Crab Meadow Watershed Hydrology Study and Stewardship Plan

Final Draft

Town of Huntington
Suffolk County, NY

Submitted to
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Cover photo credit: Crab Meadow Watershed - Infrared low-flight aerial
With thanks to: Dr. Rebecca Boger, Jose Pillich, Ellen Hartig, and Brendan Duffy

Acknowledgements

Without the collaboration of many interested participants this project could not have been possible. The following individuals and organizations are gratefully acknowledged for contributing time, energy and expertise to the studies and stewardship plan development.

Crab Meadow Watershed Advisory Committee (CMWAC)

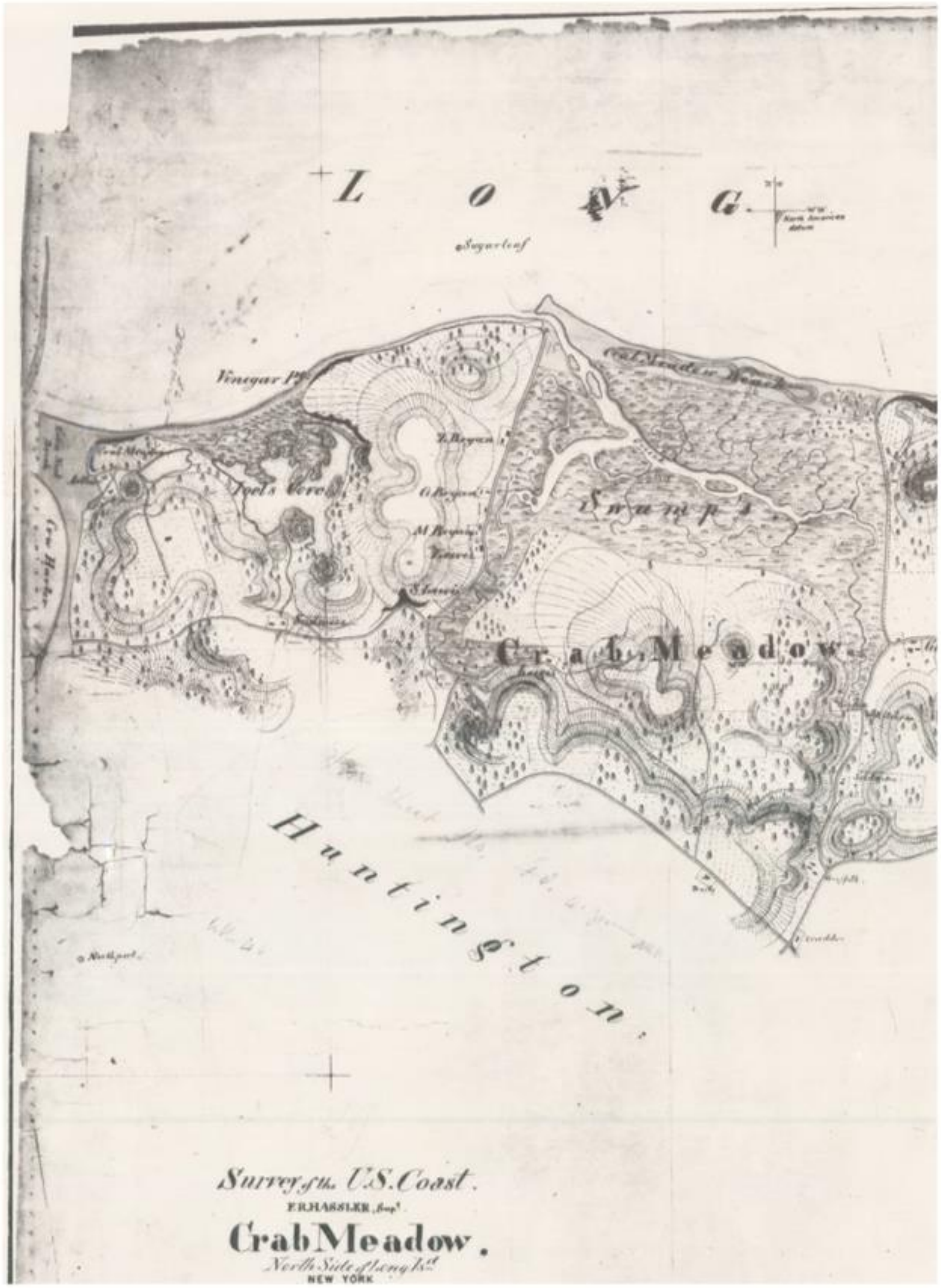
The Crab Meadow Watershed Advisory Committee was appointed by Town Board resolution on April 13, 2010 and expanded by Town Board resolutions on December 18, 2012 and January 29, 2019. Committee members who worked on this project were:

Marie Cancro and Kristin Colavito, Cornell Cooperative Extension
John Fischer and Bill O'Brien, Trout Unlimited
Stella Miller, Huntington-Oyster Bay Audubon Society
Joy Squires, Environmental Open Space and Park Review Advisory (EOSPA) Committee
Richard Meyer and Dr. David Tonjes, Huntington Conservation Board
Alex McKay, Suffolk County Park Trustees
Nick Gibbons, Suffolk County Parks, Recreation and Conservation
Dr. J. Bret Bennington, Hofstra University Center for Climate Study
Lucienne Pereira, visual artist/muralist
Jose Pillich, CUNY Graduate Center Program/Environmental Sciences
Gerard Kabacinski, Makamah Beach Homeowners Association
Ken Burr, Sound Shore Bluffs Property Owners Association Inc.
Scott Sayer, Waterside Park Association
Paul Zacher, Fort Salonga Association
Bill Berg and Janice Conte, Fort Salonga Property Owners Association

Garrett Chelius, Committee Chair, and Robert Litzke, Town Department of Maritime Services
David Kaufman and Christian Granelli, Town Department of Planning and Environment

Interested Community Members

We recognize and thank the many community members that spent their time with the consulting team and communicated with Town staff members, to share anecdotal information and concerns, and to imagine ways to enhance the watershed. It is expected that more will help to finalize this document to become a dynamic set of goals and best management practices that may be implemented in Crab Meadow and carried over throughout the Town's watershed areas.


L O N G
Sugarloaf
Vinegar Pt.
Joels Cove
Swamps
Crab Meadow
Huntington
Survey of the U.S. Coast.
F.R.HASSLER, Supt.
Crab Meadow.
North Side of Long Isd.
NEW YORK

Consulting Team

The team from GEI Consulting, Inc., P.C. assembled, interpreted, and synthesized information from multiple sources to result in the study and plan. Involved GEI staff members included Laura Schwanof, Kim Bradley, Erin Brosnan, Sarah Christian, Paul Drew, Bill Jacobs, Errol Kitt, Mary Beth Billerman, and Kristin Posnak. Unlike many other watershed plans, this stewardship plan sought to initiate, encourage and incorporate scientific endeavors, engage the involved community, and begin to establish a monitoring system of instrumentation in the critical publicly-protected open space in the primary area of the Crab Meadow Watershed (CMW).

Funding

Direct funding for this project was provided by a grant from the National Fish and Wildlife Foundation, Long Island Sound Futures Fund. It was matched by a grant from the Iroquois Gas Transmission System Community Program and in-service time and ventures of the Crab Meadow Watershed Advisory Committee members and Town of Huntington Departments of Planning and Environment, Maritime Services, Engineering Services, Parks and Recreation, General Services, Citizen Services, and Highway Department staff members.

Executive Summary

A stewardship plan is a land management tool to guide the implementation of "best practices." Protection and restoration/enhancement of this special coastal watershed for community, natural resource, and ecosystem benefit are its motivation. This endeavor has begun to identify physical conditions within the Crab Meadow Watershed and to recommend preliminary goals with a focus on lands in public ownership. It is expected that this document will be amended and extended with community input.

The Crab Meadow Watershed is an interconnected land system of glacially-formed features that as a unit drain to the Long Island Sound. The Sound impacts the land resource and the land resource affects the Sound. As the easternmost and largest coastal wetland expanse in the Town of Huntington, the Crab Meadow Watershed serves as a sentinel landmark. Crab Meadow is a designated Long Island Sound Study Stewardship Area. This document serves to identify initial strategies to maintain and enhance local watershed resources, recognizing that the Long Island Sound and its coastal watershed areas are being analyzed in several regional studies that will further define resiliency and protective measures for implementation.

Strategic goals suggested in the document have been derived in response to information obtained through stakeholder participation and reference studies. They focus on community involvement and education; habitat, plants and wildlife; water resources and water quality; access and recreation; land use; and infrastructure, restoration and historic resources.

Community Involvement and Education

- Establish CMW as Regional Coastal Research Area
- Raise overall public awareness and stewardship
- Improve educational resources and outreach
- Expand citizen science network
- Promote individual stewardship

Habitat, Plants and Wildlife

- Monitor protected areas to detect changes (e.g., species distribution, sea level rise)
- Manage, control or eliminate invasive plant species and nuisance wildlife
- Protect key nesting areas from recreational uses (e.g., plovers, snapping turtles)
- Restore and improve historic fish (Alewife) and eel (American) passages
- Maintain dynamic biodiversity inventory
- Calm traffic in proximity of park access points and at known wildlife crossings

Water Resources and Water Quality

- Define baseline conditions in surface waters and groundwater and strive to improve water quality
- Implement best management practices/green infrastructure to stem flooding, maximize infiltration, mitigate impacts to natural resources
- Measure, maintain and/or restore flows through CMW primary area
- Support and/or conduct pilot projects to confirm their potential for success (e.g., shellfish seeding in tidal creeks)
- Expand resource mapping (stormwater infrastructure)
- Continue seasonal beach clean-up days to marsh and upland parks to remove floatables and litter

Access and Recreation

- Continue watershed land conservation initiatives
- Provide sufficient parking and safe access to trails and all park resources
- Secure public recreational access agreement for portions of LIPA right-of-way that are not already in Town ownership
- Encourage major stakeholders/owners of critical holdings and individual owners to participate in watershed protection actions
- Stem vandalism and nuisance uses
- Promote passive recreation use to maintain natural area integrity

Infrastructure and Historic Resources

- Enhance resiliency of existing infrastructure
- Restore and expand opportunities for shoreline access
- Implement sustainable upgrade to Cranberry Hill Environmental Center to enable year-round use
- Develop exhibits and signage to interpret cultural and natural history of CMW
- Eliminate public property encroachments

The goals provide a framework for future efforts likely to involve the participation of several Town Departments, the CMW Citizens Advisory Committee, and other stakeholders. An initial goals chart can be found in Appendix A.

Online Resources

All of the maps and appendices contained in this document are available individually in full-size format for better viewing on the Town Crab Meadow Watershed website.

Introduction & Project Background

The Crab Meadow Watershed (CMW) Study Area includes over 3 miles of waterfront along Long Island Sound, and encompasses approximately 5.6 square miles as depicted in Figure 1. The Town Study Area is bordered to the west by the Villages of Northport and Asharoken, to the east by the Town of Smithtown (Fresh Pond), and is loosely bounded by Bellerose Avenue to the south.

In 1996, the Town Board accepted a Master Plan for the Jerome A. Ambro Memorial Wetlands Preserve and Crab Meadow Beach that was derived with community input. The initial recommendation for a hydrology study and plan was included in that document. Many goals identified in that plan were met, including construction of an accessible nature observation gazebo at Crab Meadow Beach, elevation of a large segment of Waterside Road with addition of sidewalks, establishment of a center for marine education programming, and development of interpretive trails information. In addition, the Town and County were able to protect several new park properties in the fresh headwaters areas of the primary watershed system that is a tributary to Long Island. Certain issues arose around one key acquisition, Fuchs Pond Preserve, and a subsequent elevated pond water level that required weir replacement. The focus led the Huntington Town Board to appoint individuals to a newly formed Crab Meadow Watershed Advisory Committee (CMWAC). The committee was charged with supporting the development of a hydrology study and stewardship plan intent on maintaining and/or enhancing watershed quality.

A $58,000 grant application to support a Crab Meadow Watershed Hydrology Study and Stewardship Plan was proposed to the National Fish and Wildlife Foundation's Long Island Sound Future's Fund and awarded in September of 2012. On October 28, 2012 Superstorm Sandy brought its force to Long Island and revealed certain vulnerabilities and inherent strengths in the specific watershed system. Key among these was an awakening of awareness of the value of the Town's significant wetland systems, Crab Meadow being the largest and primarily in public ownership.

Project Process

A Request for Proposals (RFP) was released, potential vendors were considered and a professional firm, GEI Consultants, Inc., P.C. (GEI) was selected and contracted by the Town. A Quality Assurance Project Plan (QAPP) necessary for data collection was approved by the United State Environmental Protection Agency as grant sponsor on May 30, 2014. This coincided with general orientation of the consultants, sharing of existing studies, reports, and GIS datasets, and planning and interacting with the CMWAC members and Town staff on how to approach the kick-off meeting and watershed model.

The initiative was introduced to town residents at an initial kick-off meeting on February 26, 2014 at the Northport Public Library. The meeting purpose was to inform the public about the project and grant, to begin a dialogue with the community, to encourage deliberation of place and role in the watershed, and to encourage community participation. PowerPoint presentations included a photo tour of the watershed and a lesson on what a hydrology study/watershed model is and how it will be used. Town Councilman Mark Cuthbertson opened the session. Six elected officials sent their staff members to the first meeting to learn of and to support the initiative -- Congressman Steve Israel, State Assemblyman Andrew Raia, State Assemblyman Chad Lupinacci, Suffolk County Legislator William Spencer, Town Councilwoman Susan Berland and Town Councilwoman Tracey Edwards.

Key presentations were made by GEI Project Lead Laura Schwanof and Hydrologist Paul Drew, and Long Island Sound Study Habitat Restoration Coordinator Victoria O'Neill. The Crab Meadow Watershed brochure was distributed at the meeting that was attended by 70 participants and followed by substantial media coverage to impart critical information on the endeavor. Residents were provided an opportunity to view large-sized aerial photos that showed a land use progression in the watershed from 1930 to present. Attendees were asked to place colored dots on a current aerial photo to pinpoint problem areas that warrant scrutiny and action. This provided essential baseline guidance to the GEI team.

A second community session was held on June 5, 2014 at The View restaurant at Crab Meadow Golf Course in the CMW primary area where afternoon and evening sessions were held. This session's goal was to inform the public of GEI's preliminary findings, of some of the research projects that are supportive to this initiative, and to encourage and accept public input. Laura Schwanof, GEI Project Lead, presented. Two research projects were highlighted with Dr. Bret J. Bennington of Hofstra University presenting in the afternoon session, "Analyzing Marsh History and Impacts/ Radiocarbon Dating of Core Samples," and Jose Pillich of CUNY Brooklyn College presenting in the evening session, "Tracking Sea Level Change / Aerial Photo Reconnaissance & Surface Elevation Table Installation."

Six break-out discussions followed and were facilitated by GEI, Town Maritime Services and Planning and Environment staff members. Three topics ran consecutively. The break-out sessions followed the topics to be included in the stewardship plan: Access and Recreation, Community Involvement and Education; Habitat, Plants and Wildlife; Infrastructure, Restoration and Historic Resources; Land Use; Water Resources and Water Quality. The sessions were attended by 65 people. Some volunteered to continue to discuss the issues, challenges and suggestions that were derived from the meeting at a follow-up session. Some residents signed on to become appointed park stewards and to assume other volunteer roles. The Town shared information on the project through multiple media modes building interest and participation. Local news media provided excellent coverage.

On July 31, 2014 a follow-up meeting of residents that volunteered for the subcommittee topics met at The View restaurant at Crab Meadow Golf Course to frame goals and strategies for the stewardship plan and to prioritize them. This planning session was attended by 30 people.

GEI prepared a draft plan and submitted materials to the Town Departments of Planning and Environment and Maritime Services, which then distributed the draft document to the Crab Meadow Watershed Advisory Committee (CMWAC) and to multiple Town department heads. The draft document was revised to include corrections from that review and add additional information. It is a dynamic document, subject to refinement.

Comments received from the public will be addressed by the CMWAC and be incorporated into the document as part of the public review process. The Town and GEI's approach to this project has been a community driven, bottom-up grass-roots approach. All related public meetings were held at locations within the Crab Meadow Watershed study area. Presentations at meetings were filmed by the Town's digital media specialist. While the first community meeting was held in the winter during a bitter cold spell that may have limited attendance, it was available to be widely viewed on YouTube, Facebook, the Town's website and on Public Access TV.

The first meeting was shown on Huntington Town TV (HTTV). It started airing in April 2014 at a frequency of 10 times per week and thereafter showed about 4 times a week. A video for the second meeting was added to the HTTV schedule in July 2014 at a frequency of 7-9 times per week and continued to be shown about 4 times a week. Maps and information relating to the project have been available on the Crab Meadow Watershed website (www.huntingtonny.gov/crab-meadow-watershed) since October 2014. Several key partnership analyses remain active.

Accomplishments – Partnerships and Research

Partnerships and research have been at the core of this endeavor from the beginning supporting project objectives. Among the projects, support and data collection efforts advancing this effort with CMWAC and Town staff member involvement that have been accomplished are:

- Crab Meadow mural, accompanying educational guide, and logo development – Lucienne Pereira, artist, with Cornell Cooperative Extension of Suffolk County Sea Stars Marine Camp;

- Crab Meadow Watershed educational materials (website framework/brochure/poster) supported by Iroquois Gas Transmission System community grant – Cornell Cooperative Extension of Suffolk County;

- Authorization to incorporate County properties in watershed analysis – Suffolk County Department of Parks, Recreation and Conservation;

- Stream temperature study (2011-present) supported by Iroquois Gas Transmission System community grant – partnership with Trout Unlimited Long Island Chapter;

- Stream visualization assessment – partnership with Trout Unlimited Long Island Chapter;

- Preliminary trout fingerling release – partnership with Trout Unlimited Long Island Chapter;

- Marsh coring and analysis – Department of Geology, Environment and Sustainability, Hofstra University Center for Climate Study;

- Low level aerial reconnaissance/photography of Crab Meadow marsh – partnership with CUNY Brooklyn College;

- Installation of surface elevation tables – partnership with CUNY Brooklyn College supported by The Nature Conservancy and NYS Department of Environmental Conservation; and

- Surface and ground water monitoring/ well data – partnership with Suffolk County Department of Health Services, Drinking Water Division;

- Sediment-bound Contaminant Resiliency and Response (SCoRR) pilot study partnership with United States Geologic Survey;

- Interpretive narrative development for educational trail signage in Ambro, Fuchs and Ingraham Nature Preserves – partnership with SUNY Stony Brook Department of Technology and Society; and

- Nitrogen uptake by *Phragmites communis* study (ongoing) with sampling from Ambro Preserve – partnership with SUNY Stony Brook Department of Ecology and Evolution working with Brentwood High School Research Science Team.

Time and cost being limited, this plan is a preliminary effort to characterize conditions, pressures, needs, and strategies. It will be refined through the public review process and evolve as information grows and research expands, as community and individual understanding increases, and as responsive stewardship actions follow. Many issues will need to be tracked. Sea level is rising, species diversity is decreasing, invasive species are spreading, and everyday life and general practice threatens the quality of Long Island Sound. There are many opportunities to implement best practices to meet these challenges.

CHAPTER 1 – EXISTING CONDITIONS REPORT

1.1 Natural Landscape / Physical Characteristics

1.1.1 Formation of Long Island

There is geologic information developed for the northern portion of Huntington available for further review on the Crab Meadow Watershed (CMW) web portal at http://www.huntington.gov/crab-meadow-watershed. Long Island was formed about 20,000 years ago when the Laurentide Ice Sheet overspread New York State during the Wisconsinan glacial episode of the Late Pleistocene Epoch. As the margin of the ice sheet advanced and retreated across an extended Atlantic coastal plain exposed by lowered sea level, a variety of sedimentary materials (glacial "drift") were deposited to form the body and landforms of Long Island.

The glacier's southerly advance halted when the rate of ice flow was balanced by the rate of ice melting at the southern margin of the glacier. This equilibrium state, maintained for a sufficient amount of time, delivered a large quantity of ice-transported sediment (glacial drift) and rock (erratic boulders) to form what is known as a "moraine" ridge along the ice sheet's southern margin. Long Island is made up of three principal moraines (Figure 1). The Ronkonkoma Moraine is the oldest, extending from the vicinity of Westbury in western Long Island to Montauk Point. Although commonly regarded as a "terminal moraine" that marks the farthest reach of the glacier's advance, glacial till and erratic boulders south of the Ronkonkoma moraine indicate that a true terminal moraine likely existed seaward of the present south shore of Long Island prior to being eroded away during post-glacial sea level rise. During glacial retreat, the ice sheet paused along the north shore of eastern Long Island and deposited drift to form a ridge from Mount Sinai to Orient Point known as the Roanoke Point Moraine. This formed a "recessional moraine" that is characterized by small lateral ridges and irregular hilly topography north of the moraine. In this region, however, most of the deposits north of the moraine ridge have been eroded away by wave action and the Long Island Sound shoreline abuts directly against the crest of the moraine.

At the southern edge of Huntington Town, the western extent of the Ronkonkoma Moraine is cross-cut by two north-south trending sets of hills. The western set resides in the area of West Hills; the eastern set covers the areas of Half Hollow Hills and Dix Hills. These hills have an elongated branching structure that resembles the lobes of a delta. Although the origin of these features is controversial, several researchers have dubbed these "Kame Deltas" (Figure 1) implying that when the ice sheet on Long Island was depositing the Ronkonkoma Moraine, water from the melting glacier was dammed up behind a now lost terminal moraine south of present day Long Island. This meltwater formed a proglacial lake and meltwater streams deposited outwash into the lake and created lobe-shaped hills of stratified sand and gravel to form the Kame Deltas.

Later, prior to the retreat of the glacier back into southern Canada, the ice sheet re-advanced from the northwest forming the Harbor Hill Moraine, a terminal "push moraine" that extends from the Island's western edge in Brooklyn to Port Jefferson. The Harbor Hill Moraine truncated the western extent of the Ronkonkoma Moraine, making the latter appear to stop near the location of Lake Success, where the moraines intersect. This last glacial advance resulted in ice riding up over previously formed recessional moraine glacial deposits, in some cases pushing and deforming them into steep ridges along the crest of the moraine (examples can be seen in Stony Brook and in East Northport). After advancing, the ice began to finally waste away, leaving behind deposits of till that form the hilly topography of western Long Island north of the Harbor Hill moraine ridge, including the necks of Huntington Township (Lloyd Neck, East Neck, Little Neck, and Eaton's Neck). The relatively flat areas south of the Harbor Hill Moraine are formed from outwash fans of sediment deposited by meltwater disgorging from tunnels along the margin of the ice sheet. These deposits of stratified drift (layered sands and gravels) coalesced to form an outwash plain that slopes gently away from the moraine crest to the south.

After the Wisconsinan glacier retreated even further north into Connecticut, glacial runoff created a huge proglacial lake on the Long Island Sound basin with the edge of the glacier acting as a dam. About 16,000 years ago, the glacial ice receded farther and the lake drained, leaving a dry valley. Winds blowing away from the glacier across the valley picked up fine glacial rock flour and deposited it across Long Island to form a surface layer of loess. As the rapidly melting glaciers around the world began returning water back to the oceans, sea level continued to rise. This eventually flooded the elongate Long Island Sound basin and hundreds of square miles of the surrounding low-lying regions between Long Island and Connecticut, and between the forks of Suffolk County, to give the characteristic shape of Long Island as we know it today.

1.1.2 Glacial Geology and Topography

As described in the Geology section above, the irregular surface topography of the Crab Meadow Watershed (CMW) has been largely determined by the advance and deposition of glaciers, particularly the glacier forming the Harbor Hill Moraine. The lowest elevations in the CMW occur near the north end of the wetland where it meets the waters of Long Island Sound. The predominant elevation of the Crab Meadow marsh is 4 feet above mean sea level (MSL). The highest elevations (approximately 250 to 300 feet above MSL) hug the ridgeline of the Harbor Hill Moraine forming the southern (secondary) watershed boundary, which closely follows an east-west orientation bounded by Bellerose Avenue and Laurel Hill Road (Figures 2 & 3). Between the northern and southern boundaries of the CMW the topography is dominated by irregular hills and depressions called "kame and kettle" topography and steep-sided, sinuous to linear valleys known as "Tunnel Valleys" (Figure 4). The largest tunnel valleys trend north to south and form the narrow harbors separating the necks that are characteristic of the north shore of western Long Island. South of the moraine crest and secondary watershed boundary the land is relatively flat and slopes gently to the south forming a broad outwash plain composed of sand and gravel deposited by flowing meltwater draining away from the terminal margin of the glacier.

The glacial drift deposits underlying northern Huntington Town are complicated. They include a mix of till (a poorly sorted mixture of sand, silt, and clay with large cobbles and boulders that forms in contact with melting ice), outwash (layered deposits of sand and gravel transported by water flowing out from beneath the melting ice), loess (windblown dust and silt-size particles of pulverized rock formed when glaciers grind rocks to a fine powder), and older Cretaceous sediments scraped up by the advancing ice and incorporated into the glacial deposits.

Kame and kettle topography forms as sediments accumulated within and on top of the glacier are left stranded on the land surface as the glacial ice wastes away. An inversion of space occurs as depressions and holes in the ice filled with sediment become irregular hills of till (kames) and blocks of stranded ice buried in till melt to leave behind crater-like depressions (kettles). Kame and kettle topography is characterized by irregular mound like hills adjacent to semi-circular depressions with a wide range of sizes. Glacial erratic boulders are common features of this terrain along with pebbly and sandy soils. Although the landscaping that accompanies development has modified the natural topography in much of the CMW, excellent examples of kame and kettle topography can still be seen in the southern part of the CMW in the Veterans Nature Study Area and Knolls and Meadowlark Parks, and in the northern part of the CMW in the Fuchs Pond, Henry Ingraham, and Makamah Nature Preserves.

Tunnel Valleys are formed when meltwater forms channels within and beneath the base of the glacier and erodes tunnels into the semi-consolidated glacial and coastal plain sediments beneath the ice. These symmetrically steep-sided, relatively narrow valleys are unusual because they begin and end abruptly, trend both uphill and downhill, intersect one another, lack a large drainage basin, and do not host flowing streams.

In the CMW prominent tunnel valleys trend north to south and terminate just south of the Harbor Hill terminal moraine located between Route 25A and Pulaski Road in Huntington (Figures 2, 3 & 4). These include the valleys that host Waterside Avenue and Vernon Valley Road (western CMW), Bread and Cheese Hollow Road and Town Line Road (eastern CMW), and Stony Hollow Road (the Stony Hollow valley is an extension of two coalescing tunnel valleys that form Northport and Centerport Harbors.) Tunnel valleys with different orientations that do not intersect the moraine ridge include the valleys that host Makamah Road (central CMW) and Main Street in Northport Village. Meltwater flowing through the main tunnel valleys exited over and through the terminal moraine ridge disgorging sediments to build up the outwash plain south of the Harbor Hill moraine in Greenlawn and East Northport.

It should be noted that both the western and middle tunnel valleys lead to the CMW, while the eastern tunnel valley does not, but is within the CMW study area. These north-south oriented features are readily visible in Figure 2, and closely correspond to the main drainage channels that feed into the Crab Meadow marsh (a.k.a. the Jerome A. Ambro Memorial Wetland Preserve).

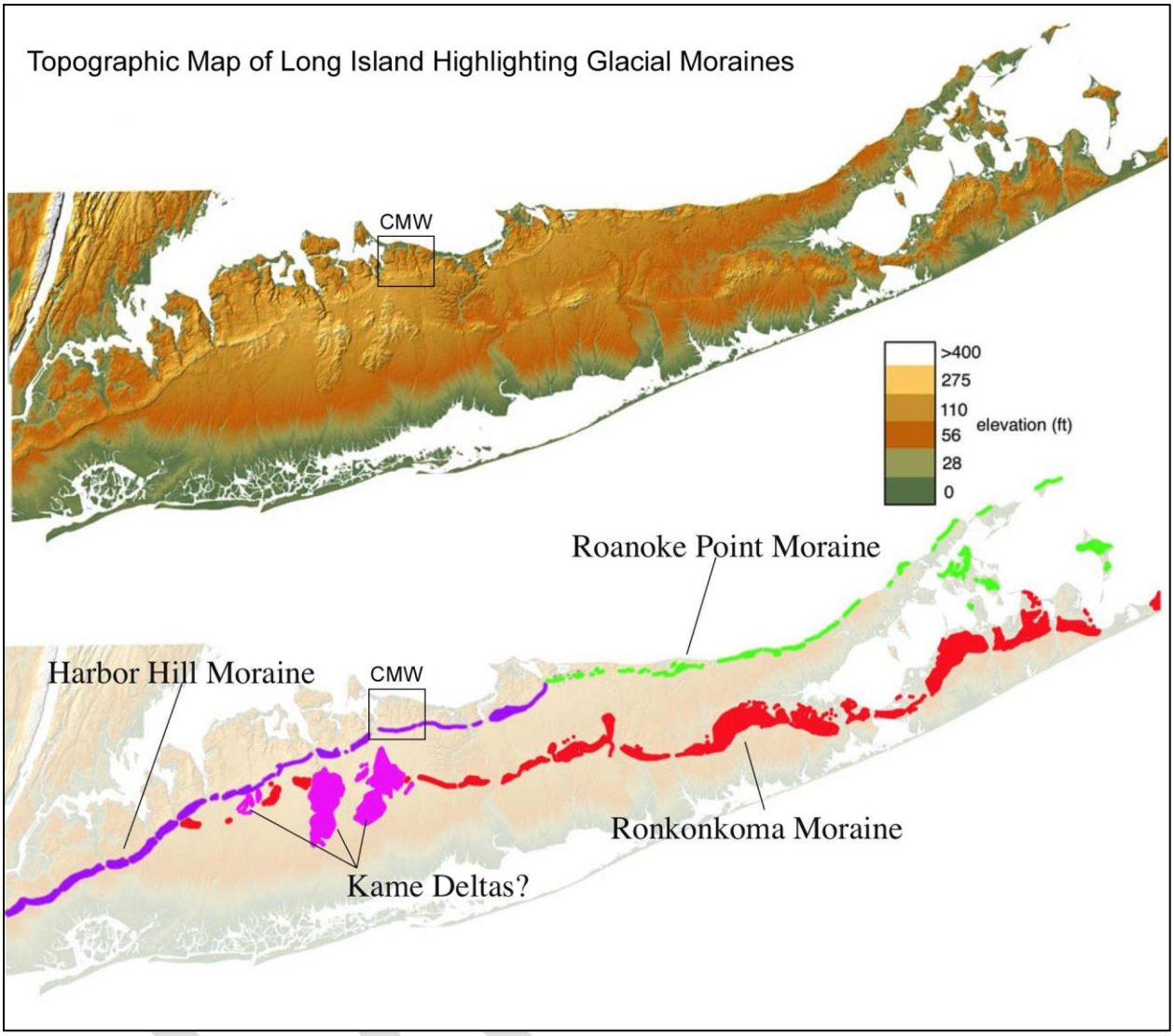


Figure 1. Digital Elevation Model topographic map of Long Island highlighting glacial moraines.

