U.S. Fish & Wildlife Service

Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York

FEBRUARY 2015

Wetland Classifications: NWI - Estuarine Intertidal Emergent Wetland, Regularly Flooded; LLWW - Estuarine Fringe Microtidal.

Cover photo: Andrea Pickerell

Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York

Ralph W. Tiner[1], Kevin McGuckin[2],
and Jason Herman[2]

[1]U.S. Fish & Wildlife Service
National Wetlands Inventory Program
Northeast Region
300 Westgate Center Drive
Hadley, MA 01035

[2]Conservation Management Institute
Virginia Polytechnic Institute and State University
1900 Kraft Drive, Suite 250
Blacksburg, VA 24061

February 2015

This report should be cited as: Tiner, R.W., K. McGuckin, and J. Herman. 2015. Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA. 25 pp. plus Appendices.

TABLE OF CONTENTS

Wetland Classifications: NWI - Palustrine Scrub-Shrub (Broad-leaved Deciduous) Seasonally Flooded; LLWW - Lotic Stream Basin Throughflow. (Ralph Tiner photo)

INTRODUCTION

The Northeast Region of the U.S. Fish and Wildlife Service has developed techniques for using its National Wetlands Inventory (NWI) data to better characterize wetlands and predict wetland functions at the watershed scale or landscape level. The techniques involve adding hydrogeomorphic-type descriptors to standard NWI data to create what is now called a "NWI+ database" (Tiner 2010, 2003a; recently updated in 2014). This database has more attributes assigned to mapped wetlands for use in describing wetlands beyond what was possible through conventional NWI classification. The Cowardin et al. system (1979) used for NWI mapping emphasizes ecological system, water depth, vegetation life-form, the frequency and duration of inundation or soil saturation, and some other features. Since this classification was designed for producing wetland maps and a basic inventory, it was not necessary to further classify wetlands by hydrogeomorphic properties. People using the maps could easily determine these properties for the specific area of interest. At the time of its development, we were working in an environment where maps were the primary product used and geospatial digital data was in its infancy. Since the 1970s, mapping technologies have advanced to the point where we no longer rely on a pre-printed set of maps (Tiner 2009). Instead desktop mapping tools are used to produce "geospatial data," to view these data on a computer and print custom maps using the NWI's "Wetlands Mapper" (http://www.fws.gov/wetlands/Data/Mapper.html). With the advancement of geographic information system (GIS) technology, we now have the ability to analyze map data for large geographical areas. We are no longer simply limited to looking at a map or series of maps, but can analyze data contained in a geospatial database.

Given the interest in using NWI data for assessing wetlands across large geographical areas, we can expand our classification of wetlands to add other characteristics important in identifying likely functions to the NWI database. For example, we can place wetlands in a landscape position, that is, their association with a waterbody (estuary, lake, river, stream, or pond) and identify their connectivity to other wetlands and waterbodies, or whether they are geographically isolated features (i.e., completely surrounded by upland). This information when combined with the basic NWI wetland features (system, class, subclass, water regime, and special modifiers) greatly expands the functionality of the NWI database. By reviewing the literature and working with wetland specialists across the Region and beyond, a set of correlations linking the attributes in the NWI+ database to numerous wetland functions have been established (Tiner 2003b). An overview of this process and applications can be found in "NWIPlus: Geospatial Data for Watershed-level Functional Assessment" (Tiner 2010).

