditions were assessed to be in the optimal range, although a suboptimal assessment of the right bank's vegetated buffer width was noted (Cashin Associates, P.C., 2007).

The overall stream condition of reach 101-3 was assessed to be in the marginal to suboptimal range due to inadequate in-stream habitat availability, little vegetative protection, and moderate levels of bank erosion, especially along the roadway. The overall buffer and floodplain condition was assessed in the poor to marginal range due to a small buffer zone width, inadequate floodplain vegetation, significant floodplain encroachment, and an uneven mix of wetland and non-wetland habitats (Cashin Associates, P.C., 2007).

The overall stream condition of reach 101-4 was assessed to be in the poor to suboptimal range due to poor vegetative protection, severe bank erosion areas, and inadequate floodplain connection. The overall buffer and floodplain condition was assessed to be in the marginal to poor range due to the lack of buffer zone and high levels of floodplain encroachment (Cashin Associates, P.C., 2007).

The overall stream condition of reach 101-5 was assessed to be in the suboptimal to optimal range because of a stable in-stream habitat, good vegetative protection, and very good floodplain connection. The overall buffer and floodplain condition was assessed to be in the suboptimal to optimal range due to a wide buffer zone and an even mix of wetland and non-wetland habitats (Cashin Associates, P.C., 2007).

Based on the conditions identified during the field assessment, a large segment of Mill River is in marginal condition and has been impacted by the surrounding land use and channelized stream banks. A number of candidate stormwater retrofit sites were identified based on the 2007 study, including:

- Town of Oyster Bay Highway Yard located on Lake Avenue
- Outfalls located in the vicinity of Glen Cove Road and Mill River Road Intersection
- Outfalls located along Lake Avenue
- Stabilization of the stream channel along Mill River Road
- Modification of the recharge basin #130 located on NYS Route 25A east of the Mill River

Similar non-structural measures were also recommended for this subwatershed (Cashin Associates, P.C., 2007).

Tiffany Creek

Two reaches were assessed in the Tiffany Creek subwatershed. The first reach (102-1) extends from Oyster Bay Cove south to a small pond located on private property. The overall buffer and floodplain condition in this reach was assessed to be in the poor to marginal range because of a small vegetated buffer zone, cultivated lawn floodplain vegetation, and a significant amount of floodplain encroachment. However, the floodplain habitat does provide an adequate mix of wetland and non-wetland habitats (Cashin Associates, P.C., 2007).

The second reach (102-2) extends from the south side of the pond in Reach 102-1 to Yellow Cote Road. The overall stream condition was assessed to be in the optimal range due to ideal in-stream habitat and vegetative protection. The overall buffer and floodplain condition was also assessed to be in the optimal range due to a wide, vegetated buffer with little or no floodplain encroachment (Cashin Associates, P.C., 2007).

The area of the subwatershed that actually contributes surface runoff to waterbodies has been reduced by the installation of upgradient recharge basins and other drainage infrastructure. Most of the development south of Route 25A appears to have recharge basins and/or drainage structures in place to contain the water quality volume. There are two recharge basins located north of Route 25A that appear to contain the water quality volume (at a minimum) and are assumed to be self-contained. An additional two basins located in close proximity to Tiffany Creek may have overflows that allow pollutants to reach the creek. The 2007 stream assessment study recommended further evaluation of these basins to determine if water quality modifications are warranted. Other candidate stormwater retrofit sites that were identified in the 2007 study report include a parcel located on the south corner of Cove Road and Shutter Lane and a number of vacant parcels located along roads close to Tiffany Creek. Similar non-structural measures were also recommended for this subwatershed (Cashin Associates, P.C., 2007).

White's Creek

Two reaches were assessed in the White's Creek subwatershed. Reach 100-1 is the tidal segment and Reach 100-2 is the freshwater segment.

The overall stream condition in reach 100-1 was assessed to be in the suboptimal range, with the east bank ranking higher because of the vegetated, stable bank and buffer width. The west bank was rated lower because of channelization and lack of vegetation. The overall buffer and floodplain condition was assessed to be in the marginal to suboptimal range because of the lack of buffer zone and floodplain encroachment along the west bank. It should be noted that although the open water segment of White's Creek is limited, an extensive upgradient drainage infrastructure system outfalls through OT-1. The system has been determined to be undersized for the flow, creating an upstream flooding condition during rainfalls events. Prior studies have been conducted to identify measures to mitigate the flooding conditions, but no solution has been implemented to date. Additional studies may be necessary to develop a solution to the flooding, which may also be able to address some of the water quality issues at this location (Cashin Associates, P.C., 2007).

Reach 100-2 is a small segment of the creek that extends south along the west side of White Street. The creek has been channelized through this section and carries storm flows from upgradient drainage infrastructure. There does not appear to be any aquatic habitat remaining in this reach. In several locations, the shoreline has been hardened by the installation of granite blocks. The reach has a commercial parking lot on the east side. On the west side, the northern segment is adjacent to a small open grass lot and the southern segment runs behind several residences. The overall stream condition was assessed to be in the suboptimal to marginal range because of disruption in vegetation and an area of bank erosion caused by high flows. The overall buffer and floodplain condition was assessed to be in the marginal to poor range because of the lack of buffer zone and floodplain encroachment (Cashin Associates, P.C., 2007).

The 2007 study report, which also cites recommendations from the Whites Creek Watershed Analysis & Stormwater Mitigation Plan dated March 1998, recommends removal of accumulated sediment and modification of NYSDOT recharge basin #15 and stormwater retrofits at outfalls that drain portions of White Street, East Main Street, and South Street. Similar non-structural measures were also recommended for this subwatershed (Cashin Associates, P.C., 2007).

10.3 Upland Assessments

Fuss and O'Neill conducted upland assessments in the harbor complex watershed on August 24 through 27, 2009. The field observations assist in identifying pollution prevention and potential restoration opportunities at hotspot land uses and residential neighborhoods in the watershed. Factors that were considered when determining which hotspots and neighborhood areas to prioritize for assessment include:

- Stream condition (assessed during stream corridor inventory)
- Site proximity to the stream and harbor complex
- Land use type and development density
- Land ownership
- Restoration potential

The assessment framework was adapted from the Unified Subwatershed and Site Reconnaissance (USSR) method developed by the Center for Watershed Protection. USSR is a "windshield survey" evaluation method in which field crews drive and walk through areas of the watershed to quickly identify pollution prevention and restoration opportunities. The three major components to the upland assessments conducted in the harbor complex watershed are: hotspots, residential neighborhoods, and streets and storm drains. All of the harbor complex subwatersheds were considered for the upland assessments, with the exception of Upper Kentuck Brook and Upper White's Creek since these subwatersheds are self-contained by existing recharge basins. Field data forms that were completed during the upland assessments are provided in *Appendix B*.