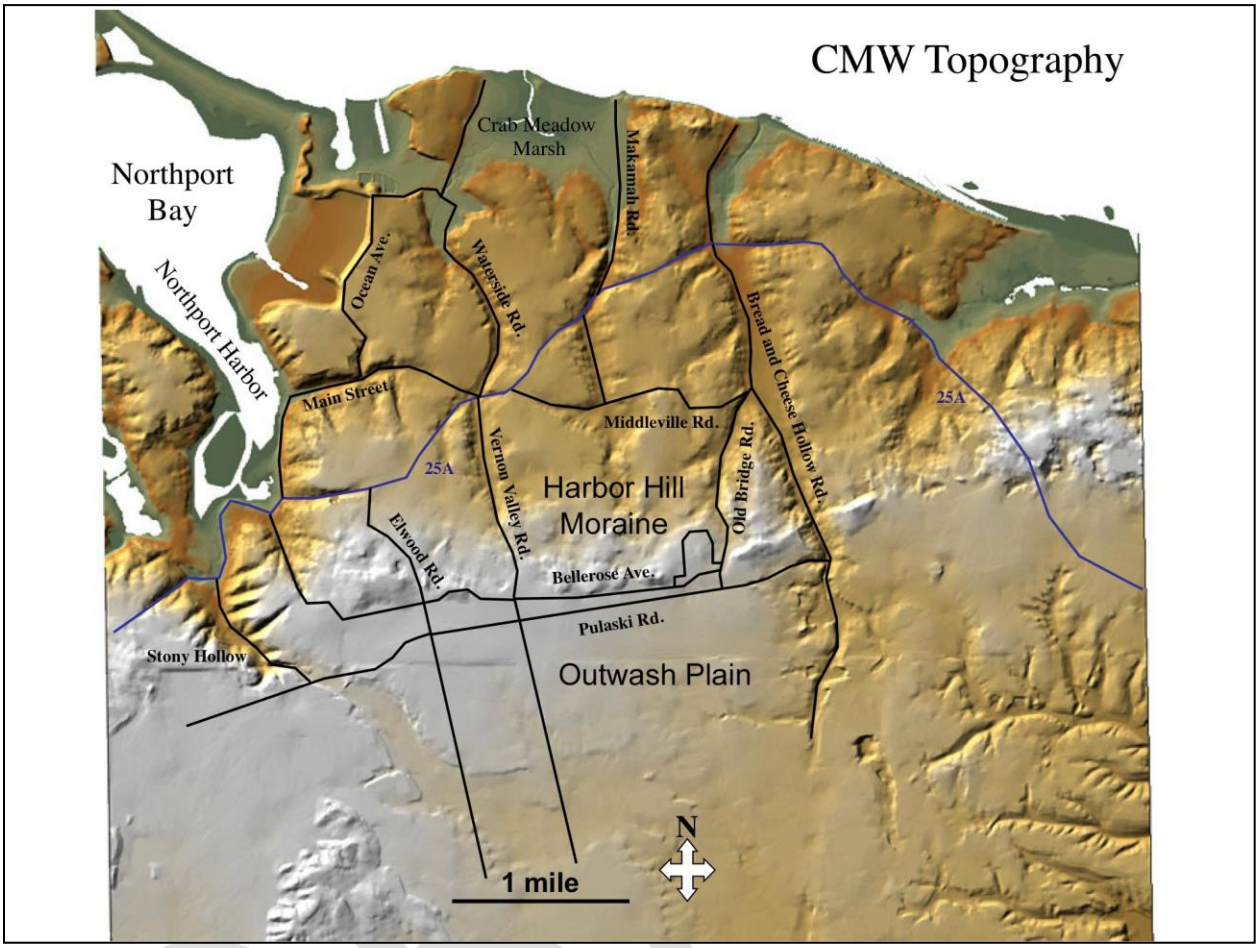


Figure 2. Digital Elevation Model topographic map of the CMW region.

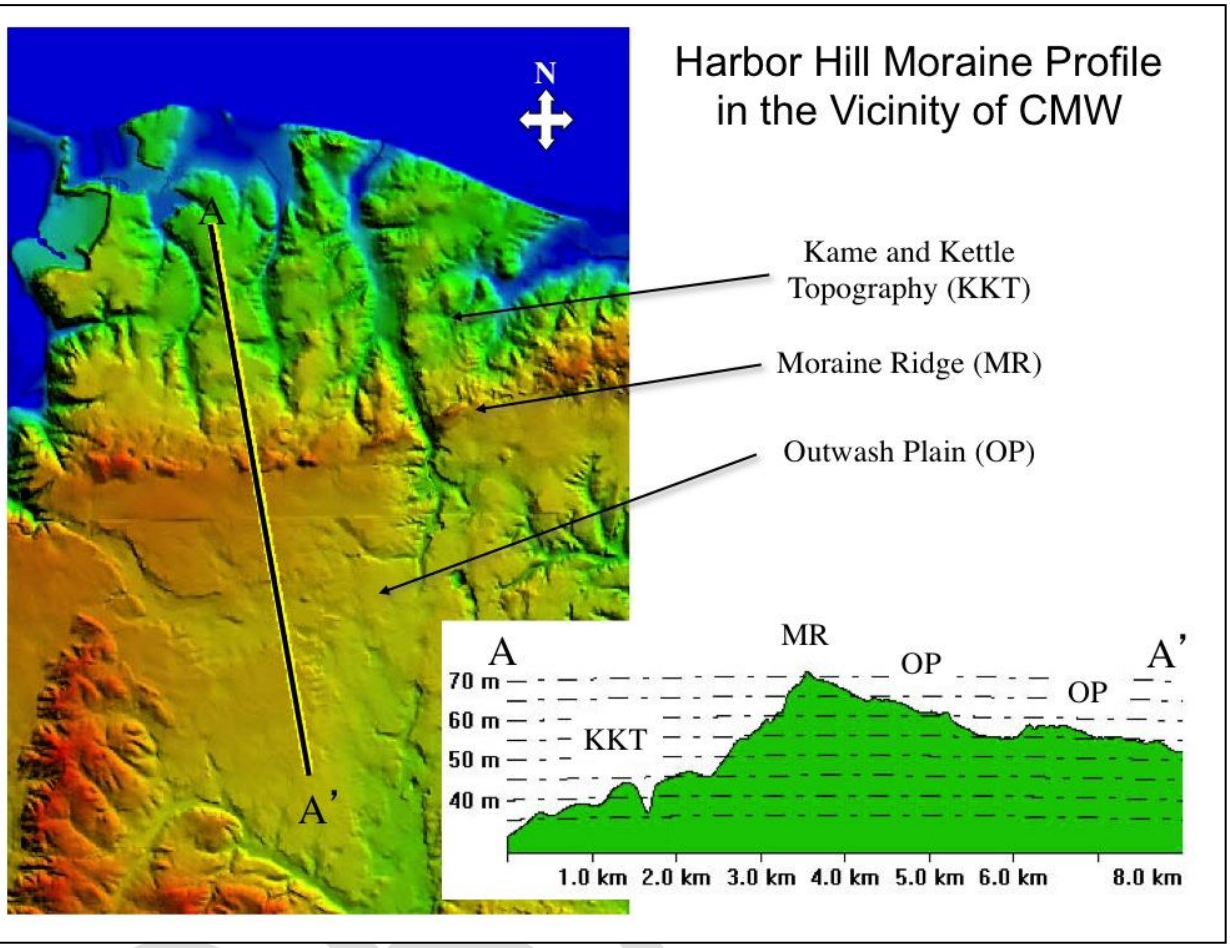


Figure 3. Topographic profile of the Harbor Hill Moraine and outwash plain in the CMW region showing elevation change across major glacial topographic features.

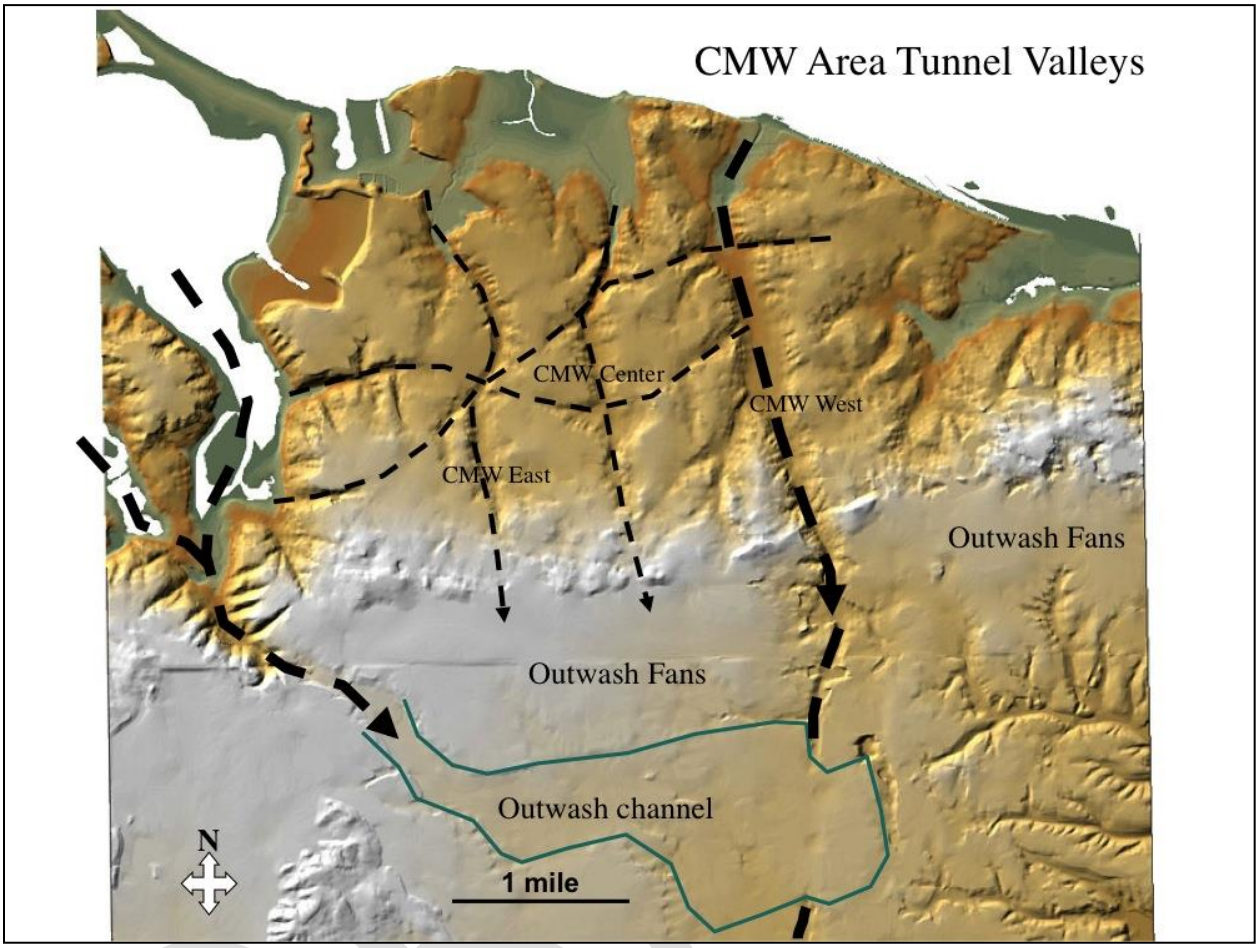


Figure 4. Anastomosing system of subglacial tunnel valleys in the CMW region.

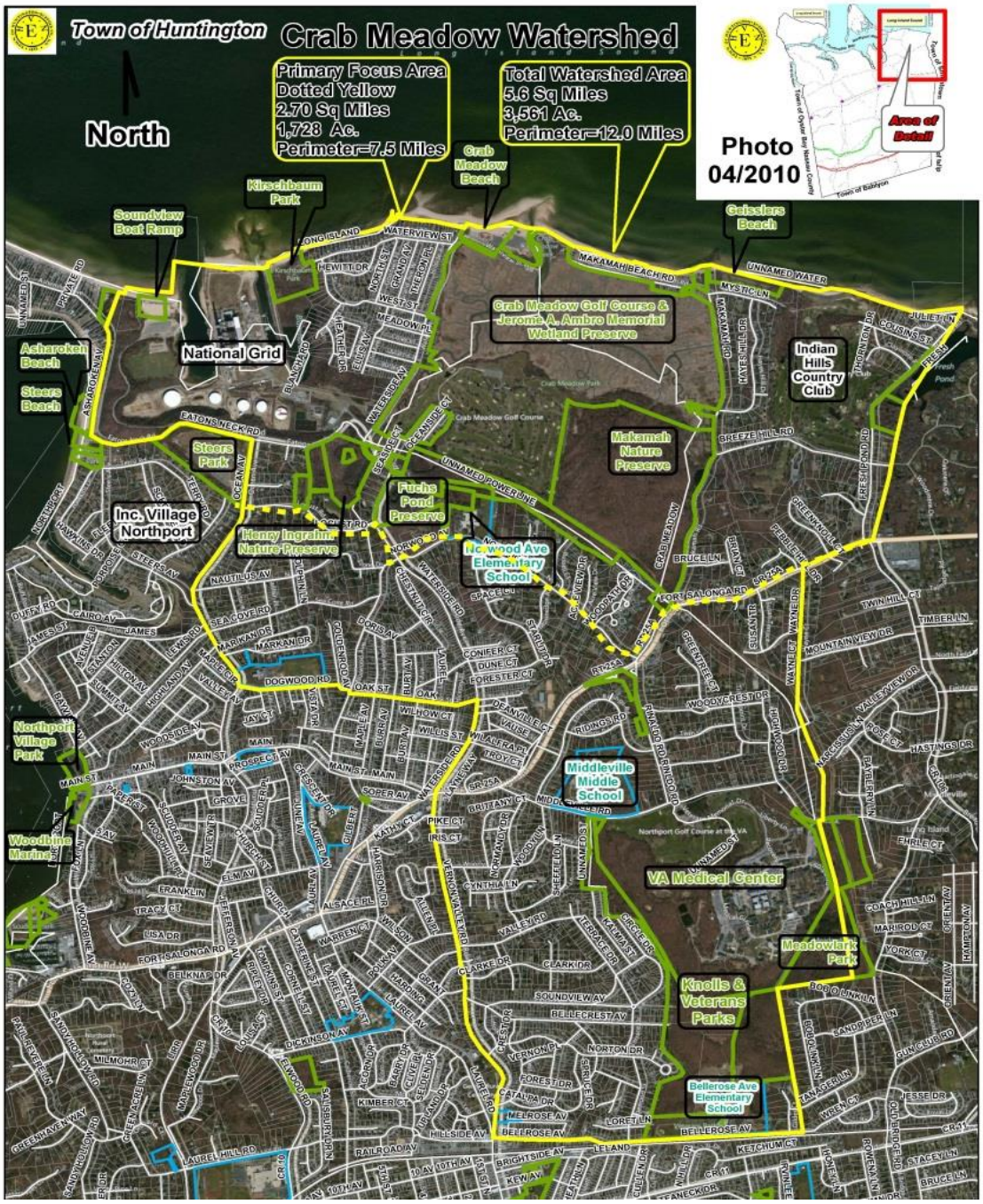


Figure 5. Crab Meadow Watershed Primary & Secondary Study Areas

1.1.3 Watershed Boundaries

Prior to the onset of this study, the Crab Meadow Watershed Advisory Committee (CMWAC) developed a preliminary watershed map shown in Figure 5. GEI conducted an independent review of the entire study area to identify the direction of surface flows and to verify the watershed boundaries based on a topographic evaluation. GEI's analysis is presented graphically in Figure 2. GEI found that the Town's Primary Focus Area along the north shore encompassed a larger extent than the actual topographic boundaries by including the National Grid Power Plant in the northwest and Fresh Pond in the northeast portions of the study area. On the southern portion of the study area, the initial watershed boundary appears to be shifted east of the actual topographic divides, with the differences most evident at the southeast and southwest corners. The original watershed boundaries followed local roadways and included complete tax parcels for ease of reference. It was GEI's recommendation that the official watershed boundaries more closely correlate to actual field conditions, as shown by the dashed lines in Figure 4. However, the preliminary watershed boundaries established by the CMWAC (that were included with the National Fish and Wildlife Foundation grant request) have been used to define the total study area, and used as the input for the hydrologic model.

As urban and suburban areas develop, the process of land grading typically directs stormwater flows away from buildings and toward area roadways where concentrated flows occur along the edges of streets. Conventional drainage systems on Long Island typically collect this runoff into curb inlet catch basins installed on either side of a crowned street, and then direct and dispose of stormwater into individual leaching pools, vertical drains or sumps that ultimately recharge shallow groundwater reserves. Since each of these drainage features collect stormwater from individual subwatershed areas, it could be argued that collectively these could reduce the overall size of the CMW. However, as the path of the groundwater collected by these structures has not yet been fully defined, it is likely that they still contribute to stream flows down-gradient within the CMW area.

1.1.4 Soils

During the late 1960s and early 1970, the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) field characterized the surface soil profiles (top 4 to 5 feet) across Suffolk County and compiled a comprehensive set of maps into the Soil Survey of Suffolk County, New York. Since then, the soil maps developed by the National Cooperative Soil Survey have been digitized into the Soil Survey Geographic (SSRGO) data set. The USDA metadata describes this data set as consisting of georeferenced digital map data and computerized attribute data. The map data includes the detailed, field verified inventory of soils and miscellaneous areas that can be cartographically shown at the scale mapped. An optional special soil features layer displays the location of features too small to delineate at the mapping scale, but large and contrasting enough to significantly influence use and management. The soil map units are linked to attributes in the National Soil Information System relational database that gives the proportionate extent of the component soils and their properties.

The soil profiles include narrative descriptions of typical soil pits, their color, slope, texture, percent organic matter, and associated engineering properties. Soils exhibiting similar characteristics were classified into groups and named as a series. The mapping units shown on a Soil Survey generally correspond to one soil series, but may also include slightly different phases of the same series, or a composite of two closely related series that are mapped together due to the scale of the mapping. Therefore, a soil mapping unit shown on the Soil Survey will consist of the dominant soil, or two or more with similar properties.

Figure 6 depicts the soil mapping units found within the CMW. The colors on the map further segregate the soil map units into various runoff-producing characteristics defined as hydrologic soil groups.

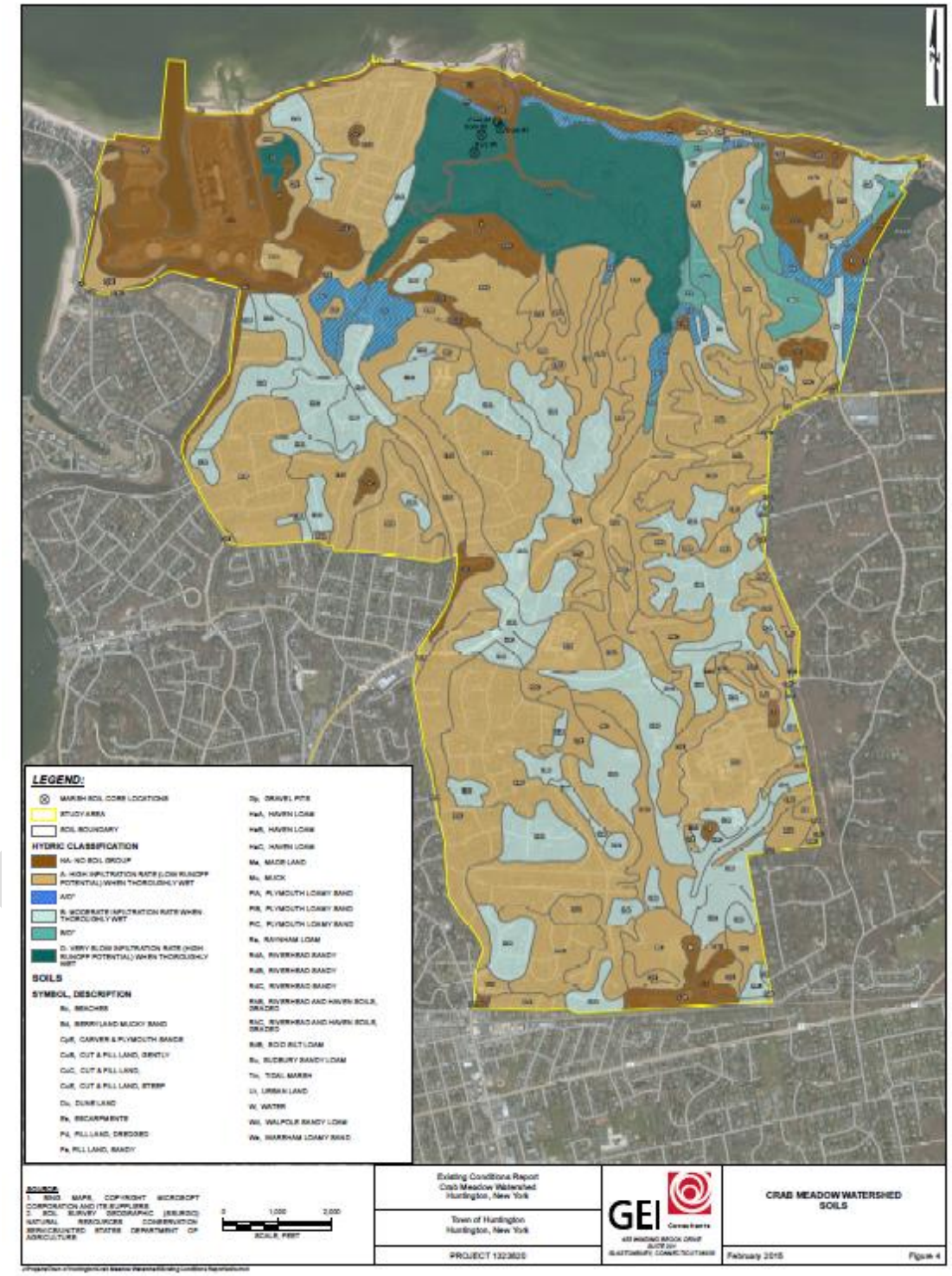


Figure 6. Crab Meadow Watershed Soils

Soils in the United States are assigned to one of four groups (A, B, C, and D) according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. According to the USDA, the hydrologic soil groups are defined as follows:

- ***Group A:*** Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

- ***Group B***: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

- ***Group C***: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

- ***Group D***: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

- ***Dual Soil Groups***: Additionally, soils may be assigned to one of three dual classes (A/D, B/D, and C/D). If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for un-drained areas. Only the soils that in their natural condition are in Group D are assigned to dual classes.

As stated above, soils in Hydrologic Group A include sand, loamy sand or sandy loam, which exhibit high infiltration rates, and typically produce little runoff when thoroughly wetted. As shown in Figure 6, the vast majority of the soil types in the CMW include relatively deep, well drained, granular soils in Group A (i.e., Carver and Plymouth sands, and Riverhead sandy loam) associated with relatively high infiltration rates, as depicted by the light brown color. Hydrologic Group B includes silt loam or loamy soils with moderate infiltration rates, and Hydrologic Group C includes sandy clay loam soils that typically contain a layer that impedes the downward movement of water. Soils in Hydrologic Group D include clay loam, silty clay loam, sandy clay, silty clay or clay mucks, and "hydric" wetland soils that are sufficiently wet in the upper horizons to develop anaerobic conditions during the growing season. Group D soils typically have very slow infiltration and percolation rates, which result in higher rates of runoff. Note that these "down-drainage" soils are indicated by the blue and green colors in Figure 6, clustered at the lower elevations in the CMW, generally surrounding the valley channels and marsh areas described in the topography section above.

Understanding the basics of the various soil series and hydrologic soil groups is necessary to convey the significance of their potential role in the CMW, their effects on water quality and quantity or delivery rates in the watershed model. Very coarse, excessively drained soils that offer little resistance to flow, such as Carver in Hydrologic Group A, exhibit rapid permeability rates, that might be considered good from a drainage disposal perspective. However, they also offer less natural fertility and are characteristically droughty, restricting the types of plants that can be supported without irrigation, and provide poor filtration of potential contaminants that might percolate down to the groundwater or be carried into surface waters.

Haven loam soils (HaA, HaB and HaC) resemble commercial topsoil, have a high available moisture capacity and moderate permeability (Hydrologic Soil Group B) are considered prime agricultural soils, and well suited for supporting most landscape uses and upland wildlife habitat. Scio silt loam (SdB) and Raynham loam (Ra) typically occupy lower-lying areas than Haven soils, have a seasonal perched water table and are often associated with wetland transitional areas. These soils are well suited to serve as stormwater detention areas and unfertilized natural buffers between landscaped upland areas and regulated wetlands.

Table 1 lists the soils mapped within the CMW, provides a brief profile description, a summary of the drainage characteristics, and a short list of characteristic native and adapted vegetation.

The more urbanized portions of the watershed mapped as urban land, or urban land-soil complexes are problematic in terms of stormwater management. As the amount of impervious surfaces increase, so does the flow rate and volume of stormwater runoff due to a reduction in natural soils areas capable of intercepting and infiltrating these flows. Additionally, as the intensity of development increases, there is typically less open space area remaining that can capture and store these increased volumes of runoff. Runoff generated from urbanized areas can easily pick up contaminants such as grease and oils, pet and wildlife wastes, and sediments along the flow path. If there are no measures in place to filter or pre-treat these loads, they can easily be transported into stormwater drainage systems, wetlands and other water bodies, resulting in water quality degradation.

Dr. J. Bret Bennington, Chairperson of Hofstra's Department of Geology, Environment, and Sustainability contributed the following site specific soil information to this study. In the spring of 2014 four sediment cores were collected from the Crab Meadow wetland to sample the sedimentary record of marsh environments. Each core was collected using standard vibracoring techniques, producing 3" diameter cores ranging from 1.2 meters to almost 2 meters in length. The cores have been split, measured, and photographed and one split of each core has been sampled at 1 cm intervals for analysis of grain size, mud content, trace metal content, and macro and micro fauna and flora. The upper 1 meter of each core consists of peat and muddy peat containing agglutinated foraminifera consistent with deposition in high marsh to low marsh environments. The lower interval of the two deepest cores consists of muddy sands populated by organisms that tolerate a narrow salinity range (e.g., marine mollusks and calcareous foraminifera characteristic of a more stenohaline bay environment).

Analyses of trace metals at different core intervals shows low levels of lead (Pb), copper (Cu), and zinc (Zn) near the bottom of the cores. Levels were found to increase beginning mid-core to levels consistent with values reported for the mid - late 20th Century, suggesting that the total amount of time encompassed by the cores is approximately 200 years. Ultimately, Hofstra intends to complete radiocarbon dating of the cores, however, that has not been completed to date. Seven additional soil cores were extracted during the installation of the piezometers surrounding the marsh, but have not yet been analyzed.

1.1.5 Wetlands

Wetlands are defined by the United States Army Corps of Engineers (USACE) and the US Environmental Protection Agency (EPA) as "an area that is inundated or saturated by surface or groundwater at a frequency and duration to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation". Wetland is a collective term for swamps, bogs, marshes, wet meadows, and similar transition areas between open water and upland habitats.

The United States Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) has several tidal and freshwater wetlands mapped within the CMW, as shown in Figure 7. The Crab Meadow Marsh is mapped as an Estuarine/Marine Wetland system of more than 2.5 acres and is characterized by the Cowardin et al. (1979) classification code E2EM1Pd (see http://107.20.228.18/decoders/wetlands.aspx) and defined below as:

- E – System Estuarine: The Estuarine System describes deepwater tidal habitats and adjacent tidal wetlands that are influences by water runoff from and often semi-enclosed by land. They are located along low-energy coastlines and they have variable salinity.
- 2 – Subsystem Intertidal: This is defined as the area from extreme low water to extreme high water and associated splash zone.
- EM – Class Emergent: Characterized by erect, rooted herbaceous hydrogphytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
- 1 – Subclass Persistent: Dominated by species that normally remain standing at least until the beginning of the next growing season. This subclass is found only in Estuarine and Palustrine systems.
- P – Water Regime Irregularly Flooded: Tidal water floods the land surface less often than daily.