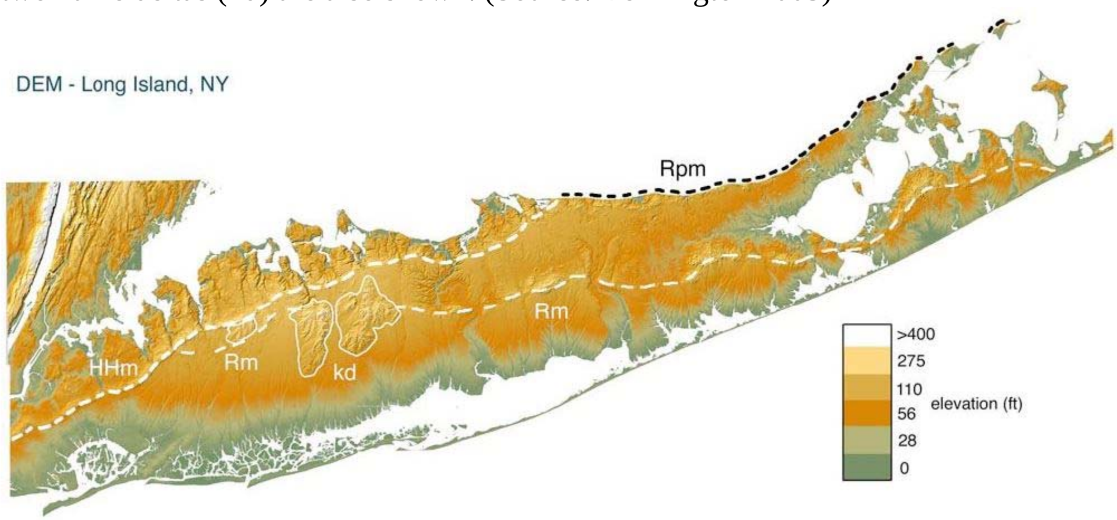
The U.S. Fish and Wildlife Service (FWS) updated its National Wetlands Inventory (NWI) data for Long Island and summarized the findings in "*Wetlands and Deepwater Habitats of Long Island, New York: Status 2004 – Results of the National Wetlands Inventory*" (Tiner 2011). Once the basic inventory was completed a number of ancillary projects were initiated using that data. After completing an update of NWI data for Long Island (NY), the NWI Program built an NWI+ database of Long Island's wetlands and waters. We also used the data to produce a watershed-level assessment of Long Island's wetlands. The purpose of this report is to present those findings.

Study Area

Located in southeastern New York, Long Island is bordered on the north by Long Island Sound, on the south by the Atlantic Ocean, and separated from Manhattan Island and the Bronx by the East River. It encompasses over 1,400 square miles of land and over 1,700 square miles of water mostly coastal embayments including Great South Bay, Moriches Bay, Shinnecock Bay, Peconic Bay, and Gardiners Bay. The Peconic River, the Island's largest river, is the only one running west to east giving it a larger drainage area than other rivers such as the Connetquot and Carmans that flow north to south into Great South Bay or the Nissequogue that flows south to north into Long Island Sound.

Two major watersheds cover the Island: Northern Long Island Basin and Southern Long Island Basin (Figure 1). The former runs north of the Harbor Hill-Roanoke Point Moraine to Long Island Sound, while the latter extends south to the Atlantic Ocean. The Southern Basin occupies the majority of Long Island (81% or 877,547 acres), with the Northern Basin covering the remaining 19 percent (210,641 acres). More information about these watersheds can be obtained online from the U.S. Geological Survey (http://water.usgs.gov/lookup/getwatershed?02030201 for the former and http://water.usgs.gov/lookup/getwatershed?02030202 for the latter).

Figure 1. Topography of Long Island highlighting glacial moraines: Harbor Hill Moraine (HHm) and Ronkonkoma Moraine (Rm), and Roanoke Point Moraine (Rpm); two kame deltas (kd) are also shown. (Source: Bennington 2003)



METHODS

For this project, updated NWI data (Tiner 2011) were examined using digital geospatial data for streams (National Hydrography Data, NHD), topography (Digital Raster Graphics, DRGs), and elevation (Digital Elevation Models, DEMs) in addition to digital imagery from the spring of 2004 (0.5-foot resolution color infrared imagery for Kings, Queens, and Nassau Counties and 1-foot true color digital imagery for Suffolk County). These data sources were used to assign hydrogeomorphic-type descriptors to existing wetland polygons to create an NWI+ database.

Creating the NWI+ Database

To be able to use the NWI database for landscape-level functional assessment, wetlands were classified by other features including their position on the landscape, landform, and water flow path following Tiner (2003a, with minor revisions). Deepwater habitats and ponds were further classified by waterbody type and water flow path. Collectively these descriptors are called "LLWW descriptors" (the acronym derived from the first letter of each descriptor). Wetlands were placed in five landscape positions which relate to their location relative to a waterbody if present: 1) marine (along the ocean), 2) estuarine (along tidal brackish waters), 3) lotic (along floodplains of rivers and streams including the freshwater tidal reach), 4) lentic (in basins of lakes and reservoirs), and 5) terrene (geographically isolated – completely surrounded by upland, or not frequently flooded by rivers and streams) (Figure 2).