10.4 Neighborhood Source Assessment

Stormwater runoff from existing residential neighborhoods is an important consideration for this study, since residential land use is the predominant land use in the Oyster Bay/Cold Spring Harbor Complex watershed. Neighborhood source assessments were conducted to evaluate pollution source areas, stewardship behaviors, and residential restoration opportunities within individual residential neighborhoods throughout the watershed. The residential behaviors that contribute to stormwater quality were assessed by considering the following source areas for "representative" neighborhoods throughout the subwatershed:

- Yards and lawns
- Driveways, sidewalks, and curbs
- Rooftops
- Common areas

Neighborhoods were selected for assessment based on their proximity to stream corridors and the harbor complex and their overall potential to contribute pollutants to the receiving waters. The selected neighborhoods include a variety of residential types, including low- and high-density single-family residential and multi-family residential (apartments). One field sheet was completed for each neighborhood assessed. The selected neighborhoods are located in the Bailey Arboretum, Cold Spring Harbor, Centre Island, Mill Neck Creek, Mill River, Oyster Bay Harbor, and White's Creek subwatersheds, as summarized in *Table 10-5*.

Each neighborhood was assigned a score for pollution severity and restoration potential. Pollution severity is a measure of how much nonpoint source pollution a neighborhood is likely generating based on readily observable features such as lawn care practices, drainage patterns, pavement staining, etc. Restoration potential is a measure of the feasibility of on-site retrofits or behavior changes based on available space, number of opportunities, presence of a strong homeowners association, and other factors.

Table 10-5. Neighborhood Source Assessments Conducted in the Oyster Bay/Cold Spring Harbor Complex Watershed

Neighborhood/ Subdivision Name	Subwatershed	Residential Type	Pollution Severity	Restoration Potential
Matinecock Lane	Bailey Arboretum	Medium to high-density single family	Moderate	Low
Harbor Road, Huntington	Cold Spring Harbor	Medium-density, single-family	Moderate	Low
Centre Island	Centre Island	Low-density/ estate, single-family	None - poor access	Unknown- poor access
Bayview Avenue	Mill Neck Creek	High-density, single-family	Moderate	Moderate
Hernan Avenue	Mill Neck Creek	High-density, single-family	Moderate	Moderate
Oyster Bay Gardens	Mill River	Multifamily Townhouses	Moderate-high	Low
Ships Point Lane	Oyster Bay Harbor	High-density single-family	Moderate	Moderate
Maxwell Avenue	Oyster Bay Harbor	Multifamilty apartments	Moderate	Low
Singworth Street	White's Creek	High-density single family	Moderate	Moderate

Matinecock Lane

This medium to high-density single family neighborhood is approximately 6.6 acres in size. The neighborhood consists of three streets with residences of similar age, density, and other characteristics, including Egypt Lane, Matinecock Lane, and Cherrywood Lane south of Horse Hollow Road and east of Bayville Road. The assessment was performed on Matinecock Lane and Egypt Lane, although the characteristics of Cherrywood Lane are generally similar. The neighborhood is adjacent to a small pond that is tributary to Factory Hollow Pond.

The lots in the neighborhood vary in size from approximately 1/8 acre to 1/3 acre in size. Overall impervious cover is estimated at approximately 30 percent. The majority of lots include intensively maintained laws (approximately 35% of lot coverage) and many include significant landscaping consisting of mulched garden beds, shrubs, trees, and hedgerows. The neighborhood forest canopy cover is significant (approximately 50%). The streets in the neighborhood are unusually narrow with a typical width of approximately 15 feet. Residents appear to park on the street on a regular basis. No sidewalks are present. Roadway drainage appears to discharge to the small pond via overland flow (curb, gutter, and piped drainage are not present). A significant proportion of the existing driveways (25% estimated) are gravel or other pervious material.

The overall pollution severity of this neighborhood is rated as moderate due to potential nutrient loads. Although it is a moderate to densely-developed neighborhood, the quantity of impervious surface is relatively low since the streets are narrow, no sidewalks are present, not all driveways are paved, and few, if any, downspouts appeared to be connected directly to impervious surface. However, the coverage by well-maintained lawns and garden beds suggest a high level of fertilizer use.

This neighborhood has low restoration potential. The majority of potential retrofits would need to occur at the lot level, such as installing rain gardens to promote stormwater infiltration and provide treatment. A small quantity of undeveloped land may be available south of the end of Egypt Lane where stormwater treatment could be implemented on a larger scale, although the ownership status is unknown.


Views of Matinecock Lane showing intensively-landscaped lawns and planting beds adjacent to the relatively narrow road (left) and a typical residential lot (right).

Harbor Road

This neighborhood consists of single-family houses as well as multifamily residences in older woodframe structures that line Harbor Road in Huntington. Lots in this neighborhood are varied, although the lots to the north (approaching Terrance Place) are generally smaller (approximately ¼ acre) and tend to contain multi-family structures, while many of the lots to the south are larger than an acre. The residences appear to vary significantly in age and condition. Harbor Road is drained via curbs, gutters, and catch basins. Many of the downspouts discharge to lawns, although the topography slopes generally downward to Harbor Road such that lot runoff would discharge to the roadway drainage system during larger storm events. The yard of at least one multi-family residence appears to be used for parking, and evidence of irrigation water running off impervious surfaces was also observed in several cases.

The pollution severity index of this neighborhood was moderate, with the potential for sediment discharge from the more densely developed areas and potential for lawn chemical discharge from the less densely developed lots. Additionally, the roadway itself is likely a significant pollutant source.

The neighborhood restoration opportunity index for this neighborhood is generally low, since the sites are constrained by slopes, the location of the roadway, and little land is available between the roadway and the harbor. A notable exception is the Cold Spring Harbor State Park parking area, located at the southern end of this neighborhood, which is likely to be a significant sediment source and has reasonable restoration potential (see *Section 10.7*).


Views of Harbor Road residences, including potential sediment source (left) and lawn irrigation runoff (right).

Centre Island

Centre Island Village consists primarily of residential land use located in the Center of Oyster Bay and connected to Bayville via a narrow isthmus. The majority of residences are large estates with well-landscaped grounds and manicured lawns. A Neighborhood Source Assessment was not completed in this area since field staff were asked to leave the area by private security personnel.

Bayview Avenue

This neighborhood is located in the Mill Neck Creek subwatershed in the Village of Bayville and includes homes on the streets bounded by Ellison Lane, Mountain Avenue and Bayview Avenue. The neighborhood consists of single family detached homes on 1/8 acre lots. Mountain Avenue and Ellison Street are paved, and Bayview Avenue has gravel cover. The majority of the drainage from the subdivision is collected in a curb and gutter system which is conveyed directly to Mill Neck Creek via an outfall at the end of Mountain Avenue.

Approximately 80 percent of the homes have roof leaders that are directed to impervious areas such as a walkway or driveway to be conveyed to the street drainage system. Due to the small lot size, approximately 60 percent of the lots consist of impervious cover. The majority of the lots in the subdivision are miticulously maintained, with the exception of some overgrown lawns with various debris along Bayview Avenue. There is little open space in the vicinity of this neighborhood.

The pollution severity of the watershed is moderate due to the unpaved roadway and debris and lack of maintenace on Bayview Avenue. The restoration opportunity in this neighborhood is low since there is little available open space to implement a structural stormwater retrofit. However, some area is available on many lots downgradient of roof leaders for the installation of a rain garden.