- d – Special Modifier Partially Drained/Ditch: A partially drained wetland that has been hydrologically altered but soil moisture is sufficient to support some hydrophytes. Totally drained areas are not considered wetland if they can no longer support hydrophytes. This modifier has also been used to indicate wetlands connected by extensive ditch networks. The "d" modifier can be applied to wetlands with ditch or drain networks or wetlands adjacent to the ditches, even if the ditch is too small to be included in the delineations. Large ditches that may be delineated as separate features should have the "x" modifier applied to the ditch itself and the "d" modifier applied to the wetland area.

The CMW contains five (5) mapped freshwater wetland systems that are under the regulatory jurisdiction of New York State Department of Environmental Conservation (NYSDEC) (i.e., NYSDEC IDs: N-1, N-2, N-3, N-6, N-7, N-8, and N-13). Some of these systems have multiple wetlands associated with a designated NYSDEC ID and many of them overlap NWI mapped systems (see Figure 5).

Freshwater wetlands are classified pursuant to state regulation (6 CRR-NY664.5) depending on cover type, ecological associations, special features, hydrological and pollution control features, distribution and location. All but wetland N-8 in the Crab Meadow Watershed are Class 2 wetlands. Wetland N-8 is Class 1. All of these are the most significant with Class 1 being the highest. The NYSDEC is considering a proposed amendment to extend mapped wetland N-8 in the vicinity of Makamah and Breeze Hill Roads.

NYSDEC regulated tidal wetlands are depicted in Figure 7 that encompasses the entirety of the Jerome A. Ambro Memorial Wetlands Preserve. The tidal wetlands found within the CMW study area consist of five major ecological zones:

- ***High Marsh (HM)*** – This is the uppermost tidal wetland zone usually dominated by salt meadow cordgrass (*Spartina patens*) and saltgrass (*Distichlis spicata*). This zone is periodically flooded by spring and storm tides, and is often vegetated by other wetland species including low vigor smooth cordgrass (*Spartina alterniflora*), seaside lavender (*Limonium carolianum*), and glassworts (*Salicornia* spp.). Fiddler crabs (*Uca* spp.), and mussels (*Geukensia* spp.) are characteristically found in this zone. The upper limits of this zone often include black grass (*Juncus gerardii*), and the salt shrubs marsh elder (*Iva frutescens*) and eastern baccharis, commonly referred to as groundselbush (*Baccharis halimifolia*). The high marsh zone is also most subject to invasion by the non-native common reed (*Phragmites australis*) when the area has been disturbed by human activities, urban sediment deposition or over-wash.

- ***Intertidal Marsh (IM)*** – This vegetated zone lies generally between the average high and low tidal elevations, and is typically dominated by smooth cordgrass. This is generally the most productive tidal zone in terms of biomass, and prime habitat for crustaceans, finfish and shellfish.

- ***Coastal Shoals, Bars and Mudflats (SM)*** – This zone includes bare areas that are exposed at low tide or covered by water to a maximum depth of one foot, typically not supporting emergent wetland vegetation.

- ***Littoral Zone (LZ)*** - This is the zone of open water to a maximum depth of six feet from mean low water elevation seaward. This zone is also highly productive supporting rooted submerged aquatic vegetation, such as widgeon grass (*Ruppia maritima*) or eelgrass (*Zostera marina*), various shellfish, finfish, and waterfowl.

- The CMW also contains a relatively small area of ***Coastal Fresh Marsh*** mapped as ***(FM)***, which corresponds to the upper tidal limits of the fresh discharge zone located north of the earthen dike in Makamah Preserve. Characteristic species along this brackish interface include big cordgrass (*Spartina cynosuroides*), narrowleaf cattail (*Typha angustifolia*) and the invasive common reed.

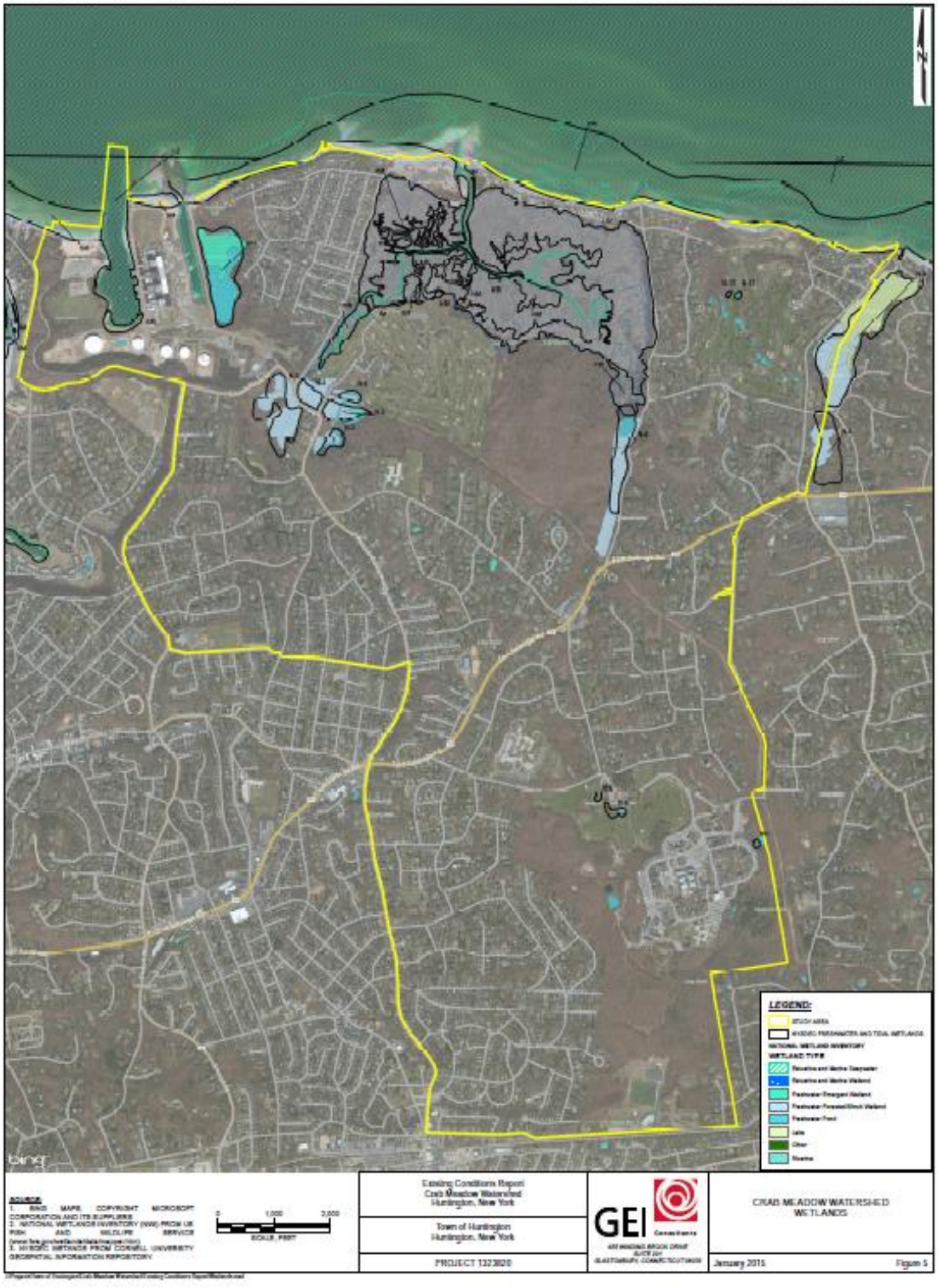


Figure 7. Crab Meadow Watershed Wetlands

Of primary concern to the Town and the CMWAC is the long-term health and vigor of the Crab Meadow Marsh. One factor that can threaten the quality of the marsh is the encroachment of invasive common reed, often forming a monoculture in the lower, down drainage (IM and HM) zones and out-competing the native marsh grasses.

Of an equal concern is the transitioning of the various vegetative zones in the marsh. The Town is collaborating with graduate students from City College of New York (CUNY) to ascertain the rate of elevation change in the marsh as compared with the rate of sea level rise. In the fall of 2012, a research project with Brooklyn College commenced to research the following objective: "What are the biogeomorphic indicators of marsh submergence that are present at the Crab Meadow Marsh?" Since this time, a number of aerial techniques have been deployed to examine soil erosion and vegetation monitoring.

Primarily, the methods have sought to establish a baseline analysis of the Crab Meadow Marsh that could be utilized for subsequent time series analysis of the location. The research has focused on examining the marsh's primary channel. Furthermore, soil erosion and vegetation investigations are also being conducted for the entire site. In 2015, CUNY and the Town installed Surface Elevation Tables (SETs) in the marsh that are being monitored annually. This is discussed further in the Instrumentation section of this report.

Monitoring the percent cover of dominant species over time will also help the Town determine if the Crab Meadow Wetland is transitioning to a more regularly flooded system that would encourage the proliferation of smooth cordgrass and expansion of the IM zone into the HM zone. In "Tidal Marshes of Long Island, New York", the Torrey Botanical Society has published an infra-red photograph of the Crab Meadow Marsh that depicts a major expansion (near doubling) of IM into the HM zones from 1974 to 2005. Mushacke (2010) explains this pattern as an "apparent reflection of higher tides and extended flooding duration that appear to be the first stages of wetland loss phenomenon." Further historic wetland trends, indicating wetland loss, are explained in Status and trends of wetlands in the Long Island Sound Area: 130-year assessment published by the U.S. Department of the Interior, Fish and Wildlife Service.

1.1.6 Flood Plains

A floodplain is an area of land prone to flooding. Floodplains are typically low lying, relatively flat areas adjacent to large bodies of water such as the Long Island Sound. One of the many responsibilities of the Federal Emergency Management Agency (FEMA) is to provide floodplain management. FEMA, under the National Flood Insurance Program (NFIP), produces Flood Insurance Rate Maps (FIRMs) identifying flood risk zones and their boundaries, floodways, and base flood elevations (BFEs). More recent maps have been created digitally to be incorporated into community Geographic Information Systems (GIS). Based on data from the FEMA GIS floodplain maps the Crab Meadow Watershed contains two (2) designated floodplain zones (see Figure 6) that are calculated by the annual chance of flooding. These floodplain zones are defined as follows:

- 1 percent annual flood hazard / Areas subject to 100-year flood events
- 0.2 percent annual flood hazard / Areas subject to 500-year flood events

The 100-year floodplain area encompasses Crab Meadow Marsh, Fuchs Pond, Fresh Pond, Power Plant Intake Lagoon, and a section of Waterside Avenue. The additional 500-year floodplain areas are small/pocket extensions of the 100-year floodplain in locations including sections of Waterside Avenue, Makamah Road, and Fresh Pond Road.

1.1.7 Coastal Erosion Hazard Area (CEHA) Boundary

Recognizing that natural shoreline features intrinsically reduce the impacts of wind and wave erosion, NYSDEC prohibits certain types of activities in designated Coastal Erosion Hazard Areas (CEHA) in order to protect vulnerable coastal areas from damages. CEHA natural protective features include beaches, nearshore habitats (sandbars, shellfish beds and aquatic vegetation), bluffs and dunes. Typically pursuant to 6 NYCRR Part 505, NYSDEC regulates activities such as marine construction, mining, grading or dredging activities, pedestrian traffic and motorized vehicles in Natural Protective Feature Areas; and the construction or placement of a non-movable structures and utility installations in Structural Hazard Areas through the issuance of coastal erosion management permits. The Town of Huntington has adopted local coastal erosion management laws consistent with New York State standards that the Department of Environmental Conservation (DEC) has certified to oversee the CEHA permit application process within local boundaries. The Department of Maritime Services administers applications for Coastal Erosion Management Permit applications. The state-regulated CEHA boundary within the Crab Meadow Watershed is depicted on Figure 8, and extends from mean high water line to the white & black dotted line.

1.1.8 Coastal Barrier Resources System

The Coastal Barrier Resources Act (CBRA) of 1982 was enacted to eliminate the incentives of Federal programs and/or actions that encouraged development on coastal barriers, such as Federal flood insurance. The CBRA established the John H. Chafee Coastal Barrier Resources System (CBRS) that designated undeveloped coastal barriers as ineligible for most new Federal expenditures and financial assistance and encouraged the conservation of hurricane prone, biologically rich coastal barriers. Areas within the CBRS could still be developed, but only through the use of private, non-Federal funds.

The CBRS contains two types of units, System Units and Otherwise Protected Areas (OPAs). **System Units** are generally comprised of private lands that were relatively undeveloped at the time of their designation within the CBRS. The boundaries of these units are generally intended to follow geomorphic, development, or cultural features. **OPAs** are generally comprised of lands held by a qualified organization primarily for wildlife refuge, sanctuary, recreational or natural resource conservation purposes. The boundaries of OPA units are generally intended to coincide with the boundaries of conservation or recreation areas such as state parks and national wildlife refuges.

The Secretary of the Interior through the U.S. Fish and Wildlife Service (FWS) is responsible for administering the CBRA. Related duties of the FWS include:

- Maintaining the official CBRS maps and providing copies for public viewing;
- Maintaining the background record for each unit;
- Consulting with Federal agencies to determine whether Federal funds can be spent within the CBRS;
- Determining whether properties are within the CBRS;
- Reviewing and modifying the CBRS every five years to reflect geomorphic changes (erosion and accretion); and
- Working with Congress, landowners, and other interested parties when questions arise over whether the CBRS boundaries were applied correctly.

Crab Meadow Beach and the Jerome A. Ambro Memorial Wetlands Preserve, as well as a portion of the Makamah Preserve and Crab Meadow Golf Course fall within mapped CBRS System Unit NY-14. CBRS NY-14 buffer zone appears to include some residential properties along Waterside Avenue, Makamah Road, and Makamah Beach Road. It extends seaward to the 20 or 30-foot bathymetric contour. The Crab Meadow unit was included in the Federal system by map dated October 15, 1992 and can be viewed at https://www.fws.gov/cbra/maps/Mapper.html.

1.2 SLOSH Model

SLOSH (Sea, Lake and Overland Surge from Hurricanes) is a computer model that was developed by the National Weather Service to estimate storm surge heights resulting from hurricanes. This model is best used as a planning tool to help define potential flooding patterns from storm surges associated with certain intensity hurricane events. The model predicts peak storm surges with 20% accuracy (e.g., if the model calculates a peak storm surge of 10 feet, an observer might record the actual storm surge to result somewhere in the range of 8 to 12 feet). SLOSH models do not incorporate the additive effects on storm surge elevations from wind- driven waves, precipitation, or runoff contributions from tributary areas. SLOSH models do reflect certain generalized conditions, such as:

- Greater storm intensities cause higher storm surges;
- Fast moving storms usually result in higher surges along open coastlines, but lower surges in sheltered bays and estuaries;
- Slow moving storms usually result in greater flooding inside bays and estuaries, and to a lesser extent along open coastlines;
- The direction of storm approach is a determining factor in overall surge heights; the approach of a storm from one direction may cause flooding, but a storm of equal magnitude approaching from the opposite direction may cause little flooding.

The Town of Huntington shared a SLOSH model developed by the NYS Office of Emergency Management in 2006 that covers the CMW study area, and the results are depicted in Figure 8 (www.nhc.noaa.gov/surge/slosh.php). The various color codes reflect the predicted extent of flooding due to a certain size or category storm. Reviewers should note that this figure is provided for hurricane preparedness purposes only, and does not reflect actual conditions measured during any particular storm event.

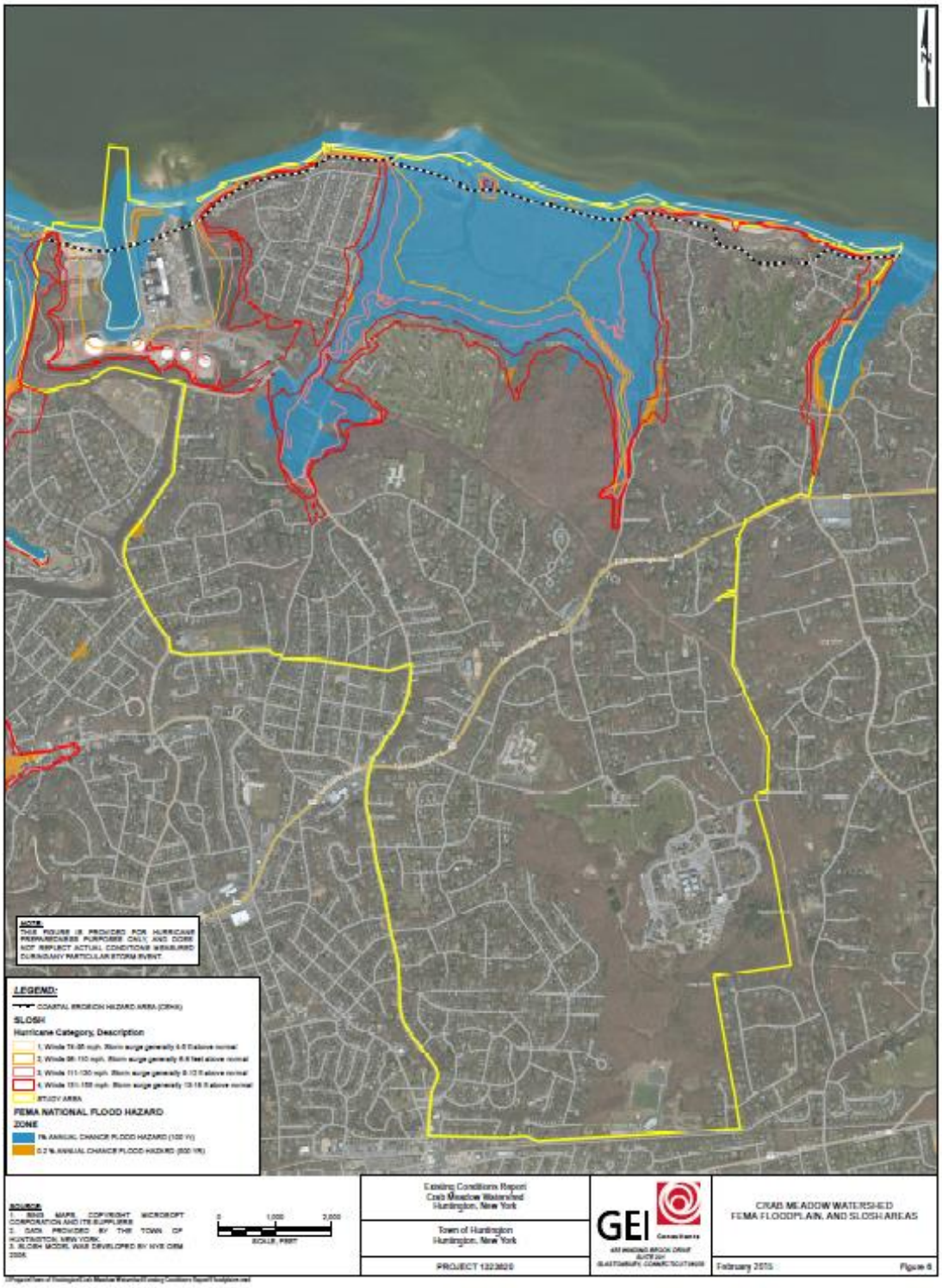


Figure 8. Crab Meadow Watershed FEMA Floodplain & SLOSH Areas

1.3 Water Quality Classifications

Waterbodies are defined by the United States Army Corps of Engineers (USACE) and the US Environmental Protection Agency (EPA) as ranging from open water habitats to waterways that have surface flowing or standing water to the extent of evidence of an ordinary high water mark. This includes rivers, streams, lakes, ponds, bays, and conduits such as canals or ditches. USACE defines the ordinary high water mark as a "line of the shore coincident with the elevation contour that represents the approximate location of the line of shore established by fluctuations of water and indicated by physical characteristics such as shelving, destruction of terrestrial vegetation, presence of litter or debris, or changes in the character of soil."

Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands. Multiple streams and waterbodies are located within the CMW. NYSDEC maps and classifies each stream or waterbody based on water quality and best usage designation, according to the "Part 701 Classifications for Surface Waters and Groundwaters".
(see: https://www.dec.ny.gov/chemical/23853.html)

NYSDEC classifies Long Island Sound as a "SA" waterbody and the tributary (length) between Crab Meadow Marsh and the Sound as a "SA" stream. NYSDEC lists "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."

All other streams and waterbodies identified on Figure 7 are designated by NYSDEC as Class "C". NYSDEC lists "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." These locations include Fresh Pond, Blanchard Lake, Power Plant discharge lagoon, Fuchs Pond, and two tributaries flowing from Route 25A to Crab Meadow Marsh.

1.3.1 Groundwater

Long Island is comprised of a wedge-shaped mass of unconsolidated sand, gravel, silt, and clay, underlain by consolidated bedrock. The thickness of these unconsolidated glacial and deltaic deposits ranges from a few hundred feet in the northwestern sections of Suffolk County to more than 2,000 feet along Suffolk's south shore barrier beaches, and is depicted in Figure 9.

These unconsolidated deposits constitute the groundwater reservoir. There are three major aquifers under Long Island that supply water to the Suffolk County residents: the Upper Glacial, Magothy and Lloyd aquifers.

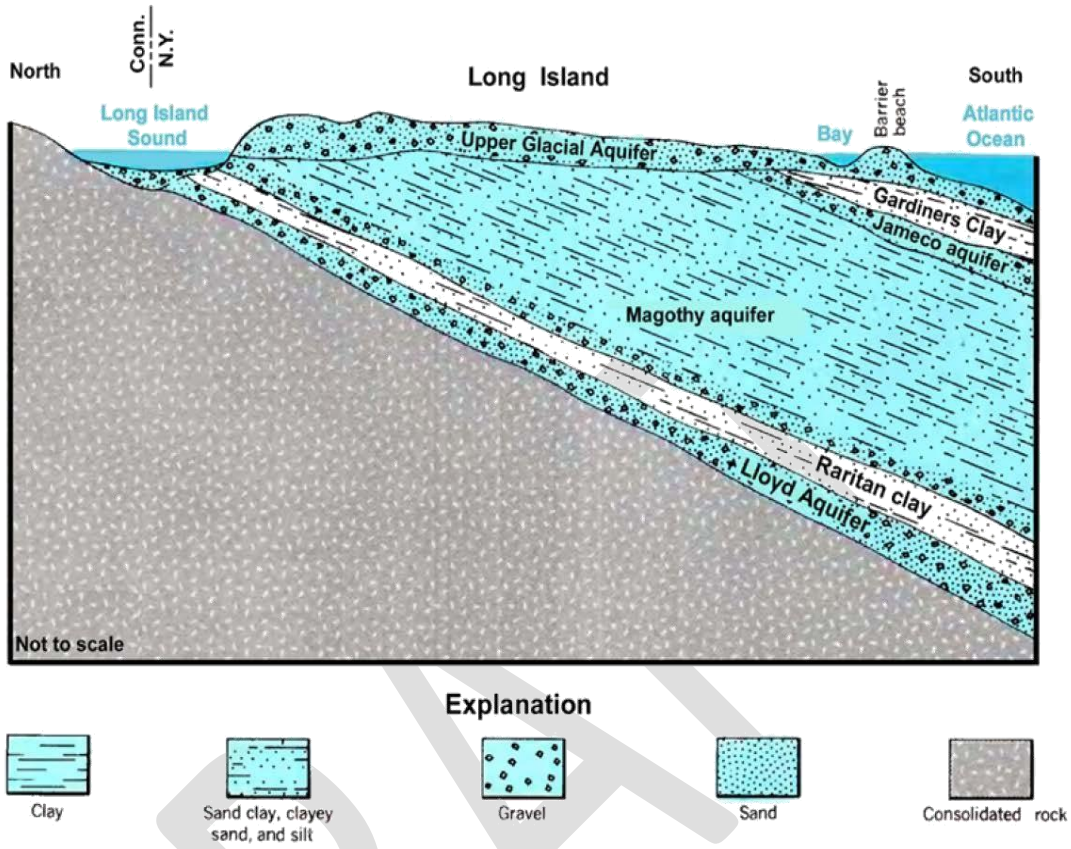


Figure 9. Major Hydrogeologic Units of the Long Island Aquifer (courtesy of NYSDEC)

The Upper Glacial is an unconfined aquifer directly underlying the ground's surface that extends up to 400 feet in depth. The Upper Glacial aquifer was formed during the last ice age.

The Upper Glacial aquifer in Suffolk County is generally of degraded quality due to past sanitary, agricultural and industrial waste disposal practices. Of note, the Harbor Hill Moraine and Ronkonkoma Moraine represent two different glacial advances and run roughly east to west for the length of Long Island. They comprise poorly sorted glacial till (sand, pebbles, rock, boulders) deposited at the glacier's leading edge. Found between these moraines and to the south, are outwash plains of well sorted sand and gravel.

The Magothy is the largest of Long Island's aquifers. Consisting of sand deposits alternating with clay, it reaches depths of 600 to 1,200 feet, and is the source of drinking water for most of Nassau County and about half of Suffolk County. The formation can be seen in the coastal bluffs of the north shore and plunges under the land surface to the south.

The Raritan Formation underlies the Magothy. Its two primary units are an upper clay member and a lower sand member named the Lloyd Sand. The clay member separates the Magothy and Lloyd aquifers and serves as a confining unit for the underlying Lloyd Sand aquifer. The clay member has a maximum thickness of 300 feet.

The Lloyd aquifer lies below the Magothy Aquifer and rests on consolidated bedrock. The Lloyd Aquifer is the deepest and oldest of Long Island's aquifers. It is a sand and gravel formation ranging in thickness from zero to five hundred feet. At its deepest, it is 1,800 feet below the surface. The water contained in the Lloyd aquifer is about six thousand years old. The Lloyd aquifer supplies water to the south shore barrier beach communities, where the Magothy Aquifer has become contaminated by salt water intrusion. Not many wells tap this formation and New York Environmental Conservation Law §15-1528 establishes a moratorium on the use of water from this formation in order to maintain it for future generations.

The Suffolk County Comprehensive Plan 2035 summarizes the Long Island Hydrogeologic Zones as either: deep flow zones that recharge water vertically into the deeper Magothy and Lloyd Aquifers, which are primary sources of drinking water; or shallow flow zones that drain horizontally towards coastal areas, rivers, streams and wetlands. While the southern end of the CMW may contribute to the Zone I Deep Flow System, the CMW primary focus area lies entirely in Zone VIII characterized by a shallow groundwater flow system.

The Suffolk County Department of Health Services (SCDHS) has provided water table and quality information specific to the CMW study area including surface water sampling locations, public and private water supply wells, and groundwater monitoring well locations. This information is included in Appendix A of this report. The groundwater contours beneath the CMW are depicted in Figure 10.

As groundwater generally flows at right angles to the water table contours, the general direction of groundwater flow across the study area is from south to north. Groundwater discharges to surface waters at the point where the top of water table intersects the land surface. As can be seen from the U-shaped bend in the isometric lines on the SCDHS water table map, the head of the stream in the County Makamah Nature Preserve represents a major discharge point for shallow groundwater flows to meet surface waters at the southeastern corner of the Crab Meadow Marsh. This roughly corresponds to the state mapped freshwater wetland labelled N-8 and the tidal wetland mapped as Fresh Marsh (FM) in Figure 7. This is also a good location to conduct future groundwater monitoring and water quality measurements, so trends may be observed over time.