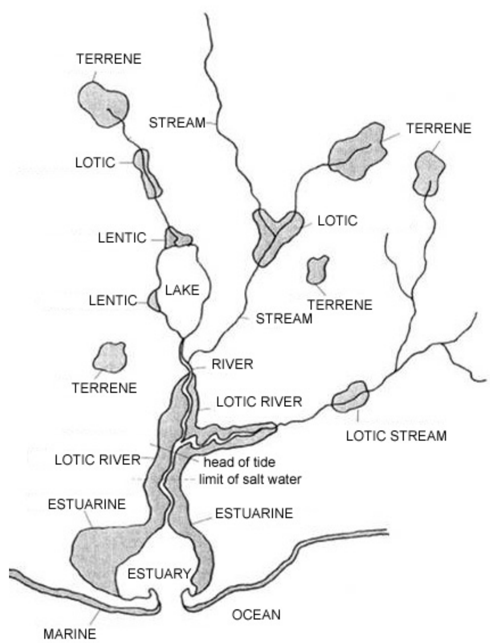


Figure 2. Wetlands classified by landscape position.

Landform describes the physical shape of the wetland with several types recognized: basin (depressional wetland), flat (wetland on a nearly level plain), floodplain (overflow land along rivers subject to periodic inundation), fringe (wetland in water, within the banks of a river, or on an estuarine intertidal plain), island (wetland completely surrounded by water), and slope (wetland on a hillside). Water flow path defines the direction of the flow of water associated with the wetlands. If the wetland is a source of a stream or seep, it is an outflow wetland. River and streamside wetlands are throughflow wetlands with water running through them (both into and out of) during high water periods. Wetlands that only receive water from channelized flow without any outflow are considered inflow wetlands. Many wetlands have no channelized inflow or outflow so their water flow path is defined as vertical flow. Water movement in these wetlands is primarily up and down with changes in the water table due to precipitation, local runoff, possibly groundwater discharge, and evapotranspiration. Wetlands along lakes and reservoirs have water levels that rise and fall with lake levels - bidirectional-nontidal. This flow path is also combined with that of the waterbody (e.g., bidirectional- outflow where associated with an outflow lake, or bidirectional- throughflow when part of a throughflow lake). Tidal wetlands experience bidirectional-tidal flow with ebb and flood tides. Figure 4 shows the classification of different types of wetlands by water flow path.

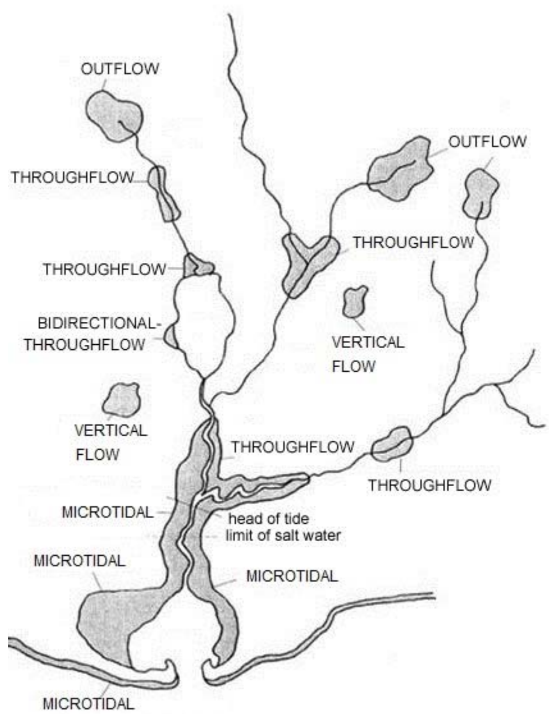


Figure 3. Wetlands classified by water flow path (including tidal range).

The characteristics of all mapped NWI wetlands and waterbodies were expanded by adding the above attributes, waterbody type and other descriptors (e.g., headwater). This NWI+ database would be used to describe wetlands by other features (wetland characterization) and to predict wetland functions for Long Island.

Data Analysis

The NWI+ database was used to generate acreage summaries of wetlands and deepwater habitats grouped by the new categories (i.e., LLWW types) and to predict wetland functions for Long Island. To do the latter, relationships between properties in the NWI+ database and a variety of wetland functions had to be established. From previous studies, a table listing each of 11 functions and the relevant wetland properties was used to identify wetlands with potential to perform each function at high or moderate levels (Appendix A). The 11 functions were: 1) surface water detention (for nontidal wetlands only), 2) streamflow maintenance, 3) coastal storm surge detention, 4) nutrient transformation, 5) sediment and other particulate retention, 6) carbon sequestration, 7) bank and shoreline stabilization, 8) provision of fish and aquatic invertebrate habitat, 9) provision of waterfowl and waterbird habitat, 10) provision of habitat for other wildlife, and 11) provision of habitat for unique, uncommon, or highly diverse wetland plant communities. The foundation for the functional assessment was an earlier report relating specific wetland types to functional performance (Tiner 2003b, slightly revised based on more recent studies).