Hernan Avenue

The Hernan Avenue neighborhood is located in the Mill Neck Creek subwatershed in the Village of Locust Valley. The neighborhood includes lots on both sides of Hernan Avenue, which extends from Bayville Road to a dead end at Oak Neck Creek (an arm of Mill Neck Creek), encompassing an area of approximately 8.2 acres. The storm drainage system consists of a curb and gutter system that conveys stormwater to an outfall at the end of Hernan Avenue into Oak Neck Creek.

The houses in this neighborhood are single family detached homes on ⅛ to ¼-acre lots. The properties have uniformly high management status, with a high percentage of the lot covered with landscaping, although the lots typically have less than 5% canopy cover. A majority (80%) of the roof leaders discharge to a pervious areas such as lawn or mulched areas. The neighborhood contains an approximately 2.4-acre wetland that is believed to provide treatment of stormwater from the neighborhood prior to discharging to Oak Neck Creek. A follow-up investigation is recommended to assess the performance of this wetland and the drainage system connectivity.

Oyster Bay Gardens

The Oyster Bay Gardens housing complex is a multi-family public housing building managed by the Oyster Bay Housing Authority. The complex is located in the Mill River subwatershed on Glen Cove Road. The grounds are generally well maintained and consist of landscaped and turf grass areas. Approximately half of the roof leaders drain to pervious areas such as the mulched areas around the buildings. Sidewalks are present along one side of the roadway.

Potential pollution sources at this location are associated with the impervious parking areas. The parking lot pavement is deteriorating in some places, and there is a significant amount of oil staining on the pavement in the parking spaces. The area for on-street parking near the building contains a significant quantity of accumulated sediment. One location on the roadway had accumulated approximately 3 inches of sediment. The cause of the sediment is believed to be a combination of inoperable vehicles being stored along the road which prevents street cleaning and the area of roadway is the low point in the road, with no catch basin for drainage.

Potential retrofit candidates for this site include a parking lot retrofit that incorporates permeable pavement and bioretention or other form of stormwater infiltration system to collect and infiltrate stormwater runoff from the parking lot.

Ships Point Lane

The Ships Point Lane neighborhood is in Oyster Bay Hamlet in the Oyster Bay Harbor subwatershed and includes single-family residences along Ships Point Lane, Melbourne Street, Sidney Street and Florence Avenue. The lots are typically ¼ acre in size with intensively-managed lawn areas, believed to include significant fertilizer use and irrigation practices.

This neighborhood is a good candidate for "green streets" retrofits. The typical street width in this neighborhood is 28 feet and had low utilization of on-street parking observed mid-morning on a weekday. A potential restoration candidate for this location includes stormwater curb extensions that can be easily retrofitted alongside the existing curb. Runoff from the street could be conveyed to these landscaped infiltration areas and would overflow into the existing drain inlets during larger storms. Since this street has a lot of unused on-street parking, the addition of curb extensions would not adversely impact existing parking. The curb extensions could provide stormwater infiltration, a more aesthetically pleasing roadway, and traffic calming.

Views of Ships Point Lane residences, which is a potential candidate for a green streets retrofit.

Maxwell Street

Maxwell Street is located in downtown Oyster Bay in the Oyster Bay Harbor subwatershed and is a mixed single family and multifamily neighborhood with lot sizes less than ¼ acre. The area is serviced by sanitary sewer. There are no catch basins located along the street and stormwater is conveyed by a curb system toward a large catch basin inlet on Shore Avenue. The lots have a high percentage of impervious cover since the buildings comprise in excess of 80 percent of the lot area, and some lots have cement walkways around the perimeter of the house to the edge of the lot making it 100 percent impervious. Several of the driveways on this street consist of a pervious material. There is a low potential for restoration in this neighborhood due to the narrow street width and small lot size, which do not typically have sufficient space for surface stormwater retrofits such as rain gardens, or landscaped areas that would benefit from irrigation from a rain barrel connected to the roof leaders.

Singworth Street

The Singworth Street neighborhood consists of the block bounded by Singworth Street, and Summers Street off of Berry Hill Road in Oyster Bay. The neighborhood subdivision has narrow, long lots approximately ¼ acre is size with well-maintained lawns. Some areas of the neighborhood have a mature tree canopy, covering upwards of 25 percent. However, there is evidence of infill and redevelopment occurring with new construction in progress. The lots in this neighborhood have potential for rain barrel implementation since the majority of the lawns are highly landscaped. Encouraging rain gardens may also be well-received in this neighborhood, and future educational efforts should target this and similar residential subdivisions.

10.5 Hotspot Site Investigation

Hotspot site investigations were conducted for representative sites with a high potential to contribute polluted stormwater runoff to the storm drainage system or receiving waters. The purpose of the investigation was to qualitatively assess the potential for stormwater pollution from previously identified commercial, industrial, municipal or transportation-related sites. The hotspot investigation was limited in scope to representative hotspot facilities in order to evaluate and illustrate common issues. The investigation was not intended to be an exhaustive review of all potential hotspot facilities in the entire watershed nor a detailed inspection or audit of each facility, which are beyond the scope of this study.

The hotspots examined in the field were located within the Bailey Arboretum, Cold Spring Harbor, Centre Island, Mill River, Oyster Bay Harbor, and White's Creek subwatersheds. Representative priority hotspots were selected to cover a range of watersheds and land uses, including transportation-related (highway/railroad/boat maintenance facilities and parking lots), commercial, industrial, and state/municipal sites. Sites are identified by the watershed abbreviation, followed by "HSI" and a numeric identifier. *Table 10-6* summarizes the selected hotspots that were evaluated. Several of the sites that were investigated are privately-owned, and field crews were unable to gain full access to the sites to closely evaluate the storm drainage and other site characteristics.

Table 10-6. Hotspot Site Investigation Summary

Site ID (Watershed)	Land Use Category	Description of Site Operations
BAI-HSI-01 (Bailey Arboretum)	State/Municipal	Locust Valley Intermediate School & Bus Maintenance Facility
CSH-HSI-01 (Cold Spring Harbor)	Transportation	Municipal Parking Lot, Main Street, Huntington
CTR-HSI-01 (Centre Island)	Transportation	Seawanhaka Yacht Club
MRV-HSI-01 (Mill River)	Municipal	Highway Maintenance Facility
OBH-HSI-01 (Oyster Bay Harbor)	Transportation	LIRR Maintenance Yard
OBH-HSI-02 (Oyster Bay Harbor)	State/Municipal	Oyster Bay High School
WCR-HSI-01 (White's Creek)	Industrial	Commander Oil Terminal
WCR-HSI-02 (White's Creek)	Commercial	Pine Hollow Shopping Center

Locust Valley Intermediate School & Bus Maintenance Facility

The Locus Valley Intermediate School is located in the Bailey Arboretum subwatershed on Ryefield Road. The property consists of a school and a regional bus storage and maintenance facility in the rear of the school. Approximately 15 school buses and 10 other vehicles are stored outdoors at the site. A small garage is located on site for the repair and maintenance of the vehicles. An uncovered outdoor fueling area is located in the center of the parking area, which is believed to be indirectly connected to the storm drainage system. The facility stores waste oil outdoors (within secondary containment) as well as miscellaneous used parts and garbage dumpsters.