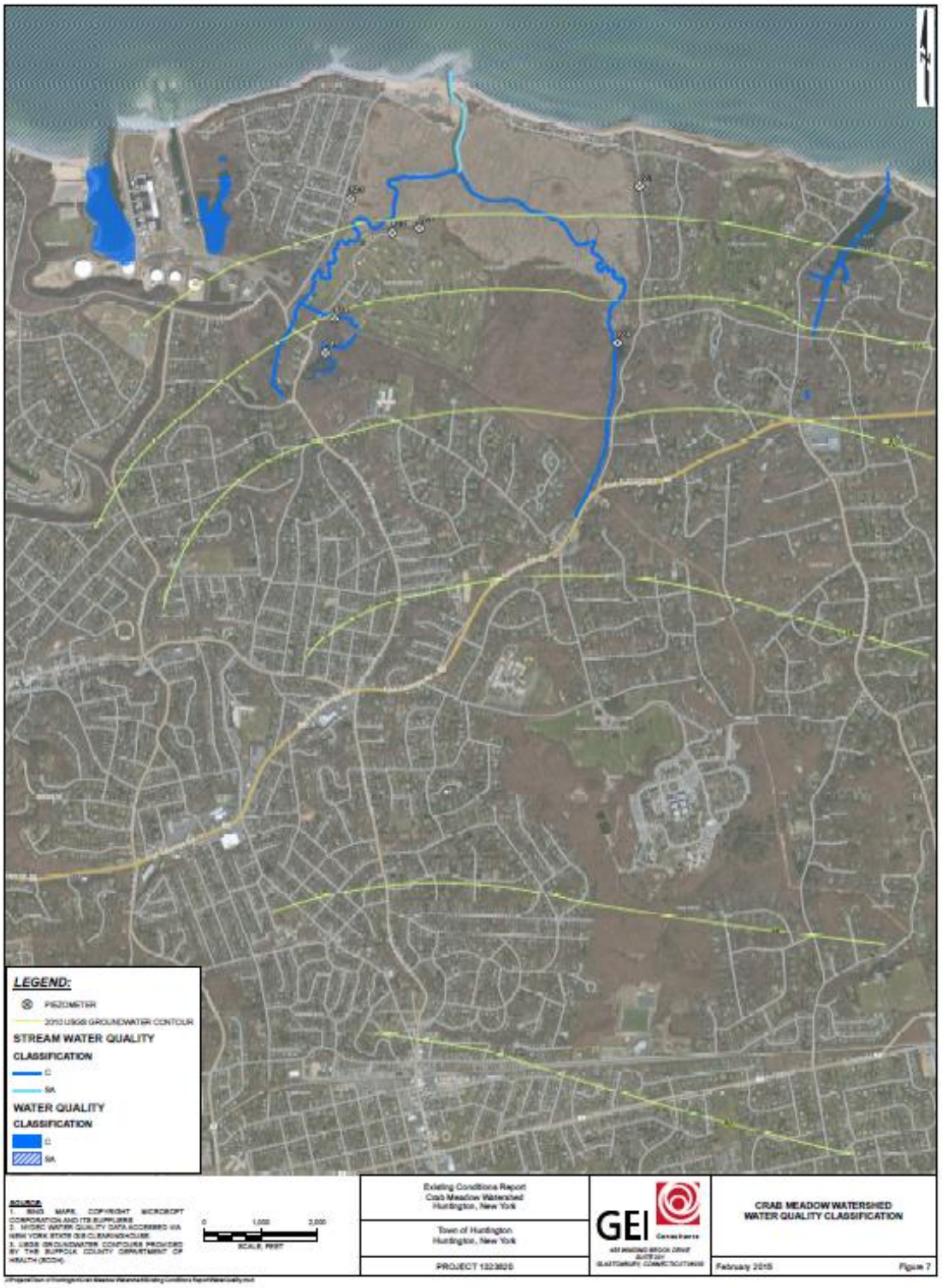


Figure 10. Crab Meadow Watershed Water Quality Classifications

1.4 SCDHS Groundwater and Surface Water Sampling and Analysis

Suffolk County Department of Health Services (SCDHS) routinely monitors water levels and quality at numerous sampling locations (both groundwater and surface water) within and adjacent to the Crab Meadow Watershed (CMW) as shown on Figure 11. SCDHS provided groundwater sampling/analysis data and surface water sampling/analysis data to the Crab Meadow Watershed Advisory Committee (CMWAC) as described below:

Groundwater Sampling Locations:

- Five (5) monitoring wells in the vicinity of the Fuchs property.
- One (1) monitoring well (S-115186) utilized for pesticide monitoring located on the Indian Hills Golf Course (IHGC).
- Two (2) public water supply wells as components of Suffolk County Water Authority (SCWA) wellfields.
- One (1) public water supply well as a component of the Northport Veterans Administration (VA) Hospital wellfield.
- Twenty-two (22) private water supply wells (*locations of these wells not provided in order to protect the integrity of the source*)

Surface Water Sampling Locations:

- Five (5) sampling locations in the watershed drainage area upland of Fresh Pond,
- Two (2) sampling locations in Makamah Preserve,
- Six (6) sampling locations in the vicinity of Fuchs Pond, Scherer's Pond and Ingraham Preserve,
- One (1) sampling location in the middle of Blanchard Lake, and
- Three (3) sampling locations in the Crab Meadow Golf Course (CMGC).

SCDHS has provided water quality data from each of the above-mentioned sampling locations as shown in the tables below. The data includes the physical parameters (i.e., pH, dissolved oxygen [DO], temperature, conductivity) recorded at each sampling location along with the chemical constituents that were tested from each of the samples, such as levels of inorganic compounds, herbicides, metals volatiles and semi-volatile compounds.

The Long Island Nitrogen Action Plan (LINAP) offers a summary of guidance values and approaches developed during other studies, including a table developed by USEPA (2005) that documented ranges of water quality indicators based on a water body's ecological health:

Indicator	Good Water Quality	Fair Water Quality	Poor Water Quality
Dissolved Inorganic Nitrogen	<0.1 mg/l	0.1 – 0.5 mg/l	>0.5 mg/l
Dissolved Inorganic Phosphorus	<0.01 mg/l	0.01-0.05 mg/l	>0.05 mg/l
Dissolved Oxygen	>5 mg/l	2-5 mg/l	<2 mg/l

The parameters selected above were based on the ability to compare values to NYSDEC's Division of Water Best Usage Classifications for the sampled water bodies and the discharge water quality standards for those classifications. The NYSDEC acceptable parameter values for fresh surface water are shown in Table 3 below. All of the sampled water bodies in the CMW fall into Water Body Class C.

Table 3

NYSDEC Acceptable Parameter Values for Fresh Surface Waters

Parameter	Standard	Water Body Class
pH	6.5<pH<8.5	C
D.O (mg/L)	>4*	C
Total Coliform MPN/100mL	<2400	C
Fecal Coliform MPN/100mL	<200	C
Nitrate (mg/L)	10	A
Ammonia (mg/L)	2.2	C
*mg/L and ppm are equivalent units		

Note that summary data tables provided by SCDHS are a summary of the detected analytes only. If an analyte was run but not detected in any of the samples on that table, it is not included in the summary data tables.

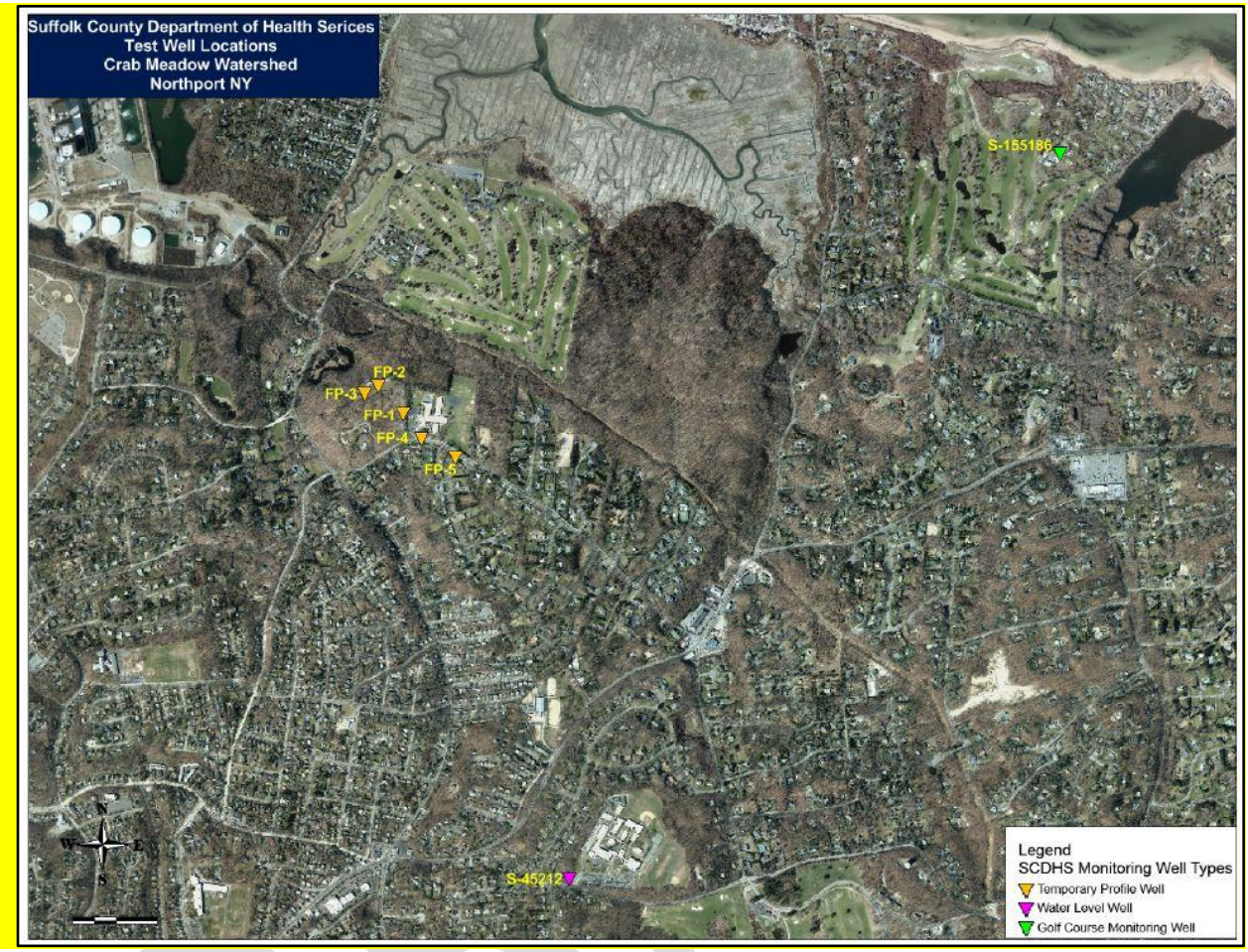


Figure 11: SCDHS Test/Monitoring Well Locations; Crab Meadow Watershed

Observations:

Monitoring Well Sampling Data

Fuchs Property Profile Wells - These wells were profiled and sampled one time in 2009. Low concentrations of chlorinated volatile organic compounds (VOC's) were observed in each of the wells. Nitrate concentrations ranged from 2.4 ppm to 13 ppm, and averaged 6.4 ppm.

Indian Hills Golf Course (IHGC) Monitoring Well - The data provided indicated that this well was sampled generally once or twice a year from 2000 to 2015 (17 samples of the permanent well were provided). Nitrate concentrations indicate an increasing trend during the time period of the provided data, from 3.6 ppm in 2000 to 5.3 ppm in 2015. The NYS Drinking Water Standard for nitrate is 10 ppm. The herbicide Dacthal (tetrachloroterephthalic acid) was detected in all but four of the seventeen samples analyzed, with concentrations ranging from 16 ppb to 34 ppb. The NYS Drinking Water Standard for the Dacthal is 50 ppb. Five other pesticides were detected, as well as three pharmaceuticals/personal care products, all at low or trace concentrations.

Private Well Data - Data from twenty-two private wells sampled from 1997 to 2015 was provided. Some of these wells were sampled once during the time period while others were sampled multiple times. SCDHS did not provide the locations of the private wells in order to protect the integrity of the source, and therefore this data cannot be used to identify area specific water quality issues. Private wells tend to be relatively shallow in depth and are therefore good indicators of the aquifer's shallow water quality. The following general observations can be made from the provided data:

- Low concentrations of VOC's were detected in nine of the twenty-two private wells which were analyzed for VOC's. All concentrations were below their respective New York State (NYS) Drinking Water Standard.

- Two of the twenty–two private wells had detection of a degradation product of Dachtal at concentrations below the NYS Drinking Water Standard.

- One of the twenty-two private wells was sampled for the emerging contaminant 1,4-dioxane, and it was detected at a concentration of 0.26 ppb which is below the currently proposed NYS Drinking Water Standard of 1 ppb.

- Three of the twenty-two private wells exhibited nitrate concentrations of 10.6 ppm, 11.2 ppm and 11.4 ppm, exceeding the NYS Drinking Water Standard of 10 ppm.

Public Water Supply Well Data - Data from two SCWA wellfields (Waterside Road and Middleville Road) and from the Northport VA Hospital located on Middleville Road was provided. These wellfields contain multiple wells at their sites; however the data does not distinguish individual wells and is grouped by the respective wellfields. The data provided was from samples collected from the late 1990's to 2013-14.

It should be noted that the data provided was from samples collected prior to water treatment, and is not necessarily reflective of the quality of the water being served to the distribution system, and ultimately to the customer. The untreated water quality is most appropriate as a general indication of the raw quality of the groundwater that is within the CMW, and is therefore appropriate to evaluate as a part of this study. Unlike the shallow private wells, public water supply wells tend to draw their water from deeper segments of the aquifer, and are therefore good indicators of the water quality in the deeper aquifer segments. The public water supply data provided indicates that the groundwater

in the deeper portions of the aquifer in the CMW contains low concentrations of VOCs and elevated nitrate concentrations.

Generally, the data indicates that, similar to the private well data, generally low concentrations of VOCs have been detected. There appears to be a slight decline in concentrations in the more recent samples, when compared to the older samples. Overall, nitrate concentrations appear elevated, generally above 7 ppm, and also at times detected above the NYS Drinking Water Standard of 10 ppm in the untreated water.

Surface Water Sampling Data

The majority of the reported levels were within the acceptable parameter values for fresh surface waters when compared to the current NYSDEC Discharge Water Quality Standards, with the following exceptions:

- Ammonia levels were elevated at the CMGC Pond #10 green and Fuchs Pond Creek.
- DO levels were low at the Fuchs Pond Creek (west tributary), CMGC Pond #7, CMGC Pond #8 and CMGC Pond #10.
- Total Coliform levels were elevated at Fresh Pond, Fresh Pond tributary and Fresh Pond Creek.
- Fecal Coliform levels were elevated at Fuchs Pond, Fresh Pond tributary and Fresh Pond Creek.
- Low concentrations of VOC's were detected at eight of the nineteen locations sampled.
- Pesticides were detected at eight of the nineteen locations sampled.
- Personal care products and/or pharmaceutical compounds were detected at eleven of the nineteen locations sampled.

Using the LINAP guidance values referenced above, the following observations can be made:

- Eleven of the nineteen sample locations exhibited Dissolved Inorganic Nitrogen concentrations that are within the "*Poor Water Quality*" range. The remaining seven locations could not be assessed since the reported detection limit in these samples was not low enough to make a comparison to the guidance values.
- No samples were analyzed for Dissolved Inorganic Phosphorus.

It is anticipated that further important groundwater and surface water information will be availed through environmental assessments of proposed applications for land use changes in and through regional studies considering the Crab Meadow Watershed. While this document is not intended to be a land use plan for the watershed, it is recognized that land use can affect water quality.

The summary data tables provided by SCDHS listed below are provided in Appendix B of this document:

Monitoring Well Sampling/Analysis Data

- Table A-1; Fuchs Pond - Well Information and Field Parameters
- Table A-2; Fuchs Pond - Standard Inorganics and VOC's
- Table A-3A; Fuchs Pond - Metals Part 1
- Table A-3B; Fuchs Pond - Metals Part 2

- Table B-1; Indian Hills Golf Course (IHGC) Monitoring Well S-115186 - Field Parameters, Standard Inorganics and VOC's
- Table B-2; IHGC Monitoring Well S-115186 – SVOC's, Herbicide Mets, Dacthal, Chlorinated Acids and Radiologicals
- Table B-3A; IHGC Monitoring Well S-115186 - Metals Part 1
- Table B-3B; IHGC Monitoring Well S-115186 - Metals Part 2

- Table C-1; Suffolk County Water Authority (SCWA) Wells - Standard Inorganics, Rad and SVOC
- Table C-2A; SCWA Wells - VOC's Part 1
- Table C-2B; SCWA Wells - VOC's Part 2
- Table C-3A; SCWA Wells - Metals A thru L
- Table C-3B; SCWA Wells - Metals M thru Z

- Table D-1A; Northport Veteran's Administration (VA) Hospital Water Supply Well - Standard Inorganics, Rad and SVOC Part 1
- Table D-1B; Northport VA Hospital Water Supply Well - Standard Inorganics, Radiologicals and SVOC Part 2
- Table D-2AA Northport VA Hospital Water Supply Well - Metals A thru L Part 1
- Table D-2AB Northport VA Hospital Water Supply Well - Metals A thru L Part 2
- Table D-2BA; Northport VA Hospital Water Supply Well - Metals M thru Z Part 1
- Table D-2BB; Northport VA Hospital Water Supply Well - Metals M thru Z Part 2
- Table D-3A; Northport VA Hospital Water Supply Well - VOC's Part 1
- Table D-3B; Northport VA Hospital Water Supply Well - VOC's Part 2
- Table D-4A; Northport VA Hospital Water Supply Well - VOC's and Perchlorate Part 1
- Table D-4B; Northport VA Hospital Water Supply Well - VOC's and Perchlorate Part 2

- Table E-1; Private Water Supply Wells - Standard Inorganics, Radiologicals and Conductivity
- Table E-2A; Private Water Supply Wells - Metals A thru L
- Table E-2B; Private Water Supply Wells - Metals M thru Z
- Table E-3; Private Water Supply Wells - SVOC's, VOC's and Chemicals

Surface Water Samples Set 1: Crab Meadow Golf Course (CMGC) Ponds
Fresh Pond – Upland Watershed Drainage Area
Indian Hills Golf Course (IHGC) Ponds

- Table F-1; Surface Water Samples (SWS) Set 1 - Field Parameters
- Table F-2A; SWS Set 1 - Bacteria and Metals Part 1
- Table F-2B; SWS Set 1 - Metals Part 2
- Table F-3; SWS Set 1 - Standard Inorganics and VOC's
- Table F-4; SWS Set 1 - Radiologicals and SVOC's
- Table F-5A; SWS Set 1 - Herbicide Mets Part 1
- Table F-5B; SWS Set 1 - Herbicide Mets Part 2, Carbamates and SVOC 526

Surface Water Samples Set 2: Blanchard Pond
Fresh Creek/Pond
Fuch's Creek/Pond
Makamah Creek/Pond

- Table G-1; Surface Water Samples (SWS) Set 2 - Field Parameters
- Table G-2A; SWS Set 2 - Bacteria and Metals Part 1
- Table G-2B; SWS Set 2 - Metals Part 2
- Table G-3; SWS Set 2 - Standard Inorganics and VOC's
- Table G-4; SWS Set 2 - Radiologicals and SVOC's
- Table G-5A; SWS Set 2 - Herbicide Mets Part 1
- Table G-5B; SWS Set 2 - Herbicide Mets Part 2, Carbamates and SVOC 526

1.5 Habitats

The CMW contains numerous ecologically important and designated habitats, as depicted in Figure 12. The New York Natural Heritage Program (NHP) defines an ecological community as a variable assemblage of interacting plant and animal populations that share a common environment. The NHP classification system is presented in the publication "Ecological Communities of New York State, Second Edition" by Edinger et al. (2014).

The NHP classification system is used in conjunction with the NHP ranking system. Each ecological community has a global and state rarity rank as determined by NHP. The global rank reflects the rarity of the community throughout the world and the state rank reflects the rarity within New York State.

The following table provides a list of the major ecological communities found within the CMW area. This list has been compiled from published documents provided by the Town of Huntington, and supplemented with findings from the field reconnaissance effort conducted for this study.

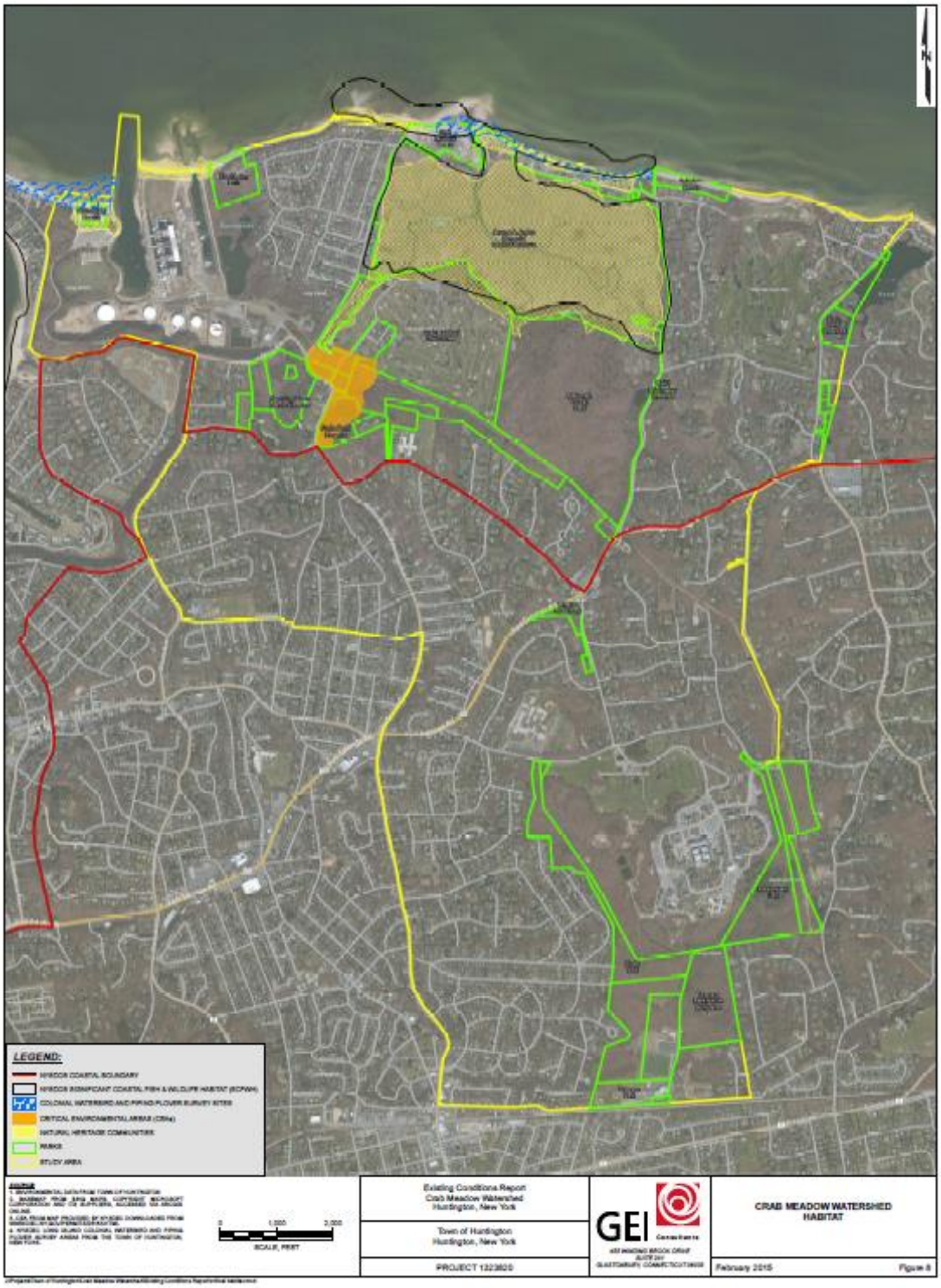


Figure 12. Crab Meadow Watershed Habitats

TABLE 4	
Ecological Communities Identified in the Study Area	
Ecological Community	**NHP Rank**
Chestnut oak forest	G5 S4
Coastal oak-hickory forest	G4 S3
Coastal Plain Stream	G3G4 S1
High salt marsh	G4 S3S4
Maritime beach	G5 S3S4
Maritime dunes	G4 S3
Mowed lawn with trees	Unranked/common
Mowed roadside/pathway	Unranked/common
Maritime shrubland	G4 S4
Oak-tulip tree forest	G4 S2S3
Rich mesophytic forest	G4 S2S3
Red maple-hardwood swamp	G5 S4S5
Shallow Emergent Marsh	G5 S5
Shrub swamp	G5 S5
Successional maritime forest	G4 S3S4
Successional old field	G5 S5
Successional shrubland	G4 S4
Successional southern hardwood forest	G5 S5
Unpaved road/path	Unranked/common

NHP RANKING SYSTEM DEFINITIONS

Global Rank:

G1 - Critically imperiled globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.

G2 - Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.

G3 - Either rare and local throughout its range (21 - 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g., a physiographic region), or vulnerable to extinction throughout its range because of other factors.

G4 - Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 - Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

State Rank:

S1 - Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2 - Typically 6 - 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 - Typically 21 - 100 occurrences, limited acreage, or miles of stream in New York State.

S4 - Apparently secure in New York State.

S5 - Demonstrably secure in New York State.

1.5.1 Sensitive Habitats and Rare Species Occurrences

As discussed in the Wetlands section above and depicted in Figure 7, there are both freshwater and tidal wetland systems mapped by NYSDEC within the CMW. In order to protect state mapped wetlands, NYSDEC regulates the 100 foot adjacent area surrounding mapped freshwater wetlands and certain activities within 300 feet inland of mapped tidal wetlands.

The Town of Huntington and County of Suffolk have been proactive in identifying and preserving the most ecologically sensitive habitats within the CMW. The majority of the headwater areas that feed the various drainage ways discharging into the Crab Meadow Marsh have been acquired, protected or set aside as conservation lands and parks (see Figure 13).

Ensuring that these areas will be protected in perpetuity is one of the best means of preserving such sensitive habitats. The interconnectivity of these open spaces is also particularly relevant when considering the movement of wildlife between various habitats.

The Town has compiled a preliminary database of flora and fauna that have been identified and observed utilizing various parks within the CMW. This database is available for public review on the Crab Meadow Watershed website at: https://www.huntingtonny.gov/Crab-Meadow-Watershed/Habitat. North American river otter (Lontra canadensis) have recently been documented in the CMW indicating that the linked open spaces are providing wildlife corridors, and that the aquatic resources are valuable.

The following subsections describe the various habitat protection mechanisms that are in place and notable species of significance.

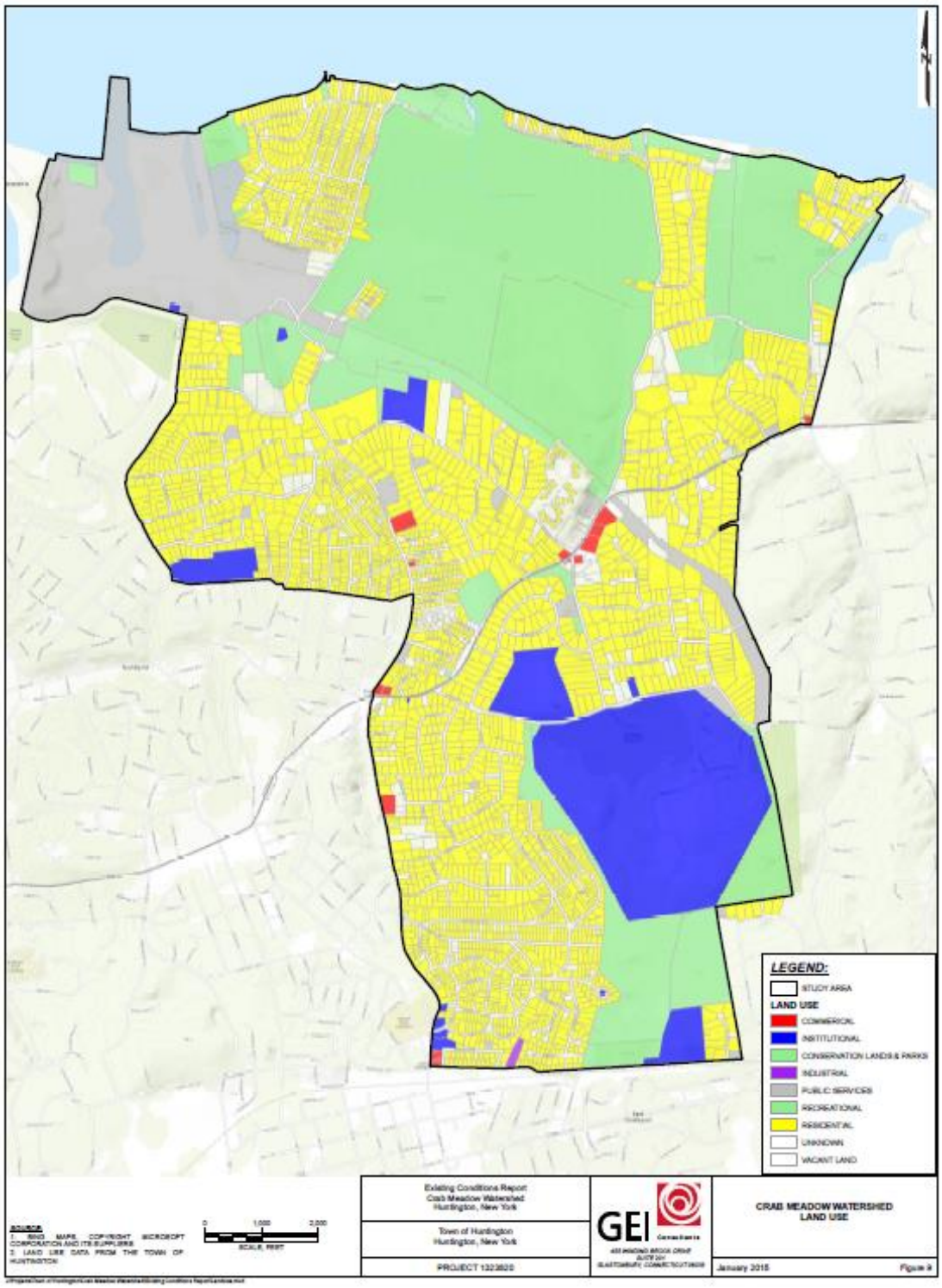


Figure 13. Crab Meadow Watershed Land Use

1.5.2 NYSDOS Significant Coastal Fish and Wildlife Habitat

The Crab Meadow Wetlands and Beach, the focal point of this study and stewardship plan (see Figure 13), has been designated by the New York State Department of State (NYSDOS) as a Significant Coastal Fish and Wildlife Habitat, since it represents one of the largest tracts of undeveloped salt marshes on Long Island's north shore. The intent of the NYSDOS designation is to protect, preserve and restore the vitality of this habitat. The wetland system, and associated tidal creek and beach areas consist of approximately 300 acres of undeveloped salt marsh and approximately 30 acres of beach and tidal flats.

The Crab Meadow Wetlands and Beach provide important nesting and feeding habitat for a variety of shorebirds, including the state-endangered piping plover (*Charadrius melodus*) and state-threatened least tern (*Sterna antillarum*), foraging habitat for state-threatened northern harrier or marsh hawk (*Circus cyaneus*), as well as a productive nursery habitat for finfish, shellfish and crustaceans.