Displaying the Findings

A set of geospatial data layers were created to highlight wetlands by landscape position, landform, water flow path, and wetlands of significance for each of eleven functions. The data were accessible via the NWI+ web mapper (http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5043-nwi-web-mapper) which is hosted by the Association of State Wetland Managers. It is an online mapping tool (ESRI's ArcGIS Explorer) that allows users to view the results of this analysis on aerial imagery or various maps (topographic or planimetric). The tool also permits users to zoom in and out of the image or map to gain different perspectives on the wetlands and their surroundings.

LIMITATIONS OF THE ASSESSMENT APPROACH

Source data are a primary limiting factor for landscape-level functional assessment. NWI digital data and existing stream data (e.g., NHD and DRGs) are used as the foundation for these assessments. All wetland and stream mapping has limitations due to scale, photo quality, date of the survey, and the difficulty of photointerpreting certain wetland types (especially evergreen forested wetlands and drier-end wetlands; see Tiner 2011 for details) and narrow or intermittent streams especially those flowing through dense evergreen forests and beneath built-up lands.

Recognizing source data limitations, it is equally important to understand that this type of functional assessment is a preliminary one based on wetland characteristics interpreted through remote sensing and using the best professional judgment of various specialists to develop relationships between wetland characteristics in the database and wetland functions. It is designed for landscape- or watershed-level assessments covering large geographic areas.

Wetlands are rated based on their biotic or abiotic characteristics as having high or moderate potential for supporting a wetland function. Wetlands not assigned a rating are assumed to have little or no potential for providing such function at a significant level. The ratings are based on a review of the literature and best professional judgment by numerous scientists studying wetlands from public agencies, private non-government organizations, and academia. Also, no attempt is made to produce a more qualitative ranking for each function (comparing to a "reference" type representing a wetland of the type in the "best" condition, or on size or the degree to which it actually performs a function given opportunity and adjacent land uses) or for each wetland based on multiple functions as this would require more input from others and more data, well beyond the scope of this type of broad-scale evaluation. For a technical review of wetland functions, see Mitsch and Gosselink (2008) and for a broad overview, see Tiner (2005a).

Functional assessment of wetlands can involve many parameters. Typically such assessments have been done in the field on a case-by-case basis, considering observed features relative to those required to perform certain functions or by actual measurement of performance. The preliminary assessments based on remotely sensed information do not seek to replace the need for field evaluations since they represent the ultimate assessment of the functions for individual wetlands. Yet, for a watershed analysis, basin-wide field-derived assessments are not practical, cost-effective, or even possible given access considerations. For watershed planning purposes, a more generalized assessment (level 1 assessment) is worthwhile for targeting wetlands that may provide certain functions, especially for those functions dependent on landscape position, landform, hydrologic processes, and vegetative life form (Brooks et al. 2004). Subsequently, these results can be field-verified when it comes to actually evaluating particular wetlands for acquisition purposes (e.g., for conserving biodiversity or for preserving flood storage capacity) or for project impact assessment. Current aerial photography may also be examined to aid in further evaluations (e.g., condition of wetland/stream buffers or adjacent land use) that can supplement the preliminary assessment.

The landscape-level functional assessment approach -"Watershed-based Preliminary Assessment of Wetland Functions" (W-PAWF) - applies general knowledge about wetlands and their functions to develop a watershed overview that highlights possible wetlands of significance in terms of performance of various functions. To accomplish this objective, the relationships between wetlands and various functions are simplified into a set of practical criteria or observable characteristics. Such assessments may be further expanded to consider the condition of the associated waterbody and the neighboring upland or to evaluate the opportunity a wetland has to perform a particular function or service to society, for example.