The pavement and gravel areas where buses are stored were in good condition with some evidence of oil staining. A follow-up inspection or future education effort is recommended to examine the used equipment stored along the fence on Ryefield Road and in the rear of the facility along the wooded area. The outdoor storage of waste equipment is a potential source of oil pollution into the storm drainage system. It is recommended that the outdoor fueling station be covered to decrease the potential for gasoline discharges to be conveyed to the storm drainage system. This site may be a higher priority for follow-up since the stormwater appears to drain from the maintenance facility toward the school playground.

Covering the outdoor fueling station at the bus maintenance facility would decrease the stormwater pollution potential of the fueling activities.

Municipal Parking Lot, Main Street, Huntington

The municipal parking lot in the commercial district along Main Street in Huntington is approximately 35,000 square feet, with approximately 95 parking spaces. This potential hotspot was assessed mid-morning on a weekday and the lot was approximately one-third full. The parking lot was not determined to be a hotspot for pollution sources, although the area is a potential stormwater retrofit candidate since the parking lot drains to two curb inlets along Main Street. There is a small grass island between the parking area and Main Street that has approximately 10 trees planted in a brick and concrete surface.

Seawanhaka Yacht Club

The Seawanhaka Yacht Club is located on Centre Island on Seawanhaka Road. The club provides members with boat storage and launching. The facility is regulated under the state and federal NPDES program. Access to the site for further investigation was denied, and a follow-up interview or inspection is recommended.

Highway Maintenance Facility

The Town of Oyster Bay highway maintenance facility is located in the Mill River subwatershed on Lake Avenue. Stormwater discharge from the facility drains directly to the Mill River via a series of outfalls. The facility is used for the maintenance, fueling, washing and storage of fleet vehicles. Vehicles and the fueling station are located outdoors with no cover. The maintenance and repair of vehicles occurs in a covered garage. Sand and salt storage and loading operations are located outdoors and uncovered. Garbage dumpsters on-site were observed to be uncovered and overflowing with garbage.

Uncovered materials storage

Uncovered fueling station

Uncovered and overflowing dumpster

This facility was also identified during the 2007 stream assessments conducted on behalf of Nassau County as a candidate site for significant retrofits and operational improvements. The 2007 study report recommended that the entire yard be redeveloped to contain all storm runoff onsite and to bring the facilities into conformance with current hazardous materials regulations (Cashin Associates, P.C., October 1, 2007).

A follow-up on-site investigation is recommended to further assess the pollution potential from the salt and sand stockpile, the fueling station, outdoor vehicle storage, the sand and salt loading operation, and any current stormwater controls that may exist at the facility. Recommended best management practices include construction of containment berms and/or a covered structure for the sand and salt stockpile, the addition of a canopy over the fueling station, and installing structural controls such as oil/water separators and stormwater management controls for site runoff. This site is a high priority for follow-up since stormwater from the facility discharges directly to the Mill River.

LIRR Maintenance Yard

The Long Island Railroad Maintenance Yard is located in the White's Creek subwatershed in Oyster Bay Hamlet. The yard contains many electrical boxes and has seven divided tracks for the temporary storage and maintenance of railway cars. No confirmed sources of pollution were observed from outside the fence of the property. Potential pollution sources include motor oil and lubricating oil associated with railcar maintenance. A follow-up inspection of this facility is recommended.

Oyster Bay High School

Oyster Bay High School is located on Main Street in Oyster Bay and includes the school building, administration building and associated parking lots. There were no observed sources of pollution at the site, other than the parking areas and maintained lawn. There are large areas of turf grass adjacent to the parking areas that can be seen from Main Street, which could be an ideal location for a high-visibility structural stormwater retrofit that could also have educational benefits. An infiltration basin on the property could collect runoff from the parking area associated with the administration building.

Commander Oil Terminal

The Commander Oil Terminal is a bulk oil receiving and storage facility located at the end of South Street in the White's Creek subwatershed. The facility is regulated under the National Pollutant Discharge Elimination System (NPDES) permit program and is registered with the

NYSDEC under the Oil Spill Prevention, Control and Compensation Act for Major Oil Storage Facilities. Under these and federal oil pollution prevention regulations, the facility must implement a Spill Prevention, Control and Countermeasure Plan and potentially a facility response plan in the event of an oil spill to navigable waters.

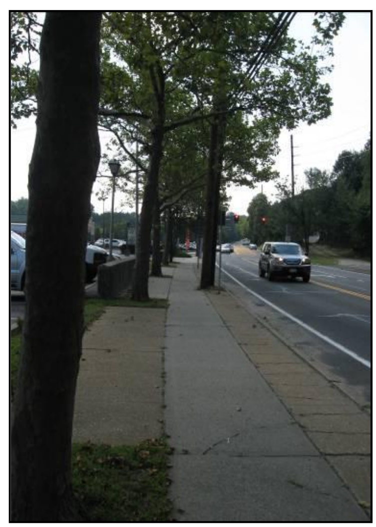
Pine Hollow Shopping Center

A hotspot site investigation was conducted at the commercial stores at the Pine Hollow Shopping Center located on Pine Hollow Road (Route 106) in the White's Creek subwatershed. The focus of the investigation was the Stop & Shop located at the south end of the shopping complex and the Rite Aid, which is located one building north of the Stop & Shop. Stormwater from the rooftops and paved areas, including the parking lot, discharges to the drainage system along Pine Hollow Road.

Uncovered, overflowing dumpster

Outdoor storage of materials

Many stormwater pollutant sources were observed on this site. Vehicles, pallets, cardboard, and various bakery racks and store shelving are being stored outdoors uncovered in the rear of the buildings. The waste is not managed properly, and dumpsters were left uncovered with overflowing trash left in trash bags on the ground next to the dumpster. The parking lot and paved area behind the building is stained with oil and has a buildup of sediment.



Pine Hollow Shopping Center along Pine Hollow Road

The Pine Hollow Shopping Center is a confirmed hotspot. A follow-up inspection should be conducted. This and similar commercial retail centers should be included as targets for future education and outreach efforts. This site is also a good candidate for structural stormwater retrofits since the stormwater is conveyed toward the drainage system along Pine Hollow Road. Potential retrofits include parking lot bioretention, particularly along the perimeter of the parking lot adjacent to Pine Hollow Road.

10.6 Streets and Storm Drain Assessment

Urban streets and storm drains can be a source of stormwater pollutants if not maintained on a regular basis. The condition of the local road and storm drain infrastructure can be assessed to determine if existing maintenance practice could reduce pollutant accumulation. Selected streets and storm drains were assessed during the upland field inventories conducted the week of August 3, 2009. Most of the streets and storm drains that were assessed are located in or near hotspot or neighborhood source assessment locations. Findings of the street and storm drain assessment are summarized below. Photographs of the storm drains and the street conditions evaluated are provided as *Table 10-7*.