Other probable or confirmed breeding bird species in this Significant Coastal Fish and Wildlife Habitat include Green Heron (*Butorides virescens*), Snowy Egret (*Egretta thula*), Black-crowned night heron (*Nycticorax nycticorax*), Clapper Rail (*Rallus longirostris*), Swamp Sparrow (*Melospiza georgiana*) and Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*).

Comparing the GIS database record (circa 1998) obtained from the New York State GIS Clearinghouse to present conditions, the Crab Meadow Wetlands appear to be increasing in size, although the periphery of the marsh is impacted by development. This ecological community is characterized as a well-developed high marsh in a meso-tidal setting, where the tidal range is two (2) to four (4) meters.

The marsh basin is confined by a barrier spit along its north boundary. In the state's1998 designation, potential threats to this ecological community were identified as development on the barrier spit and the adjacent Town golf course, declining water quality in Long Island Sound, aerosol deposition from a nearby power plant, and suburban development.

Management recommendations provided in the GIS database also include developing an agreement with the golf course for a natural buffer and to reduce pesticide and nitrogen inputs. Since then, local water quality has improved, aerosol deposition has decreased, and the Town of Huntington's Crab Meadow Golf Course is managed less intensively (as discussed in site specific recommendations in Chapter 2).

The Crab Meadow Wetlands are also recognized by the Long Island Sound Study Initiative as a Stewardship Site, which seeks to preserve native communities, protect critical habitats for endangered and threatened species, and promote multiple uses balanced with long-term scientific research and education.

1.5.3 Colonial Waterbird Nesting Sites

Crab Meadow Beach is a designated survey site for the NYSDEC Long Island Colonial Waterbird (LICW) and Piping Plover Survey (see Figure 11). The LICW and Piping Plover Survey is a continuation of monitoring efforts of Long Island area birds that began in 1983. Approximately 65 sites are surveyed annually. The survey began in 1983 when only least terns and piping plover were monitored. Since 1995, other tern species, black skimmers and plovers have been surveyed annually. Waterbird species including gulls, heron and egret species are also surveyed. These surveys are conducted through a coordinated effort of conservation groups, local governments and volunteers.

Crab Meadow Beach supports habitat for nesting piping plover and least tern, with nesting pairs of both species consistently recorded during the NYSDEC survey period. A small portion of the LICW and Piping Plover Survey Site Asharoken Beach also lies within the CMW boundaries. Asharoken Beach has also been found to provide critical nesting habitat for piping plover and least tern, with nesting pairs recorded during recent NYSDEC survey periods.

1.5.4 Endangered, Threatened, and Rare (ETR) Species and Significant Ecological Communities

The New York Natural Heritage Program (NYNHP) maintains records of federal and state- listed endangered or threatened species, rare species of special concern, and significant ecological communities. NYNHP data on ETR species and communities was obtained from the New York State GIS Clearinghouse. This data included significant natural communities and colonial waterbird and piping plover survey sites in the Crab Meadow Watershed.

In addition, a letter request was sent to the NYNHP for file records and species occurrence documentation concerning any Federal and State listed endangered or threatened species occupying the CMW study area and vicinity. A response letter was received on February 24, 2015 listing the following documented occurrences on or within the vicinity of the Crab Meadow Study Area.

Table 5			
Documented Rare Species Occurrences in the Study Area			
COMMON NAME	**SCIENTIFIC NAME**	**NY STATE LISTING**	**FEDERAL LISTING**
BIRDS:			
Common Tern	*Sterna hirundo*	Threatened	None
Least Tern	*Sternula antillarum*	Threatened	None
Piping Plover	*Charadrius melodus*	Endangered	Threatened
COMMON NAME	**SCIENTIFIC NAME**	**NY STATE LISTING**	**HERITAGE CONSERVATION STATUS**
SIGNIFICANT NATURAL COMMUNITIES:			
High Salt Marsh	N/A	N/A	High Quality Occurrence of Uncommon Community Type
RARE PLANTS:			
Slender Crabgrass	*Digitaria filiformis*	Endangered	Critically Imperiled in NYS
Silvery Aster	*Symphyotrichum concolor* var. *concolor*	Endangered	Critically Imperiled in NYS

As described above, the Crab Meadow Marsh and Beach areas provide critical nesting habitat for state-endangered piping plover and state-threatened least tern and foraging habitat for state-threatened northern harrier. Additionally, Crab Meadow Beach is listed as confirmed nesting habitat for state-threatened Common Tern (Sterna hirundo), according to NYNHP GIS data obtained from the New York State GIS Clearinghouse.

Several nesting platforms were erected within the marsh for Osprey (Pandion haliaetus), that have been active and pairs have been successful at producing fledglings over the past several years. According to NYSDEC, osprey populations have been rebounding across the state since the ban of DDT in New York in 1971. "In 1995, there were 230 breeding pairs on Long Island alone. In 1983, the osprey was down- graded to 'Threatened' from its 1976 listing as 'Endangered,' and in 1999 it was down-graded from 'Threatened' to 'Special Concern'."

See (https://www.dec.ny.gov/animals/7494.html).

1.5.5 Stream Visualization Assessment

In cooperation with Trout Unlimited's Long Island Chapter, a stream visualization assessment was conducted to determine a basic level of ecological health of the streams in the CMW. The stream assessment was conducted by two teams on April 11, 2015. It started with a full group instruction at Crab Meadow Beach during which the basic evaluation process was reviewed. The relevance and value of citizen input was cited as a key element. Familiarity with the locale assured accuracy of responses to the standardized state survey form. The teams then moved to the locations for conducting the stream assessment: the west stream in the Town's Jerome Ambro Memorial Wetlands Preserve, 100 feet north of the Fuchs Pond outlet culvert; and the east stream in the County Makamah Nature Preserve downstream of the footbridge and approximately 900 feet upstream of Makamah Pond. Each stream segment was analyzed for key parameters, including reach length, channel form and condition, bank curves and stability, riffle embeddedness, pool status, and bankfall width. Natural features and the proximity of influencing features, such as land use, were identified. Measurements were taken and macroinvertebrates were noted. Field findings were documented on scored data summary sheets that were submitted to the NYSDEC (see Appendix C). The assessment revealed that the study areas supported prolific insect life, however, the habitat could be enhanced.

The Jerome A. Ambro Preserve's west branch stream segment was deemed a possible reference reach candidate and the Makamah east stream segment was found to be a reference reach candidate. Throughout the watershed, this could be used as a reference from which to judge assessments of other stream segments. The assessments are a snapshot of stream functionality. Information garnered from the assessments and the temperature studies lead the Trout Unlimited experts that have reviewed the areas to believe that sea-running brook trout, a Long Island heritage species, could potentially survive well within the Crab Meadow Watershed. Fuchs Pond is groundwater-fed and Makamah Preserve has groundwater seeps that could support trout populations. Additional studies are needed to determine specific challenges to overcome in the system.

1.5.6 Critical Environmental Areas (CEAs)

Local agencies may designate specific areas within their geographic boundaries as "Critical Environmental Areas" (CEAs). State agencies may also designate geographic areas they own, manage or regulate. To be designated as a CEA, an area must have an exceptional or unique character with respect to one or more of the following:

- A benefit or threat to human health;
- A natural setting (e.g., fish and wildlife habitat, forest and vegetation, open space and areas of important aesthetic or scenic quality);
- Agricultural, social, cultural, historic, archaeological, recreational, or educational values; or
- An inherent ecological, geological or hydrological sensitivity to change that may be adversely affected by any change.

As depicted in Figure 8, the headwaters of the Crab Meadow Marsh were designated in 1988 as the "Crab Meadow Addition CEA" to preserve its benefits related to human health and drinking water supply protection. The area was nominated to the New York State Legislature by the Suffolk County Legislature. Following designation, the potential impact of any Type I or Unlisted Action under State Environmental Quality Review (SEQR) must be evaluated, and a determination of significance prepared pursuant to Section 617.7 of SEQR. The Town and County have since acquired all of the parcels in the CEA, with the exception of two that are owned by the Long Island Power Authority (LIPA).

Also nominated by the County Legislature and designated by the New York State Legislature in 1988 was the "Fresh Pond Greenbelt CEA" for its benefit to human health and to protect drinking water. The Fresh Pond Greenbelt CEA lies in the Towns of Huntington and Smithtown.

1.5.7 NYSDOS Coastal Boundary

Pursuant to the Federal Coastal Management Act, New York State has defined its coastal zone boundaries and the policies to be utilized to evaluate projects occurring within the designated zones. In 1981, New York State adopted the Waterfront Revitalization and Coastal Resources Act, creating the NYS Coastal Management Program (CMP). The CMP has 44 policy statements supportive of the Act's intent to promote a balance between economic development and coastal resource preservation. The NYSDOS coastal boundary is shown on Figure 8. This segment of the coastal boundary is also within the Long Island Sound Coastal Management Plan (LISCMP). The LISCMP is based on public consensus and close consultation with the state agencies whose programs and activities affect the coast. It integrates the capabilities of state and local government into an enforceable program for the Sound. It complements the Long Island Sound Study Comprehensive Conservation and Management Plan that focuses on water quality in the deep waters of the Sound, by addressing the upland watershed and harbor and nearshore waters. In January, 2015, the Town submitted a draft Local Waterfront Revitalization Plan (LWRP) to NYSDOS for the unincorporated areas along the Town's waterfront. Since then, NYSDOS staff and Town staff have revised and reviewed several drafts and are nearly completed with this effort. The CMW is a subsection of the draft plan, and this hydrology study and stewardship plan for the CMW is a stated goal of and will be referenced in the LWRP.

1.5.8 NYS Waterfront Revitalization and Coastal Resources Act

In 1981, the State of New York enacted the Waterfront Revitalization and Coastal Resources Act (Article 42 of the Executive Law) establishing a New York State Coastal Zone Management Program (CZMP) in accordance with intent of the Federal law. New York State chose a balanced approach that provides for the preservation and protection of coastal resources as well as the management of development and redevelopment in appropriate locations within New York's designated coastal areas. A key feature of the New York State program was to encourage local municipalities to prepare their own Local Waterfront Revitalization Programs (LWRP's) for state designated waters within local jurisdiction, thereby establishing a continuum of management and consistency review binding Federal, State, and Municipal governments in the use and protection of the coastline and coastal resources.

According to the New York State Department of State (NYSDOS) whose Division of Coastal Resources manages the State's Coastal Management Program, an LWRP is "both a plan and a program."

As a plan, the LWRP documents the community's coastal assets, establishes a vision, and sets priorities for its coastal region. It does so by identifying the natural, public, working or developed characteristics of waterfront areas and determining corresponding priorities, uses and critical issues that need to be addressed.

As a program, the LWRP provides the organizational structure and reference to local laws, projects and partnerships that will make it possible to transform the LWRP planning elements into actions that benefit the local community through a combination of preservation and managed use as appropriate to its various natural, public, working, and developed waterfront areas.

The state-defined waterfront area of the Greater Huntington/Northport Bay Complex is comprised of four incorporated villages within the Town of Huntington and the unincorporated areas of the shorefront that can be defined as five distinct landward (or upland) sub-areas, separated from one another by the Town's four incorporated villages: Lloyd Harbor, Huntington Bay, Northport and Asharoken.

In 2015 the Town of Huntington submitted a draft LWRP encompassing the Town of Huntington's marine coastline to NYSDOS for review and comment. The draft Town of Huntington LWRP includes the following sub-areas (comprising the landward portion of the following designated coastal area in the unincorporated portions of the Town of Huntington):

- Lower Cold Spring Harbor (south of the boundary of the Village of Lloyd Harbor);
- Huntington Harbor (between the boundaries of the Village of Lloyd Harbor and the Village of Huntington Bay);
- Centerport/Northport Harbors (inclusive of Huntington Beach, Little Neck Peninsula and Centerport);
- Eaton's Neck (outside of the boundaries of the Village of Asharoken); and
- Long Island Sound/Huntington North-East (inclusive of Crab Meadow, Makamah Beach and Fort Salonga).

The draft LWRP has been updated, supplemented, and is still pending NYSDOS preliminary approval.

1.6 Parks and Recreational Facilities

The largest landowner in the Crab Meadow Watershed is the Town of Huntington. A total of eleven (11) parks in the primary focus area comprise a protected area expanse of 690 acres, and four (4) additional parks in the secondary watershed area encompass 190 acres (see Figure 9). These publicly-protected lands serve a diverse set of public purposes, including, but not limited to: outdoor recreation, nature interpretation, groundwater recharge, stormwater catchment and filtration, wildlife shellfish nursery habitats, storm buffers, and scenic vistas. The CMW provides many opportunities for the public to access the waterfront. Of the four (4) watershed areas within the Town of Huntington, the CMW is perhaps the most accessible due to its broad public ownership.

The narratives below provide a general overview of the Parks that are included in the CMW. Further details about each of these Parks can be found in the Town of Huntington Trails Guide and links on the Town website are noted by an asterisk (*) following each park name.

1.6.1 Primary Focus Area

Starting at the Long Island Sound coastline, the Town's 14.2-acre ***Crab Meadow Beach**** at the terminus of Waterside Road is the Town's most heavily used public swimming area. It is an original Town Board of Trustees' holding. This active park contains a boardwalk with Spanish-style beach pavilion including a restaurant on the west side and a Town Beach Maintenance area on the east side, three gazebo structures, a picnic pavilion/barbeque area that can host major events, half-basketball court, on-beach playground with climbers/swings, extensive parking area, and a kayak launch site.

The ***Jerome A. Ambro Memorial Wetlands Preserve**** wraps around the east and south sides of Crab Meadow Beach. It is the largest park in Town ownership spanning 322 acres between Waterside and Makamah Roads and extends north to Long Island Sound. It consists chiefly of tidal wetlands, but incorporates brackish and freshwater wetlands along the eastern edge of the Crab Meadow Golf Course as well. This preserve is the result of the Town's most ambitious acquisition project with over 120 component parcels merged into the current holding. The LIPA right-of-way traverses the Jerome Ambro Memorial Wetland Preserve, having preceded its dedication as parkland. It contains underground utilities, including four buried electrical transmission lines, a fiber optics line, and the Iroquois Gas Transmission System's natural gas pipeline. A Master Plan for Crab Meadow Beach and the Jerome A. Ambro Memorial Wetlands Preserve was drafted with community input in 1992. A primary recommendation in that plan was to increase the understanding of how flows work through the watershed system.

The 20.7-acre ***Fuchs Pond Preserve**** was acquired in two components by the Town and County. The Town owns the homestead parcel that contains the former estate buildings, including the Cranberry Hill Environmental Center, a circa 1920 Tudor estate home. Its woodland borders the Jerome Ambro Memorial Wetland Preserve. The Cranberry Hill Environmental Center is licensed to Cornell Cooperative Extension for marine summer camp programs from April through October. It is situated at the top of a ridge and provides long winter views to Long Island Sound. Suffolk County owns the surrounding uplands and the groundwater fed "S"- shaped Fuchs pond below. The pond has a weir that is connected by underground piping directly to a stream channel in the Jerome Ambro

Memorial Wetland Preserve. The County component was rededicated as the Alexander G. McKay Preserve at Cranberry Hill Fuchs Pond County Park in 2018.

The Town's ***Crab Meadow Golf Course**** was formerly a private golf club designed in the early 1920s and later abandoned. The property, visible from Waterside Road and accessed by Seaside Court was acquired by the Town in the early 1960s.

The current public recreational facility includes a 122-acre, championship 18-hole, par 72 course with driving range, paved and stone dust cart paths, putting green, clubhouse with restaurant and pro shop, maintenance and storage areas. The facility offers picturesque public water views. The location provides a prime vantage point looking out across the Ambro Preserve, Crab Meadow Beach and Long Island Sound.

The Crab Meadow Golf Course blends to the east into the coastal woodlands of the 161-acre Suffolk County ***Makamah Nature Preserve****, a passive park with trails. The Makamah Preserve has access points at a southern gravel parking area/trailhead on NYS Route 25A and a northern trailhead on the west side of Makamah Road. An extensive trails network winds through its rolling woods and along its ponds and marsh edge. The ***Davis Brickmaker Preserve*** is a one-acre wooded parcel directly across from the northern trailhead to the Makamah Preserve. It was purchased by the Town to provide safe parking access to the northern trailhead of the Makamah Preserve.

Geissler's Beach is a prime fishing location situated at the terminus of Makamah Road. The 9.3-acre site contains an "L"-shaped parking area that was recently reconfigured to retreat it from its Long Island Sound frontage. It is visited by harbor seals in the colder months. A small woodland edge and raised bluff covered in native maritime growth back this beach front area. Similar to a portion of the Ambro Preserve to its west, it has a cut face to the Sound that has been significantly altered by storms and upland human activities.

The 27.3 acre- ***Henry Ingraham Nature Preserve**** borders the east side of Waterside Road between Locust and Eaton's Neck Roads. It was acquired as a partnership between the Town and the County. The Town and County co-own a 10-acre upland field and forested parcel. The Town owns a 17+ acre portion that includes a steeply-sloped woodland, shrub swamp, marsh, and open water/pond with weir. Water flows through the site via piping under Waterside Road. An Iroquois Gas Transmission System grant assisted the Town's acquisition, along with other small parcels contiguous to the Ambro and Fuchs Preserves. A historic cemetery is situated at a high point on the Henry Ingraham Preserve property. A loop trail is accessed from Waterside Road, and a pervious parking area has been installed.

Kirschbaum Park is a 13.4-acre parcel located at the western terminus of West Waterview Street to the west of Crab Meadow Beach. A high-density residential community fills the span between these two parks. Kirschbaum Park adjoins the freshwater Blanchard Lake wetlands on its south and west sides. Blanchard Lake is located on private property owned by National Grid (owners of the Northport Power Plant facility).

On the eastern side of the National Grid facility is the Town's ***Soundview Beach***, an unimproved 4.1-acre passive beachfront area. A small former bait and tackle shed adjoins the site on property known and operated by the Town under lease as the ***Soundview Boat Ramp***. The Soundview Boat Ramp provides substantial paved parking for boaters and a sheltered access point for vessel launching by residents. On the east side of the parking lot is an area owned by National Grid that is leased to the Cow Harbor United Soccer Club to provide playing fields for local youths.

The Suffolk County-owned passive ***Fresh Pond Park***, also known as Fresh Pond Greenbelt, adjoins the Crab Meadow Watershed boundary at its eastern boundary. The park lies within the Towns of Huntington and Smithtown.

1.6.2 Secondary Watershed Area

Parkland and recreational resources located south of Norwood Road in the secondary watershed area are dominated by the Veterans Parks Complex, comprised of the active 12.3-acre Town **Veterans Park**, 34.1-acre passive Town **Veterans Nature Study Area**, 60.3-acre Town **Meadowlark Park**, active and the passive 82.5-acre County and Town-held **Knolls Park**. All four (4) parks were at one time part of the Federal Veterans Administration Medical Center (VAMC) property. Trails unite each of the park components. The Town Trails Committee is actively engaged in devising an overall trails plan for the Complex. Each parcel in the assemblage has specified deed conditions pertaining to the Federal program through which it was conveyed, or the public funding program that enabled its acquisition as parkland. A gas line runs though portions of Veterans Park, Knolls Park, and Veterans Nature Study Area to serve the VAMC.

Veterans Park is located in the southernmost part of the assemblage on Bellerose Avenue. This active park lies at the southern boundary of the watershed and is a tiered park due to its steep morainal topography. It was conveyed for recreational use. Its complement of improvements

include a concrete skate park, Boundless (universally-accessible) playground, two Little League baseball fields, a lighted regulation-sized soccer field, one hard-surface volleyball court, four handball courts, two basketball courts, a 1/4-mile walking/jogging track, a restroom/storage/security building, and parking area.

Meadowlark Park is a primarily wooded site at the north easternmost section of the assemblage, and provides a gravel parking area at the Middleville Road frontage. It was conveyed for outdoor recreation purposes by the U.S. Department of Interior, subject to a prior easement granted to the Long Island Lighting Company (now LIPA). Meadowlark Park was designated by the Town Board for multi-use trails. Concerned Long Island Mountain Bicyclists (CLIMB) has a license agreement with the Town that enabled creation of five miles of single-track mountain bike trails at the site. It is the only defined mountain bike trail in the Town. Trails at the site are also used for running, snow shoeing/cross-country skiing, and horseback riding.

The ***Veterans Nature Study Area*** lies in the mid-eastern section of the assemblage with no street frontage. Title for the park was conveyed through the U.S. Department of Education to be used for

environmental education purposes. A small corner piece was acquired through a subdivision set-aside. The only recreational improvements in the Veterans Nature Study Area are trails that traverse its mature and early woodland, successional meadow, hill and glen areas. It is a dedicated park-preserve (preservation area) pursuant to Huntington Town Code. The site contains a 3-acre former Brownfields site once used by the VAMC that was remediated by the Town with considerable state grant assistance. The U.S. Department of Education fully released the property to the Town in 2015, citing completion of its educational obligations.

Knolls Park was acquired jointly by the County and Town and spans the western portion of the park complex from Veterans Park to Middleville Road. It is comprised of three components. The southeastern 20 acres were acquired under the County Greenways/Active Recreation Program and directly adjoin Veterans Park. While County-owned, the Town has a long-term management agreement that allowed its active development of two lighted regulation-size synthetic playing fields, practice field, restroom/concession building and extensive parking. The Town and County acquired the passive southwestern 30 acres with funds provided by the County Land Preservation Partnership Program, the Town Environmental Open Space and Park Fund Program and the Town Environmental Capital Reserve Program. The northern 33 acres were purchased under Suffolk County's (1/4% sales tax) Drinking Water Protection Program. Shared use and access easements enable Town management of the site as a whole as well as county resident's full use of the property. Areas of the site that were filled/impacted by the Federal government prior to its release into private ownership were cleaned up and certified by the Suffolk County Department of Health Services upon public acquisition.

The Town's newest addition to the Crab Meadow open space resources is ***Surrey Ridge Park***, an 11.1-acre wooded site southeast/across Route 25A from the Makamah Preserve acquired in two sections in 2016 and 2018. The rail climbs the steep moraine from Route 25A to a level hilltop, the former site of Surrey Ridge Nursery. It was purchased to provide a greenbelt trail linkage between the Makamah Preserve and the Veterans Parks Complex, particularly Meadowlark Park. It adjoins the LIPA right-of-way that is used locally as a connecting trailway to Middleville Road. The trail is used by runners, hikers and cyclists.

1.6.3 Private Recreation and Conservation

In the primary focus area is the privately-held 140-acre Indian Hills Golf Course, an 18-hole par 72 recreational facility with clubhouse/catering that lies to the east of Geisslers Beach. The clubhouse (Henry Cartwright Brown house) is a Town-designated historic landmark, as is 44 Breeze Hill Road to the east. Private association holdings are also present in the CMW bordering the Long Island Sound owned by organizations such as Sound Shore Bluffs Property Owners Association, Indian Hills Estates, and Waterside Park Association.

Other significant private recreational resources in the CMW secondary area include the 100-acre 9-hole VAMC Golf Course that is managed by the Northport American Legion Post 694. This course adjoins Knolls Park. One horseback riding facility lies within the watershed, the Stony Hollow Equestrian Center on NYS Route 25A. Another lies to the east outside the watershed, the Ketcham Horse Farm at the corner of Old Bridge and Bread & Cheese Hollow Road.

Under an innovative open space initiative enacted in 2008, the Town Transfer of Density Flow Rights Program allows landowners of vacant and/or oversized natural parcels to take advantage of an opportunity to conserve their property and transfer their potential wastewater density flow rights elsewhere. Huntington Planning Board's designation of sending areas on private properties within the CMW has resulted in protection of lands that are subject to conservation easements to insure they remain as natural areas. Buffers to the Henry Ingraham Nature Preserve and Davis Brickmaker Preserve were preserved this way, along with other individual sites in the CMW.

1.7 Land Use

The dominant land use in the Crab Meadow Watershed is single-family residential, as depicted in Figure 12. Public parkland (natural and passive/active recreational open space), institutional (public education-schools, Federal Veterans Administration Medical Center), industrial (National Grid electric generation station), and private recreation (Indian Hills Country Club, Stonyhill Equestrian Center) are the next most prevalent land uses. A small amount of commercial uses fall within the watershed area mainly along the NYS Route 25A and Vernon Valley Road corridors. Some limited commercial uses also exist on Waterside Road. There were no agricultural uses in the CMW area during the initial study period. However, a new agricultural operation (vineyard) on a 10-acre former farm site that had been fallow/wooded for many years has been established on Norwood Road, just east of the Norwood Elementary School and south of the Ambro Wetlands Preserve. Three golf courses lie within the watershed area, two in the primary watershed – the Town-owned Crab Meadow Golf Course and the private Indian Hills Golf Course—and one in the secondary watershed area – VAMC Golf Course operated by the Northport American Legion. A Long Island Power Authority (LIPA) utility corridor containing buried electric transmission cables, a fiber optic line and the Iroquois natural gas transmission pipeline runs through the watershed area.

The CMW area is essentially built out to its zoned density. In the primary watershed area of greatest influence to the water resource network that contributes to Long Island Sound, zoning is mainly R-40 Residence District. However, on the west side and upland of the Crab Meadow marsh there is a substantial R-5 zoned area and several undersized R-40 lots. In the remainder of the primary focus area there are small areas zoned R-5, R-7, R-10 and R-20 and one major stakeholder site zoned I-6 Generating Station District. It is the only industrial zoned site in the CMW area, the most intensive use in the Huntington Zoning Code, and the only site with that zoning classification in the Town of Huntington. In the secondary watershed area, R-40 remains the dominant zone followed by the VAMC zoned R-80, then areas of R-10, R-7 and R-5. A portion of the western area in the secondary watershed lies within the Village of Northport and is zoned Residence District D.

Zoning Classification	Area (acres)	Percent of Watershed
R-80 Residence District	433	12.1%
R-40 Residence District	1,900	53.3%
R-20 Residence District	13	0.003%
R-10 Residence District	218	6.1%
R-D Residence District (Village of Northport)	300	8.4%
R-7 Residence District	360	10.1%
R-5 Residence District	155	4.3%
C-6 General Business District	12	0.003%
1-6 Generating Station District	201	5.6%
TOTAL	3,592	

All zoning districts have distinct height, minimum area and bulk regulations. R-80 requires two acres, R-40 requires one acre of land; R-20 requires 20,000 square feet, R-10 requires 10,000 square feet, R-D requires 8,500 square feet, R-7 requires 7,500 square feet, and R-5 requires 5,000 square feet. R-80, R-40 and R-20 are considered low-density residential, R-10 is moderate-density and R-7 and R-5 are high-density districts. Low-density zoning applies to two- thirds of the overall CMW watershed area. 94% of the watershed area is zoned for residential use. Intensification of zoned density or new development in accordance with zoned density could pose impacts that warrant careful scrutiny.

The extensive public land ownership in the watershed provides a unique opportunity to model best management practices. This can help enlighten the community of private landowners that inhabits the watershed to become better stewards as individuals, more accountable and understanding of the ramifications of their actions.

Each new development and land use change, whether simple infill development of vacant parcels, expansion of existing built sites, or small development, has potential to take an incremental toll on the system, unless sufficiently mitigated. Any prospective plans that could intensify land use among the major stakeholder tracts – the 201-acre National Grid site and 140-acre Indian Hills Golf Club in

the primary watershed area and the 433-acre Veterans Administration Medical Center in the secondary area pose potential for more direct impact. A 110-unit assisted living facility, Freedoms Path, is being added to an underutilized component of the VAMC site through an Enhanced Use Lease. A subdivision application for the Indian Hills Golf Club requested construction of 98 new homes with retention of the 18-hole golf course. Following a Draft Environmental Impact Statement (EIS), extensive public review, and Final EIS, findings were adopted by the Planning Board on April 7, 2021 that could enable an 86-lot subdivision that retains the 18-hole golf course.

The Town has taken a proactive stance during subdivision and site plan reviews of developments requiring water quality improvements and delineation of private and public watersheds. During review of the proposed developments, the Town Highway Department may request that any existing discharge pipes that direct stormwater onto Town roads or right-of-ways be removed. The Town may also require that the natural hydrology of steams and connections be re-established to restore proper flows and limit wetland impacts.

1.8 Reported Spills and Environmental Concerns

The Town maintains a GIS database of addresses that have received federal and state air, water, and chemical bulk storage or waste disposal permits/approvals. The types of facilities that might require such permits/approvals include food markets, dry cleaners, and gasoline service stations, among others. Many of these commercial facilities border Fort Salonga Road (State Route 25A), occupy the grounds of the Veterans Association Medical Center and occur within the property boundaries of the National Grid Power Plant. These commercial and industrial centers are also characterized by higher levels of vehicular traffic and impervious surfaces that typically contribute a greater volume of stormwater runoff.

1.8.1 EPA Regulated Facilities

This GIS data set provides locational information for operational units of companies tracked by EPA major data systems including: Permitted Air Facilities, Superfund (CERCLIS) Facilities, National Priority List (NPL) Site Boundaries, Water Permit Facilities, and Resource Conservation & Recovery Act (Permitted hazardous waste) Facilities.

1.8.2 Bulk Storage Sites in New York State

This GIS data set provides point locations for: Chemical Bulk Storage Facilities pursuant to the Hazardous Substance Bulk Storage Law, Article 40 of ECL; and 6 NYCRR 595-599. Major Oil Storage Facilities pursuant to Article 12 of the Navigation Law. Petroleum Bulk Storage Facilities registered pursuant to title 10 of Article 17.