W-PAWF does not account for the opportunity that a wetland has to provide a function resulting from a certain land-use practice upstream or the presence of certain structures or land-uses downstream. For example, two wetlands of equal size and like vegetation may be in the right landscape position to retain sediments. One, however, may be downstream of a land-clearing operation that has generated considerable suspended sediments in the water column, while the other is downstream from an undisturbed forest. The former should be actively performing sediment trapping in a major way, whereas the latter may not. Yet if land-clearing takes place in the latter area, the second wetland will likely trap sediments as well as the first wetland. The entire analysis typically tends to ignore opportunity since such opportunity may have occurred in the past or may occur in the future and the wetland is there to perform this service at higher levels when necessary. W-PAWF also does not consider the condition of the adjacent upland (e.g., level of disturbance) or the actual water quality of the associated waterbody that may be regarded as important metrics for assessing the health of individual wetlands. Collection and analysis of these data may be done as a follow-up investigation, where desired.

It is important to re-emphasize that the preliminary assessment does not obviate the need for more detailed assessments of the various functions and assessment of wetland condition and opportunities to provide more benefits given the state of the contributing watershed and adjacent land use activities. This preliminary assessment should be viewed as a starting point for more rigorous assessments, since it attempts to cull out wetlands that may likely provide significant functions based on generally accepted principles and the source information used for this analysis. This assessment is most useful for regional or watershed planning purposes, for a cursory screening of sites for acquisition, and to aid in developing landscape-level wetland conservation and protection strategies. It can also be used to evaluate cumulative impacts on wetlands on key functions as was done for the Nanticoke River watershed on the Delmarva Peninsula (Tiner 2005b) or to consider the national and regional-scale impacts of policy changes on certain wetland types (e.g., geographically isolated wetlands or headwater wetlands, or determining significant nexus to waters of the United States). For site-specific evaluations, additional work will be required, especially field verification and collection of site-specific data for potential functions (e.g., following the hydrogeomorphic assessment approach as described by Brinson 1993 or other onsite evaluation procedures, e.g., rapid field assessment). This is particularly true for assessments of fish and wildlife habitats and biodiversity. Other sources of data may exist to help refine some of the findings of this report (e.g., state natural heritage data). Additional modeling could be done, for example, to identify habitats of likely significance to individual species of animals based on their specific life history requirements (see U.S. Fish and Wildlife Service 2003 for Gulf of Maine habitat analysis).

Also note that the criteria used for the relationships were based on our application of the Service's wetland classification (Cowardin et al. 1979). Regional applications of this system may differ slightly depending on regional priorities, level of field effort, and knowledge of wetland ecology. Use of the relationships in other regions of the country therefore may require some adjustment based on these considerations.

Through this analysis, numerous wetlands are predicted to perform a given function at a significant level presumably important to a watershed's ability to provide that function. "Significance" is a relative term and is used in this analysis to identify wetlands that are likely to perform a given function at a high or moderate level. It is also emphasized that the assessment is limited to wetlands (i.e., areas classified and mapped as wetlands by the NWI Program). Deepwater habitats (including submerged eelgrass beds) and streams were not included in the assessment, although their inherent value to wetlands and many wetland-dependent organisms is apparent.

It is important to note that there are some differences in the wetland area reported in this characterization from the results of the 2004 NWI for Long Island (Tiner 2011). The data have undergone additional review and editing leading to acreage differences. The acreage summaries presented in the current report reflect the data that are now posted online at: http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5043-nwi-web-mapper.

Wetland Classifications: NWI - Palustrine Emergent Wetland, Seasonally Flooded; LLWW - Terrene Basin Outflow, Headwater. (Ralph Tiner photo)

RESULTS

Digital Data and Online Maps

Geospatial data for Long Island wetlands and deepwater habitats are available online at the Association of State Wetland Managers' website "Wetlands One-Stop" (http://www.aswm.org/wetland-science/wetlands-one-stop-mapping). Custom maps for specific areas can be made using this online mapping tool. Data can be displayed on a variety of base maps from topographic maps to aerial images by Bing. While the website displays numerous data layers, the ones of particular interest for this assessment are LLWW types and wetlands of significance for various functions. For this report, a few examples of the online maps of the different themes are provided in Appendix B.

Wetland Classification - NWI Types

A total of 50,197 acres have been mapped for Long Island. It is no surprise that nearly two-thirds of this wetland acreage is estuarine (mostly salt marsh) as this was reported in an earlier publication (Tiner 2011). Table 1 highlights the major types according to Cowardin et al. (1979) based on revisions made by this project, while Figures 4-7 show the proportion of Long Island's wetlands represented by various types.

Table 1. Wetlands classified by NWI types.