Approximately half of the streets and storm drains evaluated were clean, free of sediment and debris, and in good condition. The other half had varying degrees of sediment and organic matter accumulated on top of the catch basin grates, either partially or fully prohibiting stormwater from entering the drainage system and sediment accumulation on the street. Many of the inspected catch basins had varying degrees of sediment accumulation and nearly all could benefit from increased clean-out and street sweeping. Many of the storm drains observed during the field assessments were stenciled. However, other areas of the watershed could benefit from storm drain stenciling and similar watershed stewardship signage, particularly along Harbor Road in Huntington, the Pine Hollow Shopping Complex in Oyster Bay, along Hernan Avenue, and other residential and commercial locations throughout the watershed.

Table 10-7. Streets and Storm Drain Assessment Photographs

Location	Storm Drains		Comments
Harbor Road, Huntington (Cold Spring Harbor)			
Mountain Road, Bayville (Mill Neck Creek			Catch basin grates are clean; however sediment accumulation is present on the roadway.
Hernan Avenue, Locust Valley (Mill Neck Creek)			Catch basin grates are partially or completely covered by accumulated organic material
Ships Point Lane, Oyster Bay (Oyster Bay Harbor)			
Pine Hollow Shopping Center, Oyster Bay (White's Creek)			The parking lot pavement is cracked around some of the catch basins located in the parking lot.

11 Land Use Regulatory Controls

11.1 Introduction

Municipal land use plans and regulations help shape the development patterns within a watershed and can play a significant role in protecting water quality and other natural resources at the watershed scale. These commonly include municipal comprehensive plans, zoning regulations, subdivision regulations, and stormwater regulations, all of which influence the type and density of development that can occur within a watershed. Local land use regulations often vary by municipality within a watershed, and regulations are periodically revised in response to development pressure, shifts in attitude toward natural resource protection, and political and socioeconomic factors.

In addition to municipalities, other governmental agencies also have jurisdiction over lands and activities within the harbor complex watershed. The regulatory programs and policies of these agencies also play an important role in addressing land use, water quality, and natural resource issues facing the watershed.

A key element in the development of a watershed management plan is to identify potential land use regulatory and planning mechanisms (i.e., new or modified land use regulations and planning approaches) that can be implemented by the watershed municipalities and other governmental entities to strengthen existing land use controls and better protect natural resources within the watershed. Communities in urbanized areas are also faced with a mandate to meet State and Federal Phase II stormwater permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, as well as addressing local concerns about the damaging effects of increased impervious cover and uncontrolled stormwater runoff from land development and suburban sprawl.

An opportunity exists for the watershed municipalities to strengthen existing regulatory mechanisms and satisfy Phase II stormwater requirements, while also updating and improving upon existing land use regulations and land use planning strategies to help protect and restore water quality and other valuable natural resources in the Oyster Bay/Cold Spring Harbor complex and its watershed.

This section summarizes the various governmental entities with jurisdiction over land use or resources within the watershed boundaries, including existing land use regulatory and planning mechanisms. The information presented in this section is based on responses obtained from a land use questionnaire distributed by Friends of the Bay in 2008, as well as existing regulatory and planning documents made available by the watershed municipalities and other government entities (Town of Oyster Bay, Town of Huntington, City of Glen Cove, and their incorporated villages, and Nassau and Suffolk Counties).

11.2 Summary of Regulatory Jurisdictions

This section describes the various land use regulatory jurisdictions within the Oyster Bay/Cold Spring Harbor Complex watershed. Information in this section is summarized from the Oyster Bay/Cold Spring Harbor Complex Harbor Management Plan (Cashin Associates, 2002), the Mill River Watershed Study and Public Stewardship Program (Cashin Associates, 2007), and information provided by local, county, state, and federal government entities with jurisdiction over land use or resources in the watershed.

11.2.1 Federal

United States Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) is responsible for the regulation, management, and preservation of the Oyster Bay National Wildlife Refuge. USFWS management responsibilities include, but are not limited to, restoring wetlands and managing the impoundment. In addition, the USFWS has regulatory jurisdiction over federally endangered wildlife species that could be affected by activities within the harbor complex.

United States Army Corps of Engineers

The U.S. Army Corps of Engineers (ACOE) exercises regulatory authority over actions undertaken within the waters of the United States (e.g., dredging and the placement of structures such as docks and bulkheads). Often, a separate permit is required from ACOE for actions that also require a tidal wetlands permit from NYSDEC.

11.2.2 State

New York State Department of Conservation

The New York State Department of Conservation (NYSDEC) regulates land development and other activities through their wetlands (freshwater and tidal) and State Pollution Discharge Elimination System (SPDES) programs. In general, NYSDEC is responsible for maintaining and improving the quality of New York's natural environment. NYSDEC regulates activities in and within 100 feet of New York State-designated tidal and freshwater wetlands (Part 661 of Title 6 of the New York Code of Rules and Regulations [6 NYCRR 661]). The current SPDES regulations allow NYSDEC to regulate some municipal stormwater systems, all construction activities disturbing one or more acres of land (GP-0-08-002 and GP-0-08-001 respectively), and all traditional water discharges including those from wastewater treatment plants and industrial facilities. As an example, the Oyster Bay STP effluent is regulated under this program.

New York State Department of State

The New York State Department of State (NYSDOS), Division of Coastal Resources provides technical assistance to local governments in the areas of land use regulations, site plan review and design guidelines, and provides general information on new planning techniques. NYSDOS also administers the Federal Coastal Zone Management Act of 1972 and the State Waterfront Revitalization Act of 1981, including responsibility for reviewing Local Waterfront

Revitalization Programs (LWRP), Harbor Management Plans (HMP), Watershed Management Plans, and various coastal zone projects for consistency with the State's Coastal Management Plan. NYSDOS is also responsible for the development and implementation of the Long Island Sound Coastal Management Program.

New York State Department of Health

The New York State Department of Health (NYSDOH) regulates the design and construction of sanitary sewer systems, which is a key factor that affects development patterns, land use, and pollutant sources in a watershed.

New York State Department of Transportation

Although not a directly involved in regulating land use, the New York State Department of Transportation (NYSDOT) designs and maintains state roads and the associated drainage infrastructure within the Oyster Bay/Cold Spring Harbor Complex watershed. The NYSDOT is also considered a Municipal Separate Storm Sewer System (MS4) and, therefore, regulated under NYSDEC's SPDES Phase II program.

11.2.3 County

Nassau County

Department of Public Works

The Nassau County Department of Public Works (NCDPW) is responsible for the design and maintenance of the county's roadways and associate storm drainage infrastructure. Upon the request of the Planning Commission or a municipality the NCDPW will be asked to review and approve proposed land development applications, which may be reviewed by one or more of the divisions of the NCDPW. This review may include, but is not limited to, impacts to county and local roadways and stormwater infrastructure, general site grading and drainage, and proposed sanitary facilities.

Under Municipal Law, the County Department of Public Works must review any construction for which a municipality is issuing a building permit that fronts on or abuts County roads, properties or right-of-ways (Rules and Regulations Governing Approval for Erection of Buildings on County Highways, Nassau County Department of Public Works).

The NCDPW also administers and implements the Nassau County Stormwater Management Program since the county is a regulated small MS4 under the SPDES Phase II program. The County has established an inter-municipal coalition of municipal entities within the County to implement the SPDES Phase II program regionally, consistent with the Nassau County Stormwater Management Program.