1.8.3 Remediation Sites in New York State

The points in this GIS data set represent the existence of a site which has cleanup currently, or has undergone cleanup under the oversight of NYSDEC. This dataset includes a single point location for a subset of sites which are currently included in one of the Remedial Programs being overseen by the Division of Environmental Remediation.

1.8.4 State Pollutant Discharge Elimination System

The purpose of the State Pollutant Discharge Elimination System (SPDES) Program is to protect human health and the environment. The SPDES permit program in the NYSDEC Division of Water regulates municipal and industrial wastewater treatment facilities that discharge directly into navigable waters.

1.9 Results of Field Reconnaissance

Prior to conducting the field reconnaissance effort, copies of any existing plans, maps and databases were obtained from the Town. These documents included GIS base maps (e.g., draft watershed study area, land use, contours, SLOSH model, etc.); copies of environmental reports pertinent to the study area; Fuchs Pond Restoration Weir Plan, Profile and Details (2008); and the design plans for the Rehabilitation of Waterside Road, Phase II (2001). The Town also supplied a short list of attributes that the Town had collected from drainage features located outside the study area; however, detailed drainage maps depicting the Town's stormwater collection and conveyance systems internal to the CMW had not been previously prepared. As a result, field crews were mobilized to collect baseline data for the primary focus area of the watershed. Results of the field survey are described in the following subsection.

The Waterside Road plans cover an approximately 0.7 mile of roadway located between West Street to the north and Fuchs Pond to the south. The plans proposed to capture a ½ inch rainfall event through a series of eight (8) and ten (10) foot diameter four (4) foot deep leaching basins, connected to catch basin inlets (4' x 2.5' x 5') and conveyance piping. The drainage system for the southern half of this drainage improvement project appears to be closed, with collected stormwater infiltrating the subsoil and shallow groundwater tables through the leaching pools. However, the northern half of the drainage system collects stormwater via catch basins that are piped to manholes, with overflow outlets discharging into Crab Meadow Creek at four (4) locations (opposite Meadow Place to approximately 240 feet south of Butler Place). A key component of the Waterside Road project involved elevation of the roadway in response to continued flooding. While these design plans were not post-construction drawings or "as-builts", they appear to match the drainage features identified in the field during site reconnaissance efforts.

1.9.1 Drainage Features

GEI performed a field reconnaissance of the primary Crab Meadow Watershed area to identify specific non-point source problem areas. Particular attention was paid to locate important drainage features and discharge points such as pipe outfalls, curb inlets, detention basins, streams or drainage swales, weir structures, known springs, road ends or curb cuts that pass stormwater into the wetlands and nature preserves. Figure 13 graphically depicts the man-made drainage features identified during GEI's reconnaissance field effort. The field survey crews completed field data sheets for any man-made drainage features discharging directly into the Crab Meadow Marsh. The location and structure type are indicated in Figure 14, and the condition of the stormwater drainage features is noted as an attribute within the GIS shape file, along with a copy of the field data sheet.

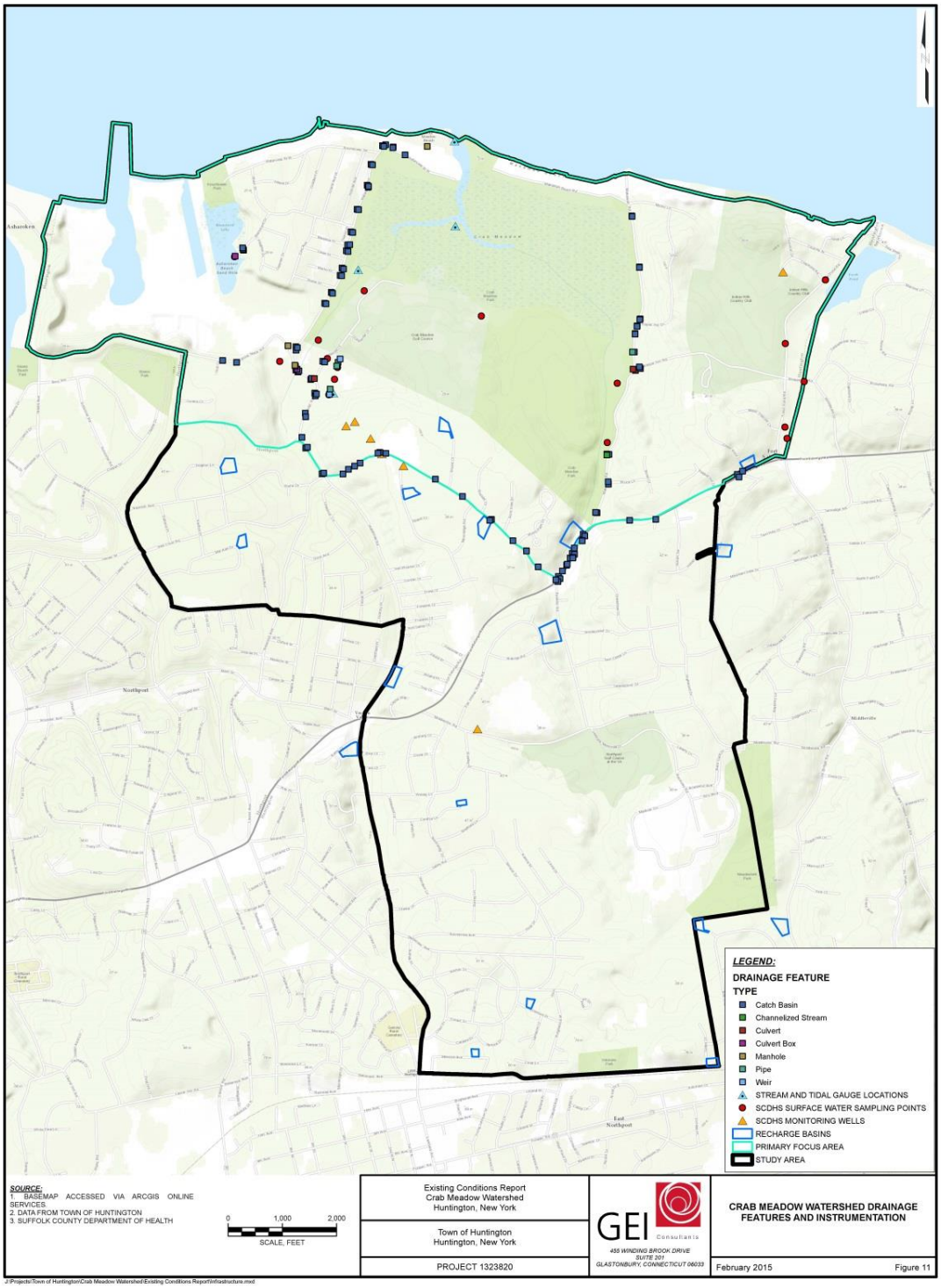


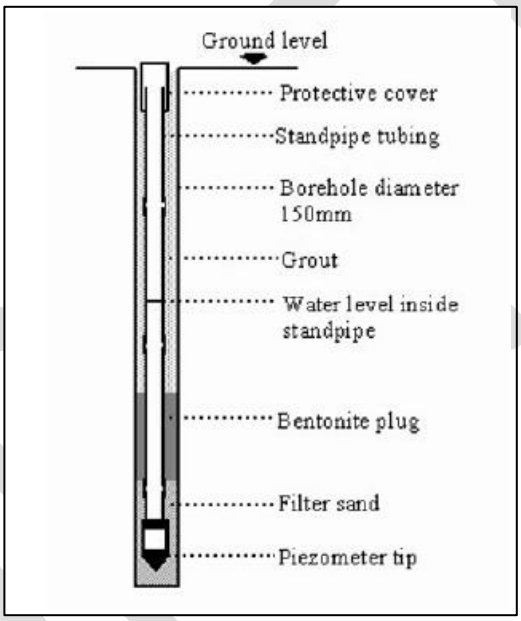
Figure 14. Drainage Features and Instrumentation

1.9.2 Field Instrumentation

The Town of Huntington has plans to set up a network of field instrumentation, so that fresh surface water and shallow groundwater levels can be monitored over time and the interactions between these flows can be better defined.

1.9.2.1 Piezometers

Piezometers provide a permanent groundwater elevation monitoring system consisting of a screened well head that is placed into saturated subsurface soil horizons. Water levels inside the riser pipe result from water pressure over the perforated bottom of the pipe. A schematic diagram of a typical piezometer installation is shown below.



Source: Adini, A. 2011. Environmental Enlightenment Newsletter #172

Direct measurements of the top of the groundwater table can be obtained using a steel measuring tape or an electronic water level meter, such as was used for this study (a 75-foot water level meter by Heron Instruments Little Dipper model 1240). A series of seven piezometers were installed as part of this study, as shown in Figure 14, and summarized in the Table below. They were installed around the perimeter of the Crab Meadow Marsh and placed in locations that would provide full coverage of the surface and subsurface hydrology; so that the Town can routinely monitor groundwater depths and extract water samples to ascertain the quality of groundwater discharging into the marsh. The casings are padlocked for security purposes.

Quarterly monitoring will be conducted throughout the annual hydrologic cycle by the Town, CMWAC or research partners, with additional measurements taken during extreme weather or precipitation events, as well as during periods of extended drought.

Table 6

Piezometers Installed in the Crab Meadow Watershed

NO.	Location	Latitude	Longitude	Measuring Point (elev. above MSL)	Approx. Sample Depth (ft.)	Approx. Screen Depth (ft.)	Initial Water Elev. (ft.)*
1	Crab Meadow Golf Course (West)	-73.3269	40.92176	6.93	12	6	2.33
2	Crab Meadow Golf Course (East)	-73.3251	40.92197	6.85	12	10	2.58
3	A. McKay/Fuchs Pond Preserve	-73.3312	40.91595	9.44	12	10	4.19
4	Meadow Avenue - eastern road end at marsh	-73.3295	40.92343	6.49	12	10	2.49
5	Makamah Road – west side, south of #126, north of # 124	-73.311	40.92391	8.26	12	10	1.79
6	Geisler's Beach				16'+ to refusal	None installed	
7	Makamah County Park	-73.3125	40.91632	7.54	12	10	2.24
8	Scherer's Pond	-73.3306	40.91759	7.23	12	10	3.14

Source: Piezometer Installations by Tri-State Drilling on 10-15-14 and 10-31-14; Earth Attributes Survey on 3-19-15.
*Initial Water Reading taken during land survey on 12-18-14.

1.9.2.2 Stream Flow Gauges and Tidal Gauges

Stream gauges consist of standard survey/water gauging staffs set on fixed posts within the stream course. A stream flow gauge is present at the outlet end of Fuchs Pond. Another stream flow gauge can be installed on the upstream side of the pond outflow in Makamah County Park.

Similarly, simple tidal gauges can consist of tide poles or tide staffs that are vertically-mounted on pilings bearing a graduated height measurement scale. These can be set up at easily accessible locations within the Crab Meadow Marsh to record the following measurements:

- Mean Higher High Water (MHHW) during spring/lunar tides,
- Mean High Water (MHW),
- Mean Tidal Level (MTL),
- Mean Low Water (MLW) and
- Mean Lower Low Water (MLLW) during spring/lunar tides.

While this type of system can provide valuable surface water elevation data, it is dependent upon people making routine visits and having ready access to the gauges at any time and during any weather condition. However, there are several other options warranting further consideration by the Town that would automate the process of data collection and enable recordings of tide level data on a set schedule, either live real-time streaming or at any specified interval and send the information to a central processing location. Some of these other systems are operated by a floating weight that directly reads the water level; or utilizes a pressure transducer and relies on water rising in a stilling basin; as well as non-contact types that rely on sonic readings beamed down to the water surface.

The key to all of these automated systems is that they need to be attached to a permanent fixed structure located at or over the water. The mouth of Crab Meadow Creek was considered as a potential location for setting up this sort of water level measuring device, however, the current condition of the stone jetty and lack of infrastructure there caused consideration of an alternative location. The tidal intake lagoon along the west side of National Grid's Northport Power Plant could provide suitable locations to erect an automated tide gauge that would be protected from winds, waves and other weather influences. Another automated tidal gauge could be mounted on a piling at the head of the western tributary to Crab Meadow Creek, proximal to the intersection of Waterside and Eaton's Neck Road. This location could detect water levels in response to both coastal storm surges, as well as overland peak flows that would be delivered to the marsh from significant rainfall events.

Alternatively, the piezometers can be fitted with pressure transducers and automated data loggers and can be networked with the automated tidal gauges via remote sensing apparatus to digitize the data to obtain near- synchronous readings from all of the sensors, thereby eliminating the time lags between manual readings. This will enable documentation during episodic precipitation or flooding events (such as hurricanes or nor'easters) without imposing risks to human safety.

The Town could also consider establishing a weather station at the Northport Power Plant, automating the stream gauges and integrating the entire system to enable measurements of both fresh surface water and groundwater flows and their interactions, to determine the marsh infiltration rates and their discharges to the Crab Meadow Marsh.

1.9.2.3 Surface Elevation Tables

The City University of New York (CUNY) assisted the Town and the CMWAC with the installation of three Surface Elevation Tables (SETs) within the Crab Meadow Marsh that were completed in May 2015. SETs are mechanical leveling devices used to measure relative elevation changes in marsh sediments over time. The SETs consist of a benchmark pipe, a fixed reference plane table and measuring pins. Also included in the SET installations were three (3) feldspar "marker horizons," that can be referenced during future sediment coring activities to more accurately determine the amount sediment accretion. Precise measurements of marsh surface elevations can enable scientists to determine rates of elevation change that are particularly important relative to sea level rise. In order for vegetated salt marshes to remain healthy against potential rising sea levels, the marshes must build up surface elevations through sediment accumulations or migrate landward. If a marsh surface elevation rises at a similar or faster rate than water levels, the marsh will likely continue to thrive. If the marsh surface does not keep up with rising sea level, it is likely to become excessively flooded and fragmented over time (see websites www.pwrc.usgs.gov/set/SET/original.html and https://dnr.maryland.gov/waters/cbnerr/Pages/sentinel-sites.aspx

1.9.2.4 Temperature Loggers

With support from an Iroquois Gas Transmission System LP grant the Town purchased temperature data loggers that have been installed and monitored in partnership with Trout Unlimited Long Island Chapter. The loggers were placed at key locations in the west and east creek branches that feed the Crab Meadow Marsh annually from 2011-2013, then left in place for a full year from 2014-2015.

Temperatures were monitored first for seasonal (May to November) fluctuations, then to achieve a full annual baseline range. This Trout Unlimited project is determining the viability of the creeks for restoration of a native brook trout fishery (see http://www.longislandtu.org/past-projects.html).

Data collected to date shows a temperature range that would support brook trout (*Salvelinus fontinalis*). Fingerling trout releases have already occurred in both the west and east creek headwater areas in association with Trout Unlimited Trout in the Classroom programs. In addition to trout, fish in the two channels that have been identified by Trout Unlimited volunteers include sunfish (*Lepomis* spp.), yellow perch (*Perca flavescens*), bass (*Micropteris* spp.), small river pickerel (*Esox* spp.) and three-spined stickleback (*Gasterosteus aculeatus aculeatus*).

1.10 Hydrologic Model

1.10.1 Urbanization

Urbanization and the development of upland areas adjacent to wetlands can cause both direct and indirect impacts on wetland hydrology. The development of upland areas adjacent to the Jerome A. Ambro Wetland Preserve could have significant effects on the hydrologic cycle within the CMW.

Removing natural vegetation and clearing land for urban development will increase soil compaction and decrease the amount of natural depression storage, leading to a decrease in groundwater interception and infiltration. Increasing the amount of paved, impervious or built surfaces will also increase the volume of stormwater runoff. These urbanizing effects usually result in the development of more defined drainage paths leading to higher flow velocities and increased soil erosion or scour potential.

The installation of man-made drainage features modifies natural hydrologic flow paths by directing surface runoff into local roadways or engineered channels that quickly deliver stormwater to adjacent wetlands, waterbodies or designed drainage basins.

Urbanization also reduces the time of concentration (the amount of time it takes for water to move across a sinuous path from a remote upland location to the disposal location in a watershed) and the ability to filter or treat stormwater before it is discharged. Collectively, clearing and urbanization within the CMW may lead to higher peak "flash type" flood flows with the potential to scour their overland flow paths, and increased potential to pick up and carry sediment and pollutant loads to their discharge points.

1.10.2 FLO-2D Hydrology Study

A Hydrology Study was completed for the CMW Study Area using the FLO-2D computer model that identifies the flow patterns/networks, and calculates the runoff volumes associated with 24- hour 2-year, 10-year and 100-year return period rainfall events.

The FLO-2D hydrologic model was prepared for the Town to provide a baseline for conducting comparative analyses of land use changes, flow path modification, stormwater best management practices, and site-specific hydrologic and hydraulic studies. GEI's Crab Meadow Watershed Hydrology Study is included in Appendix D of this report.

Floodplain cross sections were analyzed as part of this FLO-2D computer model to develop a discharge hydrograph, and to compile hydraulic results for the calculated flows across each section. These cross sections provide an estimate of the peak discharges expected to flow into the Jerome Ambro Wetland Preserve during various flooding events as shown in Table 7 below.

Table 7			
Crab Meadow Creek Peak Discharges			
Cross Section	**2-year**	**10-year**	**100-year**
Northwest Tributary	3 cfs*	12 cfs	82 cfs
Southwest Tributary	3 cfs	41 cfs	245 cfs
East Tributary	9 cfs	70 cfs	253 cfs

*cfs = cubic feet per second

These results are also graphically depicted in the figures attached to the Hydrology Study in Appendix B. As can be seen in Figures 6, 7 and 8 of the Hydrology Study (Appendix B), the model predicts that the peak flows will occur along the:

- Northwest Tributary: Waterside Road flowing east into the western limit of the Jerome A. Ambro Wetland Preserve, north of West Street; and

- Southwest Tributary: Waterside Road flowing north into the Ingraham Preserve, then via the brook under Waterside Road where it discharges into the head of the Crab Meadow tributary to the west of the Town golf course; and

- East Tributary: along Rinaldo Road north of the Veterans property, flowing north into Makamah Road and then through the fresh marsh at the southeast corner of the Crab Meadow Wetland.

The 2-year storm is likely to raise elevations at the headwaters of the marsh and cause localized ponding. However, during the 10-year storm the peak flows will concentrate in the tributaries and join to result in shallow flows through the mouth of the creek (a depth of 9 inches to approximately 18 inches). The 100-year storm will likely result in significant discharge to Long Island Sound, with flood depths in the main marsh channel ranging between 1-1/2 feet to 4 feet deep.

CHAPTER 2 – WATERSHED RECOMMENDATIONS

2.1 General Housekeeping

The following section provides a broad overview of potential watershed concerns, explains the differences between point and non-point discharges, describes the associated types of pollutants, and offers general recommendations for stormwater control Best Management Practices (BMPs) that the Town can consider in the CMW and residents can implement in their own backyard.

The material contained in this section was largely excerpted from previous watershed studies conducted elsewhere on Long Island by GEI staff, including: the Suffolk County North Shore Embayment Watershed Management Plan (SCDHS, 2005); the Scudder's Pond Subwatershed Plan (EEA, Inc. and Cameron Engineering, 2005); the Mattituck Creek Watershed Analysis (EEA, Inc., 2000); and other on-line resources.

There are two ways to classify impairment sources to any water body. One is *point source* pollution, where the pollutant source comes from an identifiable source or location. The other is *non-point source* pollution, where the pollution does not come from an easily identifiable source or location.

Point sources can originate from "any discernable, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged" [Section 502 (14) of the Clean Water Act (CWA)]. Point source discharges to surface waters or ground waters are regulated by the US Environmental Protection Agency (USEPA) through permit requirements under the CWA, NYSDEC regulation under the State Pollutant Discharge Elimination System (SPDES) Program, as well as Suffolk County Department of Health System (SCDHS) Sanitary Code pursuant to Article 7 governing Water Pollution Control.

The SPDES program governs wastewater discharges to surface waters or groundwater from collection and disposal systems including drywells, cesspools, or leaching basins which receive wastewater from floor drains, shop sinks, or other potential sources of contamination. However, the SPDES program does not apply to discharges composed entirely of stormwater, to which no pollutant has been added by industrial, commercial, or other activity, unless the stormwater discharge has been identified as a significant contributor of pollution.

A useful green infrastructure guidance document (2015) was prepared by the National Wildlife Federation and Citizens Campaign for the Environment Long Island Program, "Suffolk County Natural Vegetation and Green Methodologies Guidance for Municipalities and Developers, V.2.0". The Town has developed a Stormwater Management Program (SWMP) Plan (2012 and subsequently updated annually) in compliance with NYSDEC SPDES Phase II stormwater requirements. The SWMP addresses the following elements: Public Education and Outreach; Public Involvement/Participation; Illicit Discharge Detection and Elimination; Construction Site Runoff Control; Post-Construction Stormwater Management; Pollution Prevention/Good Housekeeping for Municipal Operations.

The Town's SWMP can be viewed at:
https://huntingtonny.gov/filestorage/13749/16439/16577/99651/26387/SWMP_Final_1019.pdf .

2.2 Overview of Non-Point Pollution Sources

Non-point sources of pollution are more diffuse and difficult to define than point sources. Non-point sources of water pollution deliver contaminants into surface waters and groundwater through seeps, leaks, runoff, and rain. The complex runoff process includes both the detachment and transport of soil particles and leaching and transport of chemical pollutants. Chemicals can be bound to soil particles and/or be soluble in rainwater. As the runoff moves, it picks up and carries away natural pollutants and pollutants resulting from human activity, finally depositing them into surface waters and ground waters.

Non-point sources are not subject to Federal permit requirements. Storm water discharges to surface waters are regulated by NYSDEC through the SPDES Permit program, particularly the General Stormwater Permit (GP-0-12-001).

This permit requires facilities to install temporary or permanent soil erosion and stormwater control measures to reduce the migration of sediment off site. Stormwater control BMPs include methods of preventing stormwater from coming into contact with pollutants (e.g., diversion measures such as dikes, swales or ditches), treatment devices (e.g., silt fences, swirl separators, sand filters) to minimize the discharge of pollutants, as well as Green Infrastructure (GI) techniques to reduce the overall volume of stormwater runoff. To obtain authorization from NYSDEC under the General Stormwater Permit, facilities must develop and implement a Stormwater Pollution Prevention Plan (SWPPP) and file a Notice of Intent (NOI) to the agency.

2.2.1 Total Suspended Solids

Total suspended solids (TSS) are the organic and inorganic particles that are suspended in and get carried by runoff water. TSS includes the textural soil components (i.e., sand, silt, clay) as well as the associated pollutants that adhere to the soil particles. TSS is problematic in marine and aquatic ecosystems as it can have lethal and sub-lethal effects on benthic organisms and fish populations by delaying the hatching time of fish eggs, killing fish by coating their gills, and by creating anoxic conditions (O'Connor et al. 1976; Naqvi and Pullen 1982).

2.2.2 Nutrients

Nutrients are essential chemicals needed by plants and animals for growth. Excessive amounts of nutrients can lead to degradation of water quality. In surface waters, nutrient availability usually limits plant growth. When nutrients are introduced into a waterbody at rates higher than normal background or natural levels, aquatic plant productivity may increase dramatically. This process, referred to as cultural eutrophication, can adversely affect the suitability of water for other uses. Increased aquatic plant productivity can lead to the addition of more organic matter, which eventually dies and decays, producing unpleasant odors, and depleting the dissolved oxygen supply required by aquatic organisms.

2.2.2.1 Animal Waste

Animal waste contains nutrients and pathogens, including fecal coliform, fecal streptococci bacteria and viruses, and can be considered either as a point or non-point source of pollution. The scattered wastes of domestic pets, horses, and wildlife (including waterfowl) are considered non-point sources because they originate in many dispersed locations and are transported by stormwater runoff to surface waters and to groundwater. Waterfowl are a significant source of coliform bacteria contamination in ponds, bays and tidal wetlands in Suffolk County. Although not the only source of pathogens, animal waste has also resulted in shellfish contamination in coastal waters. The method, timing and rate of application are significant factors in determining whether water quality contamination will result. Manure applied to the soil surface as a fertilizer is more likely to be transported in runoff than when it is incorporated into the soil.

The presence of large, open, manicured grassy areas can also indirectly contribute to pathogen levels in surface waters, along with nutrient loads, pesticides and herbicides. Canada goose droppings are a potential heavy source of pathogens. These birds feed in large numbers on expansive lawn areas, such as found on golf courses, ball fields, school grounds, etc. Many are no longer migratory and reside here year-round. Due to the inefficient digestion process of geese during grazing, large amounts of fecal wastes are left behind, which have the potential to be washed into receiving waters. The Crab Meadow Golf Course and the grounds surrounding the Veterans Hospital are known waterfowl concentration areas. Expansive parking lots used for loafing by seabirds and waterfowl can also contribute significant levels of pathogens to adjacent waterbodies.

2.2.2.2 Fertilizers

The three primary macronutrients used in fertilizers are nitrogen (N), phosphorus (P), and potassium (K). Of these three, nitrogen is generally the major groundwater contaminant. More fertilizer is often applied than can be used by the plants. Since nitrate-nitrogen is highly soluble, the nitrogen that is not taken up by plants and bacteria is often readily available to leach out of the root zone in sandy soils, and eventually reaches the groundwater or adjacent surface waters.

The application of organically derived, pelleted, time-released fertilizers into the soil surface can provide multiple benefits of reducing the potential for acute nutrient loading in surface waters. This is accomplished by providing a more efficient, long-term, controlled nutrient delivery to the plants over a seasonal time span.

Topsoil is usually rich in nutrients and other chemicals, in part due to past fertilizer and pesticide applications, as well as nutrient cycling and increased biological activity. Topsoil also contains a greater percentage of organic matter than subsoils. The topsoil layer, typically eroded and delivered as sediment, contains a higher percentage of finer and less dense particles than the parent soil. The soil erosion process often results in delivering higher pollutant levels per ton of displaced sediment, because small particles have a much greater adsorption capacity than larger particles. As a result, eroding sediments usually contain higher concentrations of phosphorus, nitrogen, and pesticides than the parent soil.

2.2.3 Pesticides/Herbicides

Pesticides and their degradation products may enter the groundwater and surface waters in solution, in emulsion, or bound to soil colloids. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems. Herbicides in the aquatic environment can destroy the food source for higher organisms. Herbicides can also reduce the amount of vegetative cover and can negatively affect egg-laying by aquatic species. At Crab Meadow Golf Course, it is the Town's intent to only use pesticides that are on the lowest end of the toxicity scale. Furthermore, the Town does not apply pre-emergent herbicides to the areas that border bodies of water. Typically, the Town also removes weeds by hand rather than making large post-emergent pesticide applications. The implementation of these practices would be prudent at other golf courses located within the Crab Meadow Watershed as well.

2.3 Urbanization Effects

The concept of urbanization was briefly introduced in the Hydrologic Model section above. As urbanization occurs, hydrologic and hydraulic changes are inevitable, and occur in response to site clearing and grading activities. The fracturing and conversion of natural open spaces into new developments also increases the effects of compaction, and the amount of impervious surfaces and maintained landscapes (Schueler, 1987). Increasing the area of impervious surfaces, such as rooftops, roads, parking lots, and sidewalks, reduces the infiltrative capacity of the native soil, and typically results in raising the volumes of stormwater runoff.

Urban development also causes an increase in pollutants. As the population density increases, there is generally a corresponding increase in pollutant loadings generated from human activities. The major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, heavy metals, road salts, petroleum hydrocarbons, pathogenic bacteria, and viruses. These pollutants typically enter surface waters via runoff without undergoing treatment.

Auto and truck engines that drip oil are the primary source of the petroleum hydrocarbon pollution found in urban runoff. Some polycyclic aromatic hydrocarbons (PAHs) are known to be toxic to aquatic life at low concentrations. Hydrocarbons have a high affinity for sediment, and they collect in bottom sediments where they may persist for long periods of time and result in adverse impacts on benthic communities. Ponds and estuaries are especially prone to this phenomenon.

Other impacts not related to a specific pollutant can also occur as a result of urbanization. Temperature changes can result from increased flows, removal of vegetative cover, and increases in impervious surfaces. Impervious surfaces act as heat collectors, heating urban runoff as it passes over the impervious surface.

Thermal loading disrupts aquatic organisms that have finely tuned temperature limits. Salinity can also be affected by urbanization. Freshwater inflows due to increased runoff can impact marine estuaries, especially if they occur in pulses, disrupting the natural salinity of the area and leading to a decrease in the number of aquatic organisms living in the receiving waters. Changes in salinity can also disrupt metabolic activity in animals. The salt concentration in the body fluids of most marine invertebrates is nearly the same as that of the environment. These forms of animals have a narrow salt tolerance and are restricted to regions of relatively stable, near-seawater salinities.

2.3.1 Septics

Septic systems and cesspools are the most commonly used on-site sewage treatment systems in Suffolk County. Pollutants from on-site systems include: nitrogen, organic chemicals, metals, bacteria, and viruses. The nitrate found in the effluent from on-site systems is highly soluble and moves easily through the soil to groundwater. Nitrates discharged in shallow recharge areas can contaminate shallow aquifers and surface waters.

Many of the septic systems located in the CMW predate SCDHS regulatory design parameters (pre 1970). Present procedure requires deep core samplings and analysis of material and drainage capacity. A septic tank is required, in addition to cesspools. Many owners of on-site systems do not follow a preventative maintenance program. More often than not, homeowners do not have the septic tanks pumped out as frequently as needed, thus allowing the sludge to flow to the leaching pool where it clogs the infiltrative surface of the leaching pool and field. Unnecessary or toxic chemicals may be poured into the system in an effort to avoid a pump out. Tree roots may also enter the piping and leaching pool and eventually prevent proper functioning.

Septic systems can be another source of pathogens to groundwater and water supply wells. Bacteria from well-functioning septic systems generally do not present a significant problem, because most bacteria are trapped in the soil or material within the leaching field area. However, failing septic systems may contribute to high total coliform counts, especially in older systems located near coastal areas. The location of subsurface wastewater leaching pools between shorefront homes and the water's edge means that high tides and storm tides can result in a temporary influx of saltwater into the leaching systems with a subsequent outflow of pollutants into adjacent wetlands and Long Island Sound.

2.3.2 Highway Deicing

Highway deicing materials include salts, gravel, sandy soils, and other materials. Sodium chloride is the most extensively used salt on Long Island. Improper storage and highway application can cause a significant impact on the environment when salts percolate through the soils and subsurface materials to the water table. Once in the groundwater, both sodium and chloride ions are non-reactive and can persist for centuries. They move with the general groundwater flow and can be carried down to deeper aquifers that are used for public water supply. Runoff from roads can carry excess deicing salts into receiving waters, result in salinity increases and a subsequent change in the physical character of the water body.

2.4 Addressing Water Quality Concerns

Water quality impairments due to stormwater runoff can generally be addressed in two ways:

1) Measures can be implemented to reduce contaminant loadings in the effluent carried by individual stormwater discharges (e.g., outfalls, streams, etc.). This approach treats stormwater runoff as a "point source" and typically involves structural devices that address a relatively small portion of the entire contributing watershed area but which can be very effective in mitigating acute, localized water quality problems.

2) The rate of contaminant generation and transport from the upland areas within the CMW can be controlled through the use of BMPs, public education initiatives, and other non-structural means. This "watershed-wide" approach treats stormwater runoff as a "non-point source", and typically involves relatively inexpensive implementation measures.

Appendix E summarizes a variety of widely supported BMP's/good housekeeping practices, some of which the Town currently employs and others that should be discussed as part of this Plan's implementation.

Appendix F describes alternative hard features and BMPs along with comparative feasibility and sizing criteria to enable proper, effective siting within the watershed. Both tables can be found at the end of this report. The implementation of structural control measures (e.g., catch basins, leaching pool systems, retention basins, etc.) can serve the multiple purposes of storing a specific volume of stormwater, allowing the stored water to be recharged to groundwater, and creating conditions by which sediment particles can settle out of suspension. The sedimentation function of stormwater management structures is particularly important, since most contaminants (including coliform bacteria and other pathogens) associate with fine-grained sediment particles. As sediment is removed from the stormwater, therefore, so too is a large quantity of contaminants.

2.5 Site Specific Recommendations

2.5.1 Henry Ingraham Nature Preserve

Henry Ingraham Nature Preserve provides habitat to a variety of unique ecological communities and wildlife species, including red fox (*Vulpes vulpes*), muskrat (*Ondatra zibethicus*) and river otter (*Lontra canadensis*). It is a Town goal to expand the contiguous habitat of this park by acquiring the 1.9-acre parcel (Sec. 010, Blk. 2, Lot 1) fronting Eaton's Neck Road from LIPA.

This parcel is currently overrun by a monoculture of common reed (*Phragmites australis*) that obstructs views around a sharp turn in the road that likely resulted from years of sediment accumulation at the base of the hill. This parcel would provide an opportunity for the Town to remove the invasive species, install a bioswale with a functional sediment pit to filter stormwater runoff, and return the vitality of the wildlife habitat and result in improved visual conditions.

The vegetative communities within the Ingraham Preserve are exemplary of native Chestnut Oak Forest and a Rich Mesophtyic Forest, including mature specimens of Chestnut oak (*Quercus montana*), Black oak (*Quercus velutina*), American beech (*Fagus grandifolia*) and the occasional sapling American Chestnut (*Castanea dentata*). Low-lying areas in the Park support emergent freshwater wetlands and scrub shrub species, including skunk cabbage (*Symplocarpus foetidus*), sweet pepperbush (*Clethra alnifolia*) and northern arrowwood (*Viburnum dentatum*). Invasive species, such as wisteria vines (genus *Wisteria*) and mulitflora rose (*Rosa multiflora*), are mostly confined to the pathways and entrance areas that may be controlled by vigilant park stewards in an effort to restore the native woodland community.

Supported by citizen input during the second public meeting and further Stewardship focus sessions, the parking lot off Waterside Avenue was completed. It was surfaced with pervious gravel (crushed bluestone) in accordance with the wetland permit issued by NYSDEC in 2013. Entrenched and staked hay bales were installed as an erosion control measure on the downslope edge of all disturbed areas during construction.

The Town should explore the possibility of installing green infrastructure in association with this feature. The invasive species (e.g., Honeysuckle) surrounding the parking lot and across from it in the Town right-of-way should also be removed and replaced with native shrubs characteristic of the surrounding Chestnut Oak Forest and Rich Mesophtyic Forest communities, in accordance with the state wetland permit. Species that would be appropriate could include: black huckleberry (*Gaylussacia baccata*), maple-leaf viburnum (*Viburnum acerifolium*), mountain laurel (*Kalmia latifolia*), witch hazel (*Hamamelis virginiana*), red elderberry (*Sambucus racemosa*), smooth serviceberry (*Amelanchier laevis*) and round leafed or alternate leafed dogwood (*Cornus rugosa* and *C. alterniflora*).

2.5.2 Meadowlark Park

Meadowlark Park is traversed by a variety of access ways, including a challenging mountain bike circuit, equestrian trails and pedestrian paths. With the exception of linear travel corridors, the park is nearly fully vegetated, and for this reason does not present a current water quality concern in the Crab Meadow watershed.

Due to the various openings and frequency of disturbance this park receives, the native oak community has been fragmented and mixed throughout with species typical of disturbed successional southern hardwood (SSH) woodlots and successional shrublands (SS). Black locust (*Robinia pseudoacacia*), Norway maple (*Acer platanoides*), Hercules-club (*Zanthoxylum clava-herculis*), mimosa (*Albizia julibrissin*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*) were found representing the SSH species; and SS species included winged and staghorn sumac (*Rhus copallina* and *R. typhina*), raspberries (*Rubus* spp), hawthorns (*Crateagus* spp.), multiflora rose and honeysuckle (*Lonicera* spp.). Non-native and invasive species are likely to perpetuate in such a disturbed community, therefore eradication programs are not recommended.

Town General Services parks maintenance staff and park stewards could, however, be trained to recognize invasive aggressive vines that can easily enter the park, be transported along the various pathways, and entangle otherwise usable open spaces. Species such as black swallowwort (*Vincetoxicum nigrum*), porcelainberry (*Ampelopsis brevipedunculata*) and mile-a-minute vine (*Persicaria perfoliata*) would warrant early detection and rapid response control actions.

2.5.3 Crab Meadow Beach

As Crab Meadow Beach separates the Long Island Sound and the Jerome Ambro Wetland Preserve, it is a significant land mass that can have major impacts on the ecological value and water quality of the marsh. There are buildings at the beach and a large paved parking area. The pavilion with a restaurant, beach maintenance area and restrooms, along with the separate picnic area, all generate solid as well as sanitary waste. Proper handling of those waste streams is essential to maintaining the surface and groundwater quality of the adjacent marsh and Long Island Sound.

Wastewater is currently collected into underground holding tanks for periodic pump outs and transfer to the Town's wastewater treatment plant. This system has come under close scrutiny of the Suffolk County Department of Health Services (SCDHS) over concerns about not meeting the current County Sanitary Code and potential for failure, although it has long been the Town's position (corroborated by the NYSDOS) that it is more protective of the environment than a conventional leaching system.

SCDHS has requested that the Town investigate other means of handling wastewater generated on-site, and the Town has weighed other disposal options. A conventional subsurface leaching system would be detrimental to the surrounding habitat, as the area is prone to flooding, has a high groundwater table, and the filtration material between the source and the discharge point is limited, posing higher risks of nutrient and pathogen releases than the current holding tank system in place. An innovative concept that has been successful in other areas involves developing a biological treatment system that routes wastewater through a series of wetland treatment cells. However, such a system could occupy a large area and would be dependent upon maintaining normal bacteriological function year-round, when the majority of uses at the beach are seasonal.

There are no stormwater collection and treatment systems currently servicing the paved parking area. It has been well documented that paved surfaces are a major contributor to non-point source pollution, from the oils, greases, other liquid chemicals and particulates that can mix with runoff and drain into surrounding waterbodies. On several site visits, a large ponded area was observed along the north side of the parking lot near the pavilions, and during the peak summer months, children were seen wading and splashing in this puddle. Numerous waterbirds regularly use the parking lot as a loafing area, contributing fecal matter and using the surface as a feeding site, dropping shells and crustaceans from the sky to crack open on the pavement below. This ponding situation needs to be rectified to reduce potential contaminants as well.

Green infrastructure measures should be considered to reduce and recycle the precipitation that falls on the area, such as installing water gardens or bioswales. These features could intercept and infiltrate rainwater, provide an accessible area for snowmelt to occur, and can also help reduce the radiant heat island effect from warming air masses over the dark pavement surface. Additional measures for collecting and temporarily storing relatively clean pavilion roof runoff in rain barrels or cisterns for landscape use will also help to reduce surface ponding on the parking lot. Additional watershed outreach and education can be provided by establishing a native maritime garden on-site. The public can visit and learn about drought tolerant and non-fertilizer dependent plants and wildflowers for their home gardens to boost biodiversity and support natural pollinators.

Litter and leachate from accumulated trash also pose a threat to water quality and wildlife habitats at Crab Meadow Beach. Recently, the Town installed self-closing domed trash receptacles to keep rainwater out and nuisance wildlife away from raiding trash cans. Daily trash collection from Memorial Day to Labor Day reduces the likelihood of unwanted releases and removes the attraction for garbage foraging pests. Raccoons (*Procyon lotor*), Norway rats (*Rattus norvegicus*), feral cats (*Felis catus*), crows (*Corvus brachyrhynchos*) and black-backed gulls (*Larus marinus*) that may congregate around such trash receptacles are also well documented predators of ground-nesting birds.

Invasive plant species, such as Asiatic bittersweet (*Celastrus orbiculatus*) and wisteria, typically become troublesome when found bordering developed properties. Implementing rapid response and eradication measures on invasive species where there are limited occurrences and before the populations expand unchecked is a very effective means of control. Training and mobilizing Town staff and park stewards to identify invasive species in the Park, and providing a means of mechanical removal will help control invasives, and reduce the threat of expansion into adjacent natural areas.

In keeping with the public stewardship interests of increasing outdoor educational opportunities at Crab Meadow Beach, the Town should consider establishing an active Nature Center, estuarine laboratory with touch tanks, and/or passive wildlife observatory at this premier Park facility. Interpretive kiosks, wildlife observation journals and signs to instruct park visitors about the types of flora and fauna they might encounter during their visit, coupled with the installation of a fully automated tidal gauge and weather station would raise public awareness about this significant natural resource and the part it plays in enhancing coastal resiliency. The Town should also consider installing alternative power sources (solar, wind, etc.) and conduct an energy audit to identify and incorporate energy saving measures for this park.

2.5.4 Veterans Nature Study Area

Veterans Nature Study Area occupies a 34-acre site that was deeded to the Town of Huntington for environmental education/student use. A three (3) acre brownfield site was recently remediated with substantial State Brownfields grant support, and reopened for educational use in 2013 after cleanup activities were completed. Maintaining native plants or promoting re- forestation on this site along with passive recreation will result in capturing and percolating clean groundwater into the watershed. The center of the site where the clean-up took place was seeded to a Suffolk County Soil and Water

Conservation District (SCSWCD)-recommended native prairie grass mixture in 2012, and currently supports a mixture of little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), and indiangrass (*Sorghastrum nutans*). White pine (*Pinus strobus*), Eastern red cedar (*Juniperus virginiana*), red oak (*Quercus rubra),* white oak (*Quercus alba*) , flowering dogwood (*Cornus florida*), and black cherry (*Prunus serotina*) seedlings were also planted by Girl Scouts and Bellerose Elementary students in 2013.

A deep gully (2-1/2 feet deep by 4 to 5 feet wide) has formed down the middle of the cleared field/ remediated area from the south to the north. Although the gully is completely contained within the site and does not result in off-site sediment migration, it does warrant stabilization before it is fully opened to public use. Gully stabilization may include grading and shaping to develop an engineered grade control structure and vegetated waterway, sized to handle the peak flows received from the developed upland subwatershed area. The Town may request further design services from the SCSWCD.

There are a few patches of invasive species within the native meadow area that may be eradicated or controlled by repetitive mowing, selective removal, smothering or other Best Management Practices (BMPs). The Town should consider developing a habitat management plan for this meadow area that incorporates invasive species controls as well as long-term monitoring of plant community succession, in which students or site stewards can actively participate.

The meadow is surrounded by mature woodlands, characterized by a mixed community of Successional Southern Hardwoods (i.e., Norway maple (*Acer platanoides*), black locust (*Robinia pseudoacacia*), tree of heaven (*Ailanthus altissima*), and black cherry along the disturbed periphery and trails; and red and black oak (*Quercus velutina*), chestnut saplings, sassafras, black birch (*Betula lenta*), and red maple within the woodlot interior. Such a grassland habitat patch could provide sustenance for white-tailed deer (*Odocoileus virginianus*); food and cover for small mammals such as red fox (*Vulpes vulpes*), eastern cottontail (*Sylvilagus floridanus*), meadow voles (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*); hunting grounds for various raptors; potential breeding habitat for wild turkey (*Meleagris gallopavo*) and a diversity of songbirds. Conducting wildlife species usage studies along with habitat monitoring presents an ideal educational opportunity for this site.

2.5.5 Kirschbaum Park

General housekeeping and stormwater control improvements are needed in this park to transform it from an underutilized Town storage area to a nature sanctuary. This park can be improved to welcome visitors, provide an additional interpretative maritime woodland, shrubland and beach trail system and wildlife viewing area. Currently, there already is an enforcement presence on site that can thwart vandalism and loitering as the house at the site is rented under license to a NYSDEC Conservation Officer (as is an apartment at the Fuchs Preserve). The property was acquired as parkland, but in the past there has been local opposition to allowing any intensification of use.

The Department of Maritime Services will need to consolidate materials and equipment, organize activities on-site and perhaps transfer some of their assets to other Town sites to enable this transformation to take place. There are potential vistas at the top of the hill, and natural areas to the east and south that could provide passive recreational opportunities. Stormwater controls (e.g., a detention basin or catch basin and leaching pool system) are needed at the top of the slope along with additional permanent seeding and landscaping, plus the installation of water bars or grade control structures down the existing path to eliminate gullying and sediment migration downhill to the east. The invasive species that have covered these accumulated sediments at the base of the hill should be removed or controlled, and accumulated sediments need be excavated or re-graded to improve pedestrian or vehicular passage.

As park users approach the bottom of the hill, they are treated to a walk through a mixed oak hickory forest that opens into an orchard-like setting, supporting a multitude of birds. From there, an interpretive trail could emerge from the woodlot and wind through the native maritime shrubland habitat. Further on the path would lead to the maritime dunes and maritime beach habitats. The wide open beach area provides nice views of the Long Island Sound and glacial erratics, as well as a close-up view of an osprey nesting platform and the power plant discharge canal, which itself can serve as an outdoor marine laboratory area. Patches of invasive Japanese knotweed (*Polygonum cuspidatum*) have established at the toe of the bluff face, where wrack and floatables have accumulated from storm events. The beach also allows visitors to approach the first of several shoreline hardening structures that were installed to protect residences to the east from the erosive effects of coastal storms, including timber bulkheads and stone and timber groins. This would be an ideal location to establish a pilot living shoreline project so that the effectiveness of various treatment measures could be examined side-by-side.

2.5.6 Blanchard Lake

Blanchard Lake occupies the low-lying area at the base of Blanchard Drive, situated between the National Grid power plant and the Sound Shore Bluff Property Owners Association. This waterbody is a secluded gem that supports aquatic life and a sizeable population of wading shorebirds; another intriguing open space area that beckons a kayak launch site. However, the pond and its access are privately held. Access to the west side of the lake is blocked and controlled by its owner, National Grid. The watershed above the lake is primarily wooded with no visible point source discharges, except one major curb inlet catch basin system at the southern terminus of Blanchard Drive with four openings. No service manholes were found at the roadside, but the outfall pipe could be traced downhill to a primitive, concrete-formed energy dissipating structure. Water quality tests should be taken near the outfall and opposite ends of the lake to confirm the overall health of this aquatic resource.

Ponds tend to become receptacles for all that flows above and below the ground within the tributary watershed by their very nature of occupying low-lying positions in the landscape. As such, these receiving water bodies tend to accumulate pollutants from both point and non-point sources, including: soluble chemicals, sediments, oils, grease and salts from road wash; sanitary wastes from domestic as well as wild sources; nitrogen and phosphorous loading; and floatable debris. In addition to anthropogenic sources, excessive water bird concentrations in the pond and adjacent

areas will exacerbate nutrient loading in pond systems. Stagnant water conditions, excess nutrient inputs and reduced dissolved oxygen levels in ponds will also contribute to algal blooms.

In 2012, the Highway Office completed a Water Quality improvement project in conjunction with NYSDEC and with cooperation from the Sound Shore Bluffs Property Owners Association. As part of this project, the Town installed stormwater pollutant removal structures within the existing drainage system upstream of the Blanchard Lake outfall, thereby intercepting and treating stormwater runoff from the contributing road network. This project significantly reduced the quantity of highway runoff and contaminants (such as sediment, heavy metals, and petroleum products) from entering Blanchard Lake. In 2014, the Highway Office installed additional drainage structures at higher elevations in the watershed to further increase collection and treatment of stormwater runoff. Additional measures that could be undertaken include conducting routine street sweeping after major storm events and controlling non-point pollutant sources, such as pesticides and fertilizers on landscaped areas, prohibiting car washing and emptying pool water into the street, and enforcing an aggressive pet waste clean-up program. A possible strategy that could be employed, sometimes used in areas that are directly up-gradient of a significant natural resource such as Blanchard Lake, would be to mandate on-site septic system inspections and clean-outs and/or dye-testing prior to property sales. This could also make sense for this community to ensure that domestic sanitary wastes are not contributing to the bacterial and nutrient loading of this waterbody.

2.5.7 Geissler's Beach

Geisslers Beach provides public fishing access to Long Island Sound (LIS) from sunrise to sunset. The installation of interpretive signage was recommended during the public forums and implemented in 2015 with the installation of a kiosk. The kiosk informs users of the types of fish and shellfish that could be encountered and legally harvested at this location. Perched on the low bluffs bordering LIS, the stormwater runoff generated by the Geisslers Beach parking lot is spilt between flows south towards Crab Meadow and flows north over the bluff face. The Town recently implemented a Best Management Practice by reconfiguring the parking lot so that it straddles the ridgeline between the LIS and adjacent uplands, and effectively increases the separation distance from the Sound. Additionally, native salt shrubs (Marsh elder, *Iva frutescens* and Groundselbush, *Baccharis halimifolia*) were recently installed bordering the fishermen's access road to the beach, which will help to naturally stabilize the shorefront. Additional landscape plantings would help to filter stormwater runoff from the park. Native maritime shrubs, such as northern bayberry (*Myrica pensyvanica*), beach plum (*Prunus maritima*), pasture rose (*Rosa virginiana*) and winged sumac (*Rhus copallina*); and salt-tolerant trees such as American holly (*Ilex opaca*), red maple (*Acer rubrum*) and shadbush (*Amelanchier canadensis*) are recommended additions for this coastal setting.

Additional guidance with selection of native and adapted vegetation for areas adjoining Long Island Sound can be found on the Connecticut Sea Grant webpage: www.clear.uconn.edu/crlg/index.html. The Town park also includes a coastal buffer on the eastern portion of Geisslers Beach that adjoins private property on the low bluff and immediately adjacent upland areas. An August 2006 Beach Erosion Study Report prepared for the Town of Huntington describes numerous adapted plants and shoreline stabilization techniques that have been implemented along Huntington's north shore.

Best Management Practices (BMPs) would prohibit the planting of non-native and fertilizer dependent species, eliminate park/bluff lawn and irrigation encroachment by adjoining homeowners, encourage removal of invasive plant species (such as kudzu that is present), create a coastal grassland area with a trail, and promote the use of native groundcovers and shrubs to support diverse and resilient living shorelines, wherever applicable. Creation of a form of ramp between the tiered levels of this area would facilitate park access, monitoring and periodic mowing. The Town should also monitor the property closely to ensure that any encroachments are removed, and that the eastern coastal buffer remains accessible to the public.

2.5.8 Fresh Pond

Fresh Pond lies at the extreme northeastern edge of the Town-defined CMW boundary. It is mostly owned by the County of Suffolk. It does not contribute flows into the Crab Meadow wetland system and the majority of the pond area is located in the Town of Smithtown. The pond collects drainage from Indian Hills Golf Course and residential areas to the west and discharges through a narrow tidal outlet directly into Long Island Sound. This area was visited immediately following a significant rainfall event (e.g., 8"+ in 24 hours) on August 13, 2014, and found to be one of the worst flooding locations within the CMW. Portions of Juliet Lane, Cousins Street and Fresh Pond Road were almost impassable due to localized street ponding and the accumulation of significant sediment loads delivered from uphill areas to the west. As discussed in the Groundwater section of this Report, total and fecal coliform levels were found to be elevated in surface water samples taken from Fresh Pond, Fresh Creek and its tributaries. This area warrants a closer look at potential drainage infrastructure improvements and stormwater control BMPs, such as installing additional catch basins and leaching pools higher up in the subwatershed to reduce flow volumes, and infiltrators and bioswales along the pond periphery to capture and treat the first flush of stormwater runoff before discharging into Fresh Pond. A dialogue could be opened with personnel from County Parks, Recreation and Conservation and Towns of Huntington and Smithtown Maritime and Highway Departments in this regard.

During the public outreach and stewardship meetings for this project, local fishermen expressed interest in improving fish passage for alewife (*Alosa pseudoharengus*) and other potential finfish species to run upstream into Fresh Pond to spawn. As the outfall connecting the pond to LIS is located in the Town of Smithtown, a joint effort would have to be undertaken to capture baseline data to support this effort, including: a study to verify the fish populations currently utilizing Fresh Pond; water quality sampling; a survey of the locations and condition of each inlet and the pond outlet; a hydraulic assessment of flow rates; as well as a hydrologic analysis of the pond minimum and maximum water levels. A mitigation project is being explored by community residents working with the NYSDEC.

2.5.9 Fuchs Pond Preserve

The Town and Suffolk County acquired the 21-acre Fuchs' Pond Preserve in 2005. Suffolk County owns most of the property, while the Town owns the 2-acre homestead parcel that includes the1920's mansion that sits atop the hill surrounded by woodlands. In 2012 the Town Board dedicated the structure as the Cranberry Hill Environmental Center. Great Horned Owls and White-tailed Deer are frequently seen on this property. This building has tremendous potential, however, only the ground floor of this unheated facility is seasonally available (May through October) for public use as an environmental education center.

The Town could consider outreach to LIPA and/or New York State Energy Research and Development Authority (NYSERDA) in search of grants available to provide supplemental power and heating for this facility. The upper floor would need to be reviewed for compliance with current codes and requirements, such as structural improvements to support additional loads. Other green infrastructure improvements, such as rain chains, rain barrels, and rain gardens could be installed around this facility as a model for teaching stormwater Best Management Practices.

The "Cranberry Hill" mansion has not been listed on the State or local Historic Register and this potential could be considered as it may open additional funding sources from the State Office of Parks Recreation and Historic Preservation (OPRHP). The Town has installed a hand-painted aquatic interpretive mural on the west side of the mansion that was completed by local artists and youth volunteers, most of whom were participants in the Cornell Cooperative Extension Marine Stars summer program. An accompanying educational guide was developed by the Town Department of Planning and Environment to foster better understanding of the mural with visiting classes. Early in 2015 an Eagle Scout candidate also installed a canopy above the mural. See: https://www.huntingtonny.gov/filestorage/13749/13847/16804/99881/41072/41080/FUCHS_POND_Mural.pdf.

A man-made, freshwater pond and wetland system claims much of the low-lying area at the base of the hill. The pond is Suffolk County parkland and is managed by their Parks, Recreation and Conservation Department. The Suffolk County Department of Public Works oversaw the replacement of the Fuchs Pond weir in December of 2010, and NYSDEC set the height of the weir overflow (O'Brien, 2011). Prior to this replacement, the water height was elevated for many years causing deforestation along the banks of the pond that were inundated. Many of the mature trees and vegetation that were lost had been planted by the site owner that built the "Cranberry Hill" (later Fuchs') house and was replaced by native growth.

The Town Department of Planning and Environment has the original planting record for the estate. Piezometers have been installed to monitor groundwater levels along with pond levels. An existing inactive well could also be used to monitor groundwater levels, in association with the piezometer that the Town recently installed on the east end of the Fuchs Pond dike. A grant from the Iroquois Gas Company enabled the Town to purchase the data loggers. The temperature loggers installed initially in 2011 have provided some data, and indicate that conditions appear to be favorable to support trout and some stocking has already occurred. This area has been suggested by anglers for consideration as a limited recreational fishing area for fly fishing only, catch and release, no barbed

hooks, such as on the Nissequogue River. Wood duck nest boxes could also be installed in the flooded area of Fuchs' Pond since there are many dead standing trees that could offer suitable habitat.

2.5.10 Scherer's Pond

Scherer's Pond was historically created in the early 1900s to support the cultivation of cranberries on the Lewis Farm. Cranberries were grown on raised beds throughout the spring and fall, bordered by shallow ditches, which were fed by freshwater springs. According to Town records, the Lewis Farm Cranberry Bogs were flooded every winter by closing the outlet through an earthen dike that runs north-south (and perpendicular to the Iroquois pipeline on the western end). Typically, in April, the water level was dropped by slowly removing flashboards from the concrete weir structure and allowing the bog to drain to the west. This historic drainage system has been modified over time, partly by human intervention along with the installation of the Long Island Lighting Company (LILCO) high voltage buried transmission cables in the late 1960s. The cable installation split Scherer's Pond into a north and south pond. NYSDEC prepared a summary report and graphic depicting the hydrologic connection between Fuchs Pond to the south and Scherer's Pond to the north (NYSDEC, 1967). The system was impacted further by installation of a natural gas pipeline by the Iroquois Gas Transmission System in the early 1990s.

Scherer's Pond is situated downstream of Fuchs Pond and would naturally receive surface water from the Fuchs Pond overflow. However, according to the NYSDEC sketch, the Fuchs Pond weir is connected via a concrete culvert that passes under the dirt road and daylights at the head of a narrow channel. This channel outlet is downhill of the earthen dike, effectively bypassing inputs into the U-shaped Scherer's Pond situated east (upstream) of the dike. As water flows north along this narrow ditch, it collects additional drainage from wetlands to the west and eventually discharges into another culvert through the earthen fill of the LIPA right-of-way/Iroquois pipeline. North of the pipeline, flows pass through another narrow channel that eventually join the discharge water from another concrete weir. From there, flows appear to continue west and away from Scherer's Pond.

Additional analysis, perhaps dye study, is needed to determine whether the Fuchs Pond weir discharge pipe is installed on the proper side of the earthen dike or whether there is another obstruction that can be removed to reconnect the historic flow path through Scherer's Pond and maintained pond water levels to the east. In addition to this question of flow path, a breach has occurred through the dike on the south pond, allowing additional water to escape the impoundment and effectively lower water levels in the eastern portion of the pond. Since both eastern sections are connected with a pipe, the water level in both the northern and southern ponds has been adversely affected.

The Town would like to restore the water levels in Scherer's Pond and would like guidance on how to properly manage this water body. Residents feel this is a real priority for action. The NYSDEC might be able to provide guidance in restoring the historic connections. As stated above, it appears that the hydraulic separation between the east/upstream side of the dike and the west/downstream side of the dike has been compromised, possibly resulting in an overall lowering of pond levels and drying of the marshes on the east side of the dike. Repair of the earthen dike and diversion of the

Fuchs Pond overflow onto the eastern/uphill side of the dike may help to re-establish Scherer's Pond water levels and the hydrology supporting wetlands on the eastern side of the dike.

The current topography throughout Scherer's Pond should be surveyed, including the dike centerline and both the western and eastern toe. All drainage structures, weirs, culverts, pipe inlets and outlet elevations in Scherer's Pond should be included in the survey, along with details of the Fuchs Pond weir structure, outfall pipe and channel. The drainage through this system should also be further examined to verify the causes for the water level shifts in Scherer's Pond. As part of this project, GEI installed a piezometer on the east side of the dike north of the pipeline so that groundwater and surface water flows to this system can be monitored over time. A subwatershed model can then be developed to predict water level fluctuations and guide future management decisions.

2.5.11 Crab Meadow Golf Course

The 122-acre Crab Meadow Golf Course is situated immediately up-gradient of the Wetland Preserve. While this recreation area maintains wide open spaces and panoramic vistas overlooking the marsh, it can also be a prime source for potential contaminants to the wetlands due to the on-site sanitary disposal system and grounds keeping practices.