Department of Health

The Nassau County Department of Health (NCDH) is responsible for the review and approval of the design and installation of on-site sewage disposal systems that are proposed for subdivisions of five or more lots. Towns and Villages in the region may also impose NCDH design requirements for smaller systems.

Planning Commission

The Nassau County Planning Commission maintains jurisdictional authority for subdivisions of five or more lots proposed in the unincorporated areas of the County. The Planning Commission, when it deems fit, may forward land development applications to the Commissioner of Public Works and/or the Nassau County Department of Health (as per the Real Property Law, Section 334a) for review and approval.

Parks, Recreation and Museums

The Nassau County Department of Parks, Recreation and Museums is responsible for operation, maintenance, and preservation of County-owned park and preserve facilities, such as the Muttontown Preserve.

Soil and Water Conservation District

Although not a regulatory agency, the Nassau County Soil and Water Conservation District is a resource to County residents and employees providing technical assistance and information on many topics including land use practices, stormwater management, and nonpoint source pollution prevention.

Suffolk County

Department of Public Works

The Suffolk County Department of Public Works (SCDPW) constructs, maintains and operates county properties and designs, constructs and maintains county roads, sewerage systems, buildings and other facilities, such as waterways, bridges, docks and marinas. The SCDPW has responsibility primarily for projects on County-maintained roads and properties, but also has the authority to review projects that are subject to Suffolk County Planning Commission review, such as large subdivisions, projects adjacent to municipal boundaries, or those near airports.

The SCDPW, in cooperation with the Cornell University Cooperative Extension, is responsible for implementing the Suffolk County Stormwater Management Program to reduce stormwater pollution from County-owned roads and properties, as Suffolk County is also a regulated small MS4 under the SPDES Phase II program.

Department of Health Services

The Suffolk County Department of Health Services, Division of Environmental Quality (Office of Wastewater Management) is also responsible for the review and approval of the design and installation of on-site sewage disposal systems for all development, including single-family residences. The Office of Pollution Control is responsible for enforcing regulations concerning toxic and hazardous materials storage, inspection of commercial and industrial facilities, and new and existing swimming pool plan reviews and inspections.

Planning Commission

The Suffolk County Planning Commission has regulatory review authority over any municipal zoning/subdivision action that would affect real property lying within one mile of an airport or a nuclear power plant or within five hundred feet from the boundary of any village or town; the boundary of any existing or proposed county, state or federal park or other recreation area; the right-of-way of any existing or proposed county or state parkway, thruway, expressway, road or highway; existing or proposed right-of-way of any stream or drainage channel owned by the county or for which the county has established channel lines; the existing or proposed boundary of any other county, state, or federally owned land held or to be held for governmental use; or certain designated bodies of water.

Soil and Water Conservation District

Similar to Nassau County, the Suffolk County Soil and Water Conservation District is a resource to County residents and employees providing technical assistance and information on topics related to the protection and preservation of natural resources.

Department of Environment and Energy

The primary mission of the Suffolk County Department of Environment and Energy is to safeguard the natural resources of Suffolk County and to provide a centralized office for consideration of issues and activities from the perspective of their impact on the environment. Although serving primarily an advisory role, the Department of Environment and Energy has jurisdiction over environmental protection laws enforced by the County, the County brownfields program, open space acquisition, farmland preservation, and conservation easements. The Division of Water Quality Improvement also interfaces with the SCDPW on issues related to the Suffolk County Stormwater Management Program.

11.2.4 Municipal

Local municipalities exert the most direct influence on land use and watershed development and redevelopment within their political boundaries. Typical local land use review functions that can affect water quality and natural resources include zoning, site plan review, subdivision review, sediment and erosion control, vegetation protection, and open space preservation. The degree of land use regulatory controls, which can vary significantly between municipalities, is established in the municipal code, primarily the zoning code and development-related regulations (usually amendments to the overall zoning code). Typical land use regulatory controls within the zoning code include minimum lot size, minimum building setbacks, off-street parking requirements, and maximum lot coverage, impervious cover limits, stormwater management design standards, vegetated buffer requirements, etc.

As indicated in *Section 2.1* of this document, the Town of Oyster Bay has the authority to regulate land use and the underwater lands within its boundary and within unincorporated villages and hamlets. The Town also has authority to regulate over-water use of coastal waters within its boundaries, but which lie outside of the 1,500-foot area of over-water jurisdiction of the incorporated villages. The Town of Oyster Bay shares regulatory responsibilities with the United States Fish and Wildlife Service within the Oyster Bay National Wildlife Refuge. These responsibilities extend to several Town agencies and departments, as summarized later in this section.

The Town of Huntington and the City of Glen Cove have similar regulatory authorities and jurisdictions as the Town of Oyster Bay within the harbor complex watershed and coastal areas.

The incorporated villages have authority to regulate land use activities and the use of underwater lands within their respective boundaries, as well as authority to regulate the over-water use of coastal waters within 1,500 feet of their corporate boundaries.

11.3 Land Use Regulatory Survey

Friends of the Bay distributed a land use survey to county and municipal entities in the watershed in 2008. The purpose of the questionnaire was to obtain information on the current land use regulations, policies, and planning documents related to zoning and subdivision review, wetlands and natural resources, comprehensive plans, open space, and stormwater management. The following sections summarize information obtained from the land use survey and subsequent coordination with the municipalities.

Table 11-1 summarizes the various land use departments and commissions of the county and municipal entities within the Oyster Bay/Cold Spring Harbor Complex watershed.

Table 11-1. Land Use Departments and Commissions within the Oyster Bay/Cold Spring Harbor Watershed

County or Municipality	Land Use Departments and Commissions
Oyster Bay	• Town Board • Environmental Resources Department ➢ Environmental Control Commission (E.C.C.) ➢ Environmental Quality Review Division (formerly Environmental Quality Review Commission) • Planning and Development Department ➢ Zoning Board of Appeals ➢ Planning Advisory Board • Department of Public Works including the Divisions of Environmental Control, Engineering, and Highways • Department of Parks • Department of Public Safety • Landmarks Preservation Commission • "SEA" Fund Committee • Hempstead Harbor Protection Committee • Eastern Waterfront Steering Committee
Huntington	• Town Board • Planning and Environment Department ➢ Zoning Board of Appeals ➢ Planning Board • Engineering Services • Parks & Recreation Department • Public Safety Department • Public Works Department • Environmental Open Space and Park Fund Review Advisory (EOSPA) Committee • Huntington Conservation Board • Historic Preservation Commission

Table 11-1. Land Use Departments and Commissions within the Oyster Bay/Cold Spring Harbor Watershed

County or Municipality	Land Use Departments and Commissions
Glen Cove	• City Board • Planning Advisory Board • Zoning Board of Appeals • Parks & Recreation Department • Public Safety Department • Public Works Department • Beautification Commission
Villages	• Village Board • Planning Board • Zoning Board of Appeals • Highway Department • Environmental Conservation Commission (not all have) • Landmark Preservation Commission (not all have)
Nassau County	• Planning Commission • Department of Public Works • Health Department • Parks, Recreation and Museums • Public Works Department • Environmental Program Bond Act Advisory Committee
Suffolk County	• Environment and Energy Department ➢ Division of Water Quality Improvement ➢ Water Quality Review Committee (WQRC) • Parks, Recreation, and Conservation Department • Health Services Department ➢ Division of Environmental Quality ➢ Office of Water Resources • Planning Department ➢ Council on Environmental Quality ➢ Environmental Analysis

Table 11-2 summarizes the current status of comprehensive master plans and key municipal land use regulations for the county and municipal entities within the harbor complex watershed.