Acres of maintained grasslands in close proximity to the open water areas also become an attractive nuisance for waterfowl. As mentioned in the General Recommendations section, congregations of waterfowl, particularly Canada geese present a major threat to water quality (nutrient and pathogen loading) due to the fecal matter they drop while grazing or loafing about. The Town runs a "Geese Peace" program pursuant to a U.S. Fish and Wildlife Service permit that involves oiling eggs in goose nests to reduce/prevent potential hatches, and control the population of resident geese. It appeared that goose nesting was not that widespread on the Crab Meadow Golf Course; in 2014, only 8 eggs were found and oiled in. In 2017, the Town began using border collies for geese control and this measure has been quite effective. The Town also instituted a program using an Agrilaser Lite to keep geese off the course after dusk.

According to the Golf Course Superintendent, greens are the only turf grass that is treated with preventative fungicide and insecticides. Both tees and fairways are only treated with pre-emergent herbicides. Any fungicide or insecticide applications for these areas would be applied on as-needed basis. Both liquid and granular slow release fertilizers are applied through the growing season (totaling approximately 6 lbs. Nitrogen/1000 sq. ft.).

As is typical for many golf courses, most of the vegetative maintenance effort is focused on the highly manicured, active play surfaces of the tees, greens and fairways. The tees receive both pre- and post-emergence herbicides, insecticides, pesticides and fungicides on an as-needed basis. The greens are routinely treated with fungicides, as well as pesticides and insecticides on an as-needed basis. The fairways receive the least amount of chemical treatment, including occasional fungicides but never any pesticides or insecticides. Irrigation for the golf course is supplied by an on-site well, based on soil moisture readings to improve application efficiency.

The dominant cover type on the golf course is a mixture of cool season grasses (e.g., 70% annual bluegrass, 15% rye grass and 15% bent grass), and there are numerous mature shade trees on the property, particularly within the rough areas between the fairways. There is a narrow strip of woodlands (between 40 to 90 feet wide) along the northern edge of the property that separates the manicured portions of the course from the adjacent marsh. However, there is little to no natural vegetative buffer along the western side of the course, closest to the tidal creek. Initiating a nest box program for insect eating birds, such as Eastern bluebird (*Sialia sialis*), tree swallow (*Tachycineta bicolor*), purple martin (*Progne subis*) or bats around the golf course could also help reduce the need for applied pesticides.

There are a few small, excavated freshwater ponds along the west side of the course, but they are surrounded by highly manicured turf areas. Vegetation around the ponds is manually removed by mowing or cutting. The golf course does not use any algaecides in the ponds. The Town could consider reducing mowing frequencies, and avoiding any chemical applications along the western and northern edges of the course to enable re-growth of a natural, unfertilized buffer. This buffer will serve as a vegetated filter strip between the manicured turf and the marsh, which can help reduce total suspended solids (TSS), animal wastes and nutrient loads in stormwater runoff. On buffer strips, wider is better, but even establishing a 10 to 20 foot wide buffer will help reduce non-point source pollution.

Encouraging the growth of tall grasses and wildflowers near the water's edge will also provide the additional benefit of discouraging waterfowl from walking up out of the marsh to feed on the turf. Geese and ducks do not like to walk into areas where they can not readily see over their heads to avoid predators. Alternatively, the Town could replace the cool season turf grasses with native warm-season, drought tolerant, prairie grasses and wildflowers along the perimeter of the course and within all rough areas to minimize maintenance costs, reduce irrigation needs, as well as reducing overall nutrient loading to stormwater runoff. Another option is to design and install shallow sedge meadows or bioswales along the northern edge of the golf course outside of the active play areas to capture and treat stormwater runoff prior to discharge into the marsh. Ideally, siting a bioswale immediately west of the parking area could capture and direct flows into the low-lying grassy areas between the willow trees. A rain garden could collect and treat runoff from the parking lot and upland turf areas.

The golf course clubhouse, maintenance building and bathrooms dispose of sanitary wastes through on-site subsurface leaching systems or cesspools. The location of wastewater disposal systems in coastal areas where shallow depths to groundwater predominate, and routine cleanouts are crucial to maintaining their function without impacting groundwater or surface water quality. Two piezometers were installed along the north edge of the golf course to enable water quality as well as water table measurements downhill of this recreational facility, and prior to discharge into the marsh.

The Town's Director of Parks and Recreation has identified the following items of concern. Further assessment can lead implementation as appropriate at Crab Meadow Golf Course:

- Remove common reed (*Phragmites australis*) along Holes 7, 8 and 10 and behind the 13th Green;
- Mitigate (perhaps by dredging) the small pond that sits behind the 7th Green;
- Restore the tee box on Hole #8. A land bridge used to connect to the grass tee box, but was lost when a culvert was washed out years ago.

Due to its critical location in the CMW, the Town is encouraged to consider certifying the Crab Meadow Golf Course in the Audubon International (AI) program. AI offers an education and environmental certification program for golf courses. By joining the membership, AI provides guidance on environmental stewardship practices to help reduce operating costs, liability risks as well as environmental impacts. A site-specific assessment is prepared for the golf course covering the following topics:

- Environmental Planning;
- Wildlife and Habitat Management;
- Chemical Use Reduction and Safety;
- Water Conservation;
- Water Quality Management; and
- Outreach and Education.

By implementing and documenting environmental management practices applied on the property, a golf course is eligible for designation as a Certified Audubon Cooperative Sanctuary, which can improve its stature and reputation (http://www.audubonintemational.org/acspgolf).

2.5.12 Jerome A. Ambro Memorial Wetlands Preserve

The Town has management control over the entire 406-acre Jerome A. Ambro Memorial Wetlands Preserve and adjacent golf course. Similar to many salt marsh systems that flank Long Island's south shore, Suffolk County cut grid ditches into the wetland in the 1930s to promote better drainage for saltwater flow/flushing to curtail mosquito breeding. That maintenance program is no longer in place, and the impact of that historic decision to modify the marsh remains today. The ditching has caused widening of the marsh channels by natural tidal flow that pulls sediment seaward. The efficacy of that broad-scale program has been challenged over the past two decades by the scientific community, concerned about the inadvertent effects on non-target species, such as shellfish, crustaceans and nesting waterfowl populations.

Volunteer members of the CMWAC and CUNY have taken an active part in studying the effects of grid ditching on the longevity of the Jerome A. Ambro Memorial Wetland Preserve. Low aerial infra-red photography was taken in 2014 to document the current conditions of the marsh as a baseline for future comparisons of marsh vitality, wetland loss, scour/erosion and sea level rise. CUNY has also teamed with the Town Departments of Planning and Environment and Maritime Services to install a series of Surface Elevation Tables (SETs) in the marsh to provide additional background data. Additionally, Hofstra University extracted soil cores from the wetland to better define the geology below the marsh surface and draw some conclusions about the historic/anthropologic changes that have occurred there. These studies are described separately in the Soils and Field Instrumentation section of this report.

Another independent study undertaken by SUNY Stony Brook and the University of North Carolina involves the expansion of invasive Asian shore crab (*Hemigrapsus sanguineus*) populations into Crab Meadow. Asian shore crabs are believed to have entered the central and northeast US waters from Virginia to Maine in the ballast of ocean going ships. Since the early 1990s, initial findings indicated that this small crab species would selectively seek refuge from desiccation under stones and shells along the rocky portions of the Long Island Sound shoreline. However, recent studies conducted by SUNY Stony Brook and the University of North Carolina at Crab Meadow and other Long Island marshes have found that this invasive crab species has extended its range from the rocky headlands inwards to salt marshes, often displacing native marsh fiddler crabs (*Uca pugilator*) from their burrows.

The ecological impacts caused by Asian shore crab on the health of cordgrass (*Spartina alterniflora* and *S. patens*) beds, fiddler crab and ribbed mussel (*Geukensia demissa*) populations, and interaction with the predatory green crab (*Carcinus maenas*) are currently under investigation (Peterson et.al, 2014). The Town is encouraged to participate in academic studies and non-destructive research projects that could yield further knowledge and characterization of the marsh preserve.

In order to enable monitoring of the long-term trends in groundwater levels and water quality reaching the wetland preserve, several piezometers were installed surrounding the marsh as shown in Figure 11 and listed below:

- On the western edge – at the eastern terminus of Meadow Lane off Waterside Avenue;
- On the southern edge – two piezometers at the northern end of Crab Meadow Golf Course, one in Fuchs Pond Preserve east of the outfall structure, and one along the eastern side of the dike and outfall structure to Scherers Pond;
- On the eastern edge – one piezometer on the dike at the Makamah Nature Preserve and another one off Makamah Road.

An attempt was made to install a piezometer along the northern edge of the marsh near Geisslers Beach, however, a deep clay layer was encountered that prevented access to the groundwater table with the geoprobe equipment that was used. It is recommended that another well be installed either at this location or elsewhere along the northern edge of the marsh to yield important information concerning the effectiveness of the marsh as a filter to process nutrients and pollutants before discharging into Long Island Sound.

The eastern terminus of Makamah Beach Road presents a novel location for establishing an overlook area. It provides sweeping panoramic views of the wetland preserve and a chance for visitors to observe the ecological variations between the intertidal marsh, high marsh and maritime upland transitional areas. As Makamah Beach Road is a private road, public access would have to be worked out. This location could provide an ideal spot to establish a viewing platform and educational kiosk along a marsh walking trail.

Residential developments on the north side of Makamah Beach Road present challenges to protection of this wetland preserve. Limited parking space, land grading and dumping threatens encroachment along the northern edge of the marsh. The Town should consider posting signs indicating the importance of protecting this northern edge of the wetland preserve and establish a designated natural buffer which could filter stormwater. Posting of the wetland preserve boundaries may encourage neighbors and visitors to this area to respect the vulnerability of this transition zone. Alternatively, establishing a boardwalk or visible buffer along this edge would mark the preserve boundaries.

An additional educational access along a perimeter marsh trail would be a future goal, perhaps linked to townwide blueway planning, and could potentially thwart unwanted activities that would be deleterious to the conservation objectives.

The edge of the marsh is always most vulnerable to the accretion and deposition of sediments from stormwater runoff and ultimately the conversion of a diverse high marsh into a monoculture of common reed and other invasive species. Oil/grit swirl separators and bioswales could be installed along the marsh perimeter at critical locations where road wash can enter the wetland preserve. The Town could consider establishing a pilot bioswale project at the junction of Waterside Avenue and Eaton's Neck Road to trap floatables and keep suspended solids from entering the marsh. The marsh edge also presents numerous opportunities to remove, control or treat the spread of common reed and replace invasive plants with native high marsh species. Such wetland restoration activities would also create a wetland migration corridor proactive to the effects of climate change and sea level rise.

The perimeter of the Jerome A. Ambro Memorial Wetland Preserve also presents numerous opportunities to engage neighborhood stewardship activities, such as erecting and maintaining nest boxes for swallows, purple martins, bats, and owls. The Town could also consider purchase and installation of a remotely operated video camera near the active osprey nesting platform in the marsh. This will allow close-up views of breeding pairs and fledglings, and provide a record of nesting success. Such a web camera could also provide a vantage point for marsh watching, an opportunity to provide visual access without impact.

2.5.13 Soundview Boat Ramp and Beach

The Town owned property north of the Soundview Boat Ramp parking lot is known as Soundview Beach and consists of a 4 acre waterfront lot. Currently, the property contains a buried gas transmission line (Eastchester expansion gas transmission line installed by Iroquois Gas) on the eastern edge. In the early 1970s, there was a proposal to build a beach pavilion on the property, but the project was never brought to fruition. The site is currently designated parkland; however, it may be a suitable site for an adult environmental center/ nature educational site. The Town has a 99-year lease for the Soundview Boat Ramp and parking area with specified use provisions. The ramps are accessible year-round for recreational vessels, used mostly by fishermen. The parking lot was repaved in 2017, and consideration should be given to directing run-off to a culvert that could be built between the main parking lot and the entrance road located to the south of the main lot.

2.5.14 Makamah Nature Preserve

Makamah Nature Preserve was originally named 'Crab Meadow Park East Watershed', as it borders the southeastern edge of the Jerome A. Ambro Memorial Wetland Preserve. Makamah Nature Preserve was acquired by Suffolk County in 1973. This 160-acre preserve is primarily covered by woodlands, but contains an open water wetland behind a constructed earthen dike that meets Makamah Road to the east. The pond drains northwards through double culverts under the earthen dike. A piezometer was installed near this principal outlet, which could provide important data about groundwater quality near the discharge point in this gaining or effluent stream. During the piezometer installation, numerous small fry were noticed seeking refuge in the plunge pool on the north side of the dike. Additional live capture and release studies are recommended at this location to identify the fish species, and to determine whether a fish ladder could enhance passage upstream of the dike. According to the Town of Huntington Trails Guide, this preserve provides habitat for 12 mammal species, and supports a wide diversity of birds (94 species) including prime habitat for owls and woodpeckers.

Chapter 3 - Draft Stewardship Plan

3.1 Stewardship Focus Groups

The previous chapters of this study present the findings of the data collection efforts along with the general and site-specific recommendations for watershed improvements compiled by the consultant and the Town. This final chapter addresses the inputs received from the public who participated in the second community outreach session held on June 5, 2014. During this meeting, the attendees were asked to break into different focus groups to identify the problems, concerns and opportunities they felt warranted attention under each of the following six Watershed Stewardship topics:

- Community Involvement and Education;
- Habitat, Plants and Wildlife;
- Water Resources and Water Quality;
- Access and Recreation;
- Land Use; and
- Infrastructure Restoration and Historic Resources.

A complete list of the public comments received from the second community outreach session is included in Appendix G. During this second meeting, several participants volunteered to continue discussing the issues, challenges and suggestions that were identified at follow-up sessions with the CMWAC. The public input solicited from the June outreach session was then prioritized, and goals and strategies were framed out at a subsequent meeting on July 31, 2014. Building upon the Master Plan, the Town and the CMWAC continued to synthesize this information into a Draft Stewardship Plan. This Stewardship plan is a living document that captures the public concerns, builds upon a scientific database and provides an initial roadmap for implementation. It is intended to morph over time, become more robust by incorporating future research, and may shift its focus in response to ecological and social changes that occur within the watershed. The Town and the CMWAC welcome public feedback on its content, and anticipate that constructive efforts will only improve its effectiveness towards achieving the Crab Meadow Watershed Stewardship goals and meeting the unknown challenges that lie ahead.

3.2 Priority Concerns

The following section highlights the top priority concerns identified during the community outreach session and subsequent CMWAC meetings.

3.2.1 Community Involvement & Education

3.2.1.1 Improve educational resources and outreach

Emphasis should be placed on increasing public outreach to stakeholders, local schools and park users to heighten their awareness of the natural resources jewel that is the centerpiece of CMW. The area is an underutilized gateway and natural laboratory for those who are interested in learning about life in a wetland, its diurnal connection to Long Island Sound, its coastal resiliency value, and the importance of the ecological network between dependent organisms. Additional educational materials should be developed and displayed throughout the watershed, such as informational signs and kiosks that explain what a park user is viewing and the functions and values of the natural resources before them. Additional information should be made publically available, such as postings on the Town's web portal, educational pamphlets and lesson plans for schools. The Town should promote increased passive accessibility to the natural features throughout the watershed to boost potential interactive opportunities and to provide wildlife viewing areas to witness the ecological interactions between organisms. The history of settlement and changing land uses is also of interest, as it sets the stage for understanding the current condition of the watershed. Periodic field-based programs should be provided to the public to enhance coastal understanding.

3.2.1.2 Promote passive recreational uses not active uses in and near the wetland

Any activities within the Jerome A. Ambro Memorial Preserve should be cognizant of the ecological thresholds for disturbance and must strike the proper balance between increased public utilization and preservation of the delicate fish and wildlife networks that keep the marsh functioning as a healthy wetlands ecosystem. Scientific research/monitoring, education, and public programming should be allowed access to the preserve's resources as appropriate and as can be safely sustained without adverse impact.

3.2.1.3 Increased enforcement is needed to thwart vandalism

There is concern about the abuse of the privileges afforded by providing public use of open spaces, such as the potential for damages to park facilities and natural resource features. The Town should encourage additional volunteer park stewards, adding a park ranger or other regular presence to thwart potential vandalism, and also the installation of high definition security cameras in areas that have historically incurred damages.

3.2.1.4 Raise overall public stewardship awareness

There is a need to raise sensitivity of the CMW residents about their connectivity to, and the potential impacts of their lifestyle on the water quality in the watershed. Clear, concise information about the effects of private land management and septic disposal methods, and the need for implementing non-point source controls/best management practices must reach area residents. Additional emphasis should also be placed on educating CMW residents about the extent of regulatory jurisdictions, reasons for instituting controls and homeowners' responsibilities under those regulations. This work was initiated by development of a Crab Meadow Watershed brochure, poster, and website supported by the CMWAC.

3.2.2 Habitat, Plants & Wildlife

3.2.2.1 Preserve existing habitats and water quality

The consensus among workshop participants is that the Crab Meadow Watershed is principally in a healthy state and that Town efforts should be focused on protecting endangered and threatened species, preserving existing fish and wildlife habitats and continuing to improve water quality.

There are numerous research opportunities (e.g., telemetry on otters, monitoring marsh elevations) to enhance the knowledge and understanding of the flora and fauna associated with a healthy CMW ecosystem, so that key life stages are properly supported. Invasive species populations need to be identified/mapped, and management plans developed and implemented to eradicate or control the spread of invasive plant species (such as common mugwort, Japanese knotweed, kudzu, Asiatic bittersweet, Boston ivy, and common reed) as well as introduced or unchecked wildlife populations (i.e., Asiatic crabs, mute swans, resident Canada geese, white tail deer) into surrounding natural areas. Public education that promotes a shift in the use of more native plants as 'ornamentals' in backyard landscapes will increase public acceptance and help drive the demand for more naturalized settings.

3.2.2.2 Control the deer population

During the last 2 to 3 years, the white-tail deer population has risen to unacceptable levels, resulting in frequent vehicular strike hazards on Route 25A and Bread and Cheese Hollow Road. Deer have overgrazed landscape beds and eliminated native spring wildflowers and woodland understory vegetation. The public requested that a cull or other control should be implemented to reduce the deer overpopulation. In 2015 the Town Code was amended to add Article VII: Deer Management to identify permitted control methods – deer fencing, planting of non-deer friendly vegetation, implementation of deterrent tactics, and bow hunting in accordance with other provisions in Town Code; to define prohibited acts – engaging in or encouraging the feeding of deer; and to establish penalties for offenses.

3.2.2.3 Improve fish passages

Road crossings, undersized culverts, and the construction of earthen dams have all contributed to restricting the movements of diadromous and catadromous fish within the CMW. The Town should examine the existing drainage conditions at all tributary areas, particularly at Fuchs Pond, Makamah Pond and also partner with the Town of Smithtown at Fresh Pond to determine if culvert replacements or fish way installations would benefit ocean running trout, American eel, alewife and blueback herring. Volunteers have stepped forward to assist the CMWAC with such efforts.

3.2.3 Water Resources & Water Quality

3.2.3.1 Identify pollutant sources and improve surface and groundwater water quality testing

Additional or routine water quality data collection is required to more accurately assess the impacts of sanitary systems, animal wastes, nutrient loading, road salts, herbicide and pesticide applications on water quality in CMW. The golf courses within the CMW were cited as concerns for potential effects on both surface and groundwater quality.

3.2.3.2 Attain better mapping

Detailed storm sewer maps and Town records covering the CMW drainage area are lacking as compared with other more developed areas in the Town. Updated mapping and field verification is needed to fill in the current data gaps. Marking street drains that discharge into the CMW drainage area was recommended to increase public awareness of the watershed boundaries. The groundwater contributing area to the CMW also needs to be better defined.

3.2.3.3 Implement stormwater best management practices

The need for cyclone separators, storm drain filters and other stormwater filtration measures should receive priority in the CMW, particularly to eliminate sediment delivery into the wetland from Waterside Road, Makamah Beach Road and Seaside Court. The Town should also provide guidance to the owners of Makamah Beach Road (private road) in this regard. Additional non-point source pollution controls are needed surrounding Fresh Pond.

3.2.4 Access & Recreation

3.2.4.1 Provide safe parking

The capacity of existing parking areas servicing local parks should be further reviewed. The Town should increase available parking, and investigate, design and implement alternative means to provide safe pedestrian and vehicular circulation where appropriate. A planned example is at the Davis Brickmaker Preserve across from the northern entrance to Makamah County Preserve from Makamah Road near Breeze Hill Road.

3.2.4.2 Expand educational outreach

Educational kiosks and interpretive signs should be installed at key places within the Crab Meadow Watershed, such as at Geisslers Beach and at Crab Meadow Beach, that describe what can be found at those locations and explain important regulations (e.g., why dogs are not allowed on beaches) and wildlife and health threats (e.g., trash, fishing debris, balloons). A volunteer network, including park stewards, should be developed to assist and to expand opportunities for public education.

3.2.4.3 Continue to acquire and link important properties

The Town should continue obtaining and protecting strategic parcels using all available methods that will enhance the contiguous buffer surrounding the marsh, and provide safe passage and linkages between destinations. Particular locations were cited including: the south side of NYS Route 25A at Makamah Preserve (since acquired by the Town) and a potential greenbelt trail that links the Ingraham Preserve, Fuchs Pond, Makamah Preserve, Meadowlark Park and Veterans Park.

3.2.4.4 Control nuisance uses

Public concerns were raised over off-hour usage of parking facilities, partying, bonfires and off- road vehicular access through parklands. This concern was mirrored in the discussions over the need for increased enforcement, as cited in the Community Involvement and Education focus group.

3.2.5 Land Use

3.2.5.1 Continue watershed land preservation

The Town should continue efforts to protect parklands, work with owners to conserve important private properties, and acquire additional contiguous open space parcels within the CMW. Residents expressed concerns about further development in the watershed. Sites of particular interest identified by residents were the Veterans Administration Medical Center that may seek to release surplus property; the future status of the National Grid site; and preserving open space on the Indian Hills Golf Course under current zoning. There are many open space values (e.g., natural, visual, floral, faunal, recreational) that are appreciated differently within the community.

A combination of best management practices can reduce watershed impacts of new construction on land resources including, but not limited to evaluating existing allowable uses and considering impacts of specific development requirements, maintaining steep slopes, avoiding sensitive habitat, reserving natural buffer, reducing impervious surfaces, retaining mature trees, implementing green infrastructure for optimized stormwater management, expanding native plantings, and adhering to low impact landscape practices.

3.2.5.2 Promote sustainability

Numerous concerns were raised over coastal shoreline issues, such as bluff slumping at Indian Hills Golf Course, sand and bluff loss at Geisslers Beach, flooding along Makamah Beach Road, and the sandbar at the mouth of the Crab Meadow tidal creek. While these areas are located within the CMW, they highlight the need for additional long-term coastal and resiliency planning for properties fronting the Long Island Sound. This topic was also highlighted as a priority concern by the Infrastructure Restoration focus group. Continued evaluation of the tidal creek channels in the

Jerome A. Ambro Memorial Wetlands Preserve should be supported to identify potential areas for restoration and inform long-term sustainability. The Town was encouraged to implement Best Management Practice (BMP) pilot projects throughout the CMW, to provide working examples for the residents. As new homes are developed and/or expanded, as infill on previously vacant parcels or replacing existing residences, owners should be informed of the potential impact of their actions and individual stewardship actions should be encouraged. The watershed brochure that encourages individual stewardship actions should be shared when new building permits are issued.

3.2.6 Infrastructure Restoration & Historic Resources

3.2.6.1 Address existing system weaknesses

The Town should examine alternatives to improve resiliency during major storm events. Flooding problems occur along Waterside Avenue at Eaton's Neck Road, Waterside Avenue at West Road, the northern terminus of Waterside Road and Makamah Beach Road. Specific infrastructure improvements were requested, including: the removal of the abandoned asphalt ramp to the south of Crab Meadow Beach in the Ambro Preserve; evaluation and mitigation of the historic embankment at Fuchs Pond, and devising a resolution to the SCDHS concern (holding tank/sanitary system) at Crab Meadow Beach.

3.2.6.2 Prioritize erosion and beach issues

Coastal processes and beach erosion issues were also highlighted above as priority concerns by the Land Use focus group, as it related to improving sustainability. Concerns raised during the community outreach session included:

- Continued extension of the sand bars at the main tidal creek outlet and whether that was an indicator that the creek was shifting back west towards its original position;
- Improperly maintained groins;
- Need for dune replenishment;
- Sand accretion on the east side of the jetty at the National Grid power plant; and
- Erosion of beach width and dunes further east.

3.2.6.3 Focus infrastructure restoration efforts on water quality improvements

While numerous concerns and recommendations were discussed, this focus group suggested that infrastructure restoration efforts should be focused on practices that would affect water quality improvements, such as:

- Installing rain gardens and other green infrastructure practices to control non-point source pollutants;
- Identifying the sources of contaminants, including the impacts of sanitary disposal on water quality within CMW; and
- Reviewing site uses and implementing improvements as necessary at key locations, such as at Kirschbaum Park to protect the adjacent Blanchard Lake.

Chapter 4 – Regional Initiatives

4.1 Relevant Regional Plans and Studies

The Town's resources are finite. The scientific expertise of regional (County, State, Federal) agencies and private partners will be critical to the Crab Meadow Watershed area in the future. Key plans and studies have been completed that have relevance to the study area. These are noted below. Town departments and community stakeholders must stay informed of regional recommendations and incorporate them, as appropriate, into local reviews, plans, and actions. CMW materials that have been assembled and prepared will be shared with the regional agencies.

4.1.1 Long Island Sound Study CCMP

The Comprehensive Conservation and Management Plan (CCMP) of the Long Island Sound Study was updated in 2015. It contains four major themes with corollary goals, ecosystem targets, and implementation actions: Clean Waters and Healthy Watersheds, Thriving Habitats and Abundant Wildlife, Sustainable and Resilient Communities, and Sound Science and Inclusive Management. The 2015 CCMP can be viewed at: http://longislandsoundstudy.net/2015/09/2015-comprehensive-conservation-and-management-plan/. Crab Meadow is a designated Long Island Sound Stewardship Area (see: http://www.longislandsoundstudy.net/2012/11/crab-meadow/).

4.1.2 New York State Sea Level Rise Task Force Report to the Legislature

This 2010 report was prepared to identify issues and recommendations to help coastal communities respond to potential impacts of projected sea level rise. Key topics in the evaluation are ecosystems, public works and infrastructure, communities, and climate justice (actions needed to adapt). The Crab Meadow Watershed will be affected by continued sea level rise. For further information see: https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/united-states/east-coast/new-york/NYSSLRT.--2010.--New-York-State-SLR-Report.pdf and http://www.dec.ny.gov/regulations/103877.html.

4.2 Important Assessments Underway

4.2.1. Long Island Nitrogen Action Plan

The New York State Department of Environmental Conservation and Long Island Regional Planning Council, are developing a Nitrogen Action plan aimed at reducing Nitrogen levels in Long Island's ground and surface waters. The initiative started in October 2015 and will involve Nassau and Suffolk Counties, local municipalities, organizations and stakeholders. The draft scope for the project specifies "The LINAP will provide an assessment of conditions based on existing data including data on groundwater quality and quantity, and surface water quality. The plan will determine nitrogen load reduction targets as well as alternatives and strategies to meet those targets." The Huntington-Northport Complex lies within a defined study area.

For further information on the project scope, public meetings and presentations, see the NYSDEC web resources: http://www.dec.ny.gov/lands/103654.html.

4.2.2 Suffolk County Subwatersheds Wastewater Plan

In July 2016 Suffolk County initiated a broad scale analysis of subwatershed resources across Long Island as a component of the Long Island Nitrogen Action Plan and in support of its Reclaim Our Waters initiative. Crab Meadow Watershed resources were included among those to be evaluated.

The draft scope of work included multiple action items:

- Task 1 –WPAC Meetings, Focus Groups and QAPP
- Task 2 –Subwatersheds Baseflow Estimates
- Task 3 –Data Inventory and Literature Review
- Task 4 –Nitrogen Load Estimates*
- Task 5 –Surface Water Modeling**
- Task 6 –Tiered Priority Areas**
- Task 7 –Nitrogen Endpoints & Reduction Goals
- Task 8 –Surface Water Wastewater Alternatives
- Task 9 –Groundwater Reduction Goals & Alternatives
- Task 10 –Cost Benefit Analyses
- Task 11 –Groundwater Modeling
- Task 12 –Subwatershed Plan

In September 2019 a Draft Generic Environmental Impact Statement (DGEIS) was accepted and availed for public review. The August 16, 2019 SEQRA notice of completion of DGEIS and notice of public hearing provides the following description of the action. "The proposed action involves Suffolk County's implementation of a wastewater management strategy based on the recommendations presented in the Suffolk County Subwatersheds Wastewater Management Plan and the changes to the Suffolk County Sanitary Code required to implement these recommendations. The Suffolk County Subwatersheds Wastewater Management Plan is a Suffolk County Reclaim Our Water and Long Island Nitrogen Action Plan initiative that provides recommendations for the development of a wastewater management program to reduce nitrogen loading from wastewater sources."

A Final GEIS was filed February 26, 2020. SEQRA Findings were adopted by the Suffolk County Legislature on March 17, 2020 by resolution number 215-2020. A copy of the FGEIS and Suffolk County Subwatersheds Wastewater Plan ("The Suffolk County Wastewater Management Program to Mitigate Nitrogen Pollution Emanating from Wastewater Sources") is available for public review at the Suffolk County Department of Health Services and online.

See: https://suffolkcountyny.gov/Departments/Health-Services/Environmental-Quality#SubWWPlan

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Appendix A

Appendix B

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Appendix C

Appendix D

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Appendix E

Appendix F

Appendix G