Table 11-2. Municipal Land Use Regulations

Plan/Regulation	Oyster Bay	Huntington	Glen Cove	Villages	Nassau County	Suffolk County
Comprehensive Master Plan	Being Prepared	Yes (Being Updated)	Draft	No	Yes	Being Prepared
Subdivision Regulations	Yes	Yes	Yes	Yes	Yes	Yes
Zoning Regulations	Yes	Yes	Yes	Yes	No	No
Floodplain Management	Yes	Yes	Yes	Some	No	No
Stormwater Regulations	Yes	Yes	Yes	Yes	Yes	No
Wetland Regulations	Yes*	Yes*	Yes*	Yes*	No	No

* Pursuant to §24-0501 of the New York State Freshwater Wetland Act (Article 24 of the New York State Environmental Conservation Law)

11.3.1 Wetland Resources

Regulations that protect wetland resources are essential to protecting and restoring the water quality and overall health of the Oyster Bay/Cold Spring Harbor Complex. In New York, activities affecting wetlands are primarily regulated at the state level and federal level. Freshwater wetlands are regulated under the Freshwater Wetlands Act (under Article 24 of the Environmental Conservation Law), while tidal wetlands are regulated under the Tidal Wetland Act of 1973.

11.3.2 Site Development

Land development and redevelopment activities in the watershed are regulated by local zoning codes and subdivision regulations. Municipal zoning and subdivision requirements dictate site development characteristics such as minimum lot size, minimum setback distances, impervious cover, roadway and drainage design standards, open space, and vegetative buffers, as well as the site plan review process itself. Local zoning and subdivision regulations vary considerably by municipality. As an example, *Table 11-3* summarizes lot specifications for each municipality in the watershed, including minimum lot size.

Table 11-3. Municipal Zoning Lot Specifications

Jurisdiction	Zone	Uses Permitted	Minimum Lot Area (SF)
Town of Huntington	C-6 General Business	All uses	--
	R-5 Residence	One & Two-family	5,000
	R-7 Residence	All uses	7,500
	R-10 Residence	All uses	10,000
	R-20 Residence	All uses	20,000
	R-40 Residence	All uses	1 acre
	R-80 Residence	All uses	2 acres
Village of Lloyd Harbor	Residence A-1	1	1
	Public Beach	Recreation	--
	Conservation Recreation	Recreation	--
	Parkland	Recreation	--
Town of Oyster Bay Includes Villages of: East Norwich Hamlet of Oyster Bay Locust Valley Syosset Woodbury	R1-5A One-Family Residence	Single family	5 acres
	R1-2A One-Family Residence	Single family	2 acres
	R1-1A One-Family Residence	Single family	1 acre
	R1-20 One-Family Residence	Single family	20,000
	R1-15 One-Family Residence	Single family	15,000
	R1-10 One-Family Residence	Single family	10,000
	R1-7 One-Family Residence	Single family	7,000
	R1-6 One-Family Residence	Single family	6,000
	RMF-6 Multi-Family Residence	Multi-family	5 acres
	RMF-10 Multi-Family Residence	Multi-family	5 acres
	RMF-16 Multi-Family Residence	Multi-family	5 acres
	RPH-20 Multi-Family Public Housing Residence	Multi-family	2 acres
	RSC-25 Multi-Family Senior Citizen Residence	Multi-family	2 acres

Table 11-3. Municipal Zoning Lot Specifications

Jurisdiction	Zone	Uses Permitted	Minimum Lot Area (SF)
	REC Recreation	Recreation	20 acres
	RO Residence-Office	Office	6,000
	NB Neighborhood Business	Business	10,000
	GB General Business	Business	--
	LI Light Industry	Industry	1 acre
Village of Mill Neck	Residence R1	Single family	8,000
	Residence R2	Single family	3 acres
	Estate E1 Districts	Single family	5 acres
Village of Bayville	Residence B	Single family	5,000
	Residence C	Single family	75,000
	Residence D	Single family	15,000
	Residence E	Single family	20,000
	Residence F	Single family	40,000
	Business	Business	--
City of Glen Cove	R-1 Residence	Single family	1 acre
	R-2 Residence	Single family	0.5 acre
	R-3 Residence	Single family	0.25 acre
	R-3A Residence	Single family	6,500
	R-4 Residence	One & Two-family	6,500-7,500
Village of Muttontown	A-1 Residence	Single family	2 acres
	E-3 Residence	Single family	3 acres
	E-5 Residence	Single family	5 acres
Village of Upper Brookville	R1 Residence	Single family	2 acres
	OP1 Open District (Suburban Estate)	Single family	5 acres
Village of Old Brookville	R-3A Residence	Single family	3 acres
	R-2A Residence	Single family	2 acres
Village of Brookville	R2	Single family[2]	2 acres[2]
	R4	Single family[2]	4 acres[2]
	R5	Single family[2]	5 acres[2]
Village of Centre Island	Residence A1	Single family[2]	3 acres
	Residence A2	Single family[2]	0.5 acre
Village of Lattingtown	R-15	Single family	15,000
	R-2A	Single family	2 acres
	R-4A	Single family	4 acres
Village of Laurel Hollow	R/I Residential/Industrial	Industrial	75 acres
	R Residential	Single family	15,000
Village of Oyster Bay Cove	A-1 Residence	Single family	2 acres
	A-2 Residence	Single family	6,000

[1]Unknown at the time of printing.
[2]Inferred from information provided on the municipal zoning maps.

11.3.3 Open Space

Open space plays a critical role in protecting and preserving the health of a watershed by limiting development and impervious coverage, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation. Open space includes preserved natural areas as well as lightly developed parks and playgrounds.

While approximately 15 percent of the Oyster Bay/Cold Spring Harbor Complex watershed consists of undeveloped land uses, not all of this land is considered open space because it may be privately owned and ultimately developed. Protected open space areas include deeded open space that is privately owned, parcels owned by land trusts, state and federally-owned land, and municipal park land. Such land is protected against future development. Several of the watershed county and municipal entities have prepared open space plans for their respective jurisdictions (*Table 11-4*).

Table 11-4. Open Space Plans

Jurisdiction	Open Space Plan
Town of Oyster Bay	Yes
Town of Huntington	Yes
City of Glen Cove	No
Villages	Some
Nassau County	No
Suffolk County	Yes*

*Open Space Acquisition Policy Plan

In addition to the designation of protected open space through donation, purchase of land by a municipality, conservation or land trusts, or other private and/or public agencies, municipalities may also require that new development projects set aside some land as dedicated open space. The subdivision regulations of many of the municipalities in the Oyster Bay/Cold Spring Harbor Complex watershed require the set-aside of a percentage of new subdivisions as open space, and some also have provisions for fee-in-lieu-of open space. *Table 11-5* summarizes responses from the surveyed watershed communities regarding their current open space regulations.

A majority of the surveyed watershed municipalities also allow cluster development, open space or conservation subdivisions, or other variations to standard lot layouts in their subdivision regulations. These are compact forms of development that concentrate density in one portion of the site in exchange for reduced density elsewhere, thereby reducing overall site imperviousness and associated stormwater impacts and potentially avoiding development in sensitive areas of a site.

Table 11-5. Open Space Regulations

Jurisdiction	Allow Cluster Development	Allow Open Space Subdivisions	Subdivision Open Space	
			Required	Fee in lieu of
Town of Oyster Bay	Yes	Yes	*	Yes
Town of Huntington	Yes	Yes	No	Yes
City of Glen Cove	Yes	Yes	Yes	Yes
Villages	No	No	Some	Some
Nassau County	N/A	N/A	N/A	N/A
Suffolk County	N/A	N/A	N/A	N/A

*In Aquifer Protection Overlay District only.
N/A - Not Applicable

11.3.4 Stormwater Management

Development of the landscape with impervious surfaces can alter the hydrology of a watershed and has the potential to adversely affect water quality and aquatic habitat. As a result of development, vegetated and forested land that consists of pervious surfaces is largely replaced by land uses with impervious surfaces. This transformation increases the amount of stormwater runoff from a site, decreases infiltration and groundwater recharge, and alters natural drainage patterns. Natural pollutant removal mechanisms provided by on-site vegetation and soils have less opportunity to remove pollutants from stormwater runoff. During construction, soils are also exposed to rainfall, which increases the potential for erosion and sedimentation. Development can also introduce new sources of pollutants from everyday activities associated with residential, commercial, and industrial land.

Stormwater runoff both during construction and following completion of construction for new development and redevelopment projects is regulated at the local and state levels. As shown in *Table 11-6*, all of the watershed municipalities have erosion and sediment control regulations as mandated by the NYSDEC Phase II Program (GP-0-08-002). All watershed municipalities have adopted regulations requiring that a soil erosion and sediment control plan be submitted with any application for development when the disturbed area of such development is more than one acre. Projects that disturb greater than one acre of land are subject to regulation under the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-08-001). This permit applies to discharges of stormwater from construction activities including, but not limited to, clearing, grading, and excavation that result in the disturbance of one or more acres of total land area as part of a development or redevelopment plan.

Post-construction stormwater quantity and quality are also regulated by the watershed municipalities through municipal planning and zoning regulations. All of the watershed municipalities are subject to the requirements of the NYSDEC SPDES Phase II stormwater program, which is regulated under the NYSDEC SPDES General Permit for the Discharge of Stormwater from Municipal Separate Storm Sewer Systems (MS4s)(GP-0-08-002). The Phase II General Permit regulates the quality of municipal stormwater discharges and requires the implementation of a Stormwater Management Program that addresses the following six minimum control measures:

1. Public education and outreach;
2. Public involvement/participation;
3. Illicit discharge detection and elimination including mapping all stormwater discharges from a pipe, conduit, or ditch owned or operated by the municipality;
4. Construction site runoff control;
5. Post-construction storm water management; and
6. Pollution prevention and good housekeeping for municipal operations.

All of the municipal entities within the watershed, including the Town of Oyster Bay, the Town of Huntington, the City of Glen Cove, and the villages and hamlets are regulated small MS4s under the NYSDEC SPDES Phase II program. This designation requires each municipal entity to develop and implement a Stormwater Management Program. As described previously, the municipal entities within Nassau County have formed a stormwater coalition with Nassau County for implementing their Stormwater Management Programs.

The NYSDEC has developed the *New York State Stormwater Management Design Manual* (as revised), which provides guidance on the measures necessary to protect the waters of the State of New York from the adverse impacts of post-construction stormwater runoff. It is intended for use as a planning tool and design guidance document by the regulated and regulatory communities involved in stormwater quality management in New York. The manual provides uniform guidance for developers, engineers, and review agencies on the selection, design, and application of stormwater control measures. All of the watershed municipalities in the Oyster Bay/Cold Spring Harbor Complex watershed have indicated that they use the stormwater manual in reviewing land development proposals.

Table 11-6. Municipal Stormwater Management Regulations

Controls	Oyster Bay	Huntington	Glen Cove	Villages	Nassau County	Suffolk County
On-Site Stormwater Management Requirements/Stormwater Management Plans	Yes	Yes	Yes	Yes	Yes	No
Erosion and Sediment Control Plans	Yes	Yes	Yes	Yes	Yes	No
Site Plan Review	Yes	Yes	Yes	Yes	Yes	No
Illicit Discharge Detection and Elimination Requirements	Yes (pending)	Yes	Yes	Yes	Yes	Yes
Environmental Assessment (SEQR)	Yes	Yes	Yes	Yes	Yes	No

11.3.5 On-Site Wastewater Disposal

As described in Section 6.3, significant portions of the Oyster Bay/Cold Spring Harbor Complex watershed are served by individual on-site sewage disposal systems, including cesspools and septic tank systems. These types of systems are a potential source of nitrogen, pathogens, and other pollution to surface waters and groundwater as a result of system failure (inadequately treating sewage or by creating potential for direct or indirect contact between sewage and the public) or malfunction (typically a slow loss of function that is difficult to detect).

All of the municipalities within the watershed rely on the County Health Departments for design guidelines and the approval of on-site wastewater disposal systems. Larger systems (e.g., 3+ family development; residential buildings housing 10 or more people; commercial, industrial, and residential development generating more than 1,000 gallons/day) are required to obtain approval from the NYSDEC SPDES program. Once constructed and operational, on-site wastewater disposal systems are no longer regulated by the County Health Department and are only inspected if a failure complaint is submitted to the County. The Towns and Villages also do not have requirements for ongoing inspection or maintenance of existing systems.

11.3.6 Aquifer Protection

Several of the county and municipal entities in the watershed have enacted aquifer protection regulations to protect drinking water supplies, in addition to the state-designated Special Groundwater Protection Areas, as defined in Article 55 of the NYS Environmental Conservation Law. As summarized in *Table 11-7*, the Town of Oyster Bay has an Aquifer Protection Overlay (APO) District, adopted in 2004, which affords added protection to both the quality and quantity of groundwater resources by restricting disturbance to natural vegetation, impervious surface coverage, hazardous material storage, creation, and disposal. The Town Code also states that the use of fertilizers, pesticides, and irrigation be minimized. Suffolk County also has designated Special Groundwater Protection Areas and associated regulations, which allow the County to acquire or purchase development rights on land within designated Special Groundwater Protection Areas and establish a Suffolk County Panel on Groundwater Protection.

Table 11-7 Aquifer/Groundwater Protection Regulations

Jurisdiction	Aquifer/Groundwater Protection Regulation
Oyster Bay	Yes
Huntington	No
Glen Cove	No
Villages	No
Nassau County	No
Suffolk County	Yes

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Appendix A

Pollutant Loading Documentation

Appendix B

Watershed Field Inventory Documentation