System	Class	Acreage
Marine	Aquatic Bed	26.1
	Rocky Shore	37.4
	Unconsolidated Shore	4,605.6
	Total	*4,669.1*
Estuarine	Aquatic Bed	192.7
	Emergent	24,447.9
	Scrub-Shrub	1,069.4
	Rocky Shore	11.8
	Unconsolidated Shore	6,269.7
	Total	*31,991.5*
Palustrine	Aquatic Bed	132.1
	Emergent	1,337.3
	Forested	6,725.6
	Scrub-Shrub	1,914.4
	Farmed	19.3
	Unconsolidated Bottom	3,298.0
	Unconsolidated Shore	85.2
	Total	*13,511.9*
Lacustrine	Unconsolidated Bottom	20.4
Riverine	Aquatic Bed	4.1

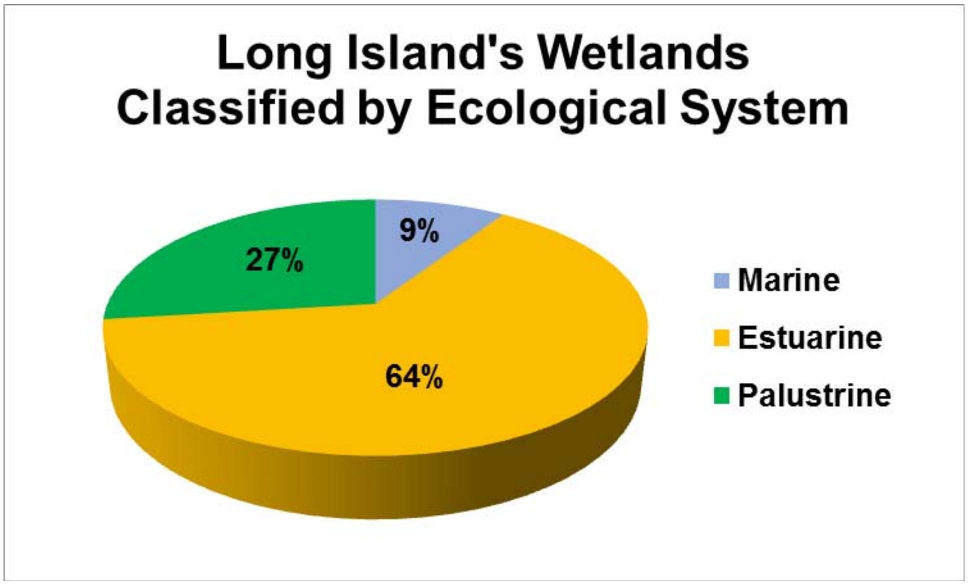


Figure 4. Proportion of wetlands by ecological system. See Table 1 for acreages.

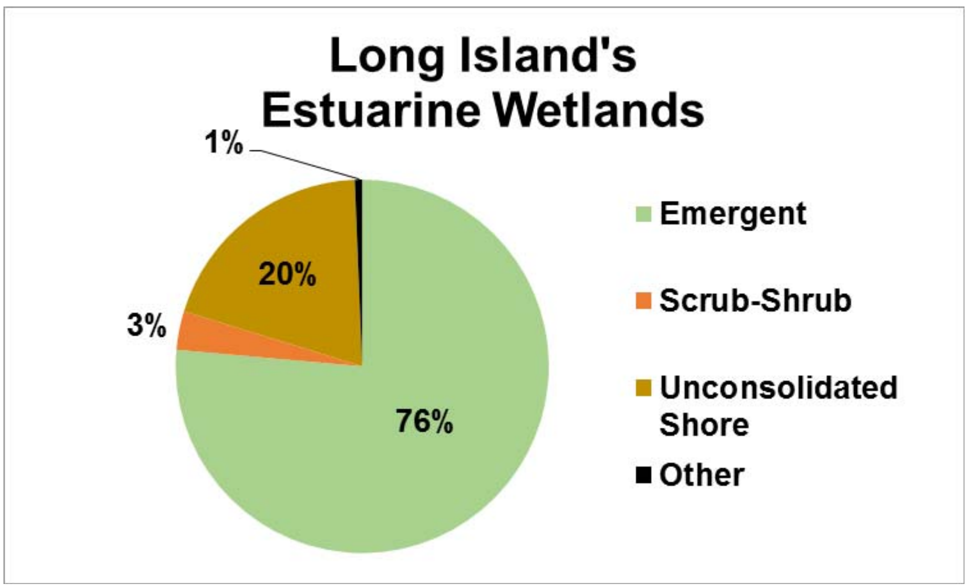


Figure 5. Long Island's estuarine wetlands. See Table 1 for acreages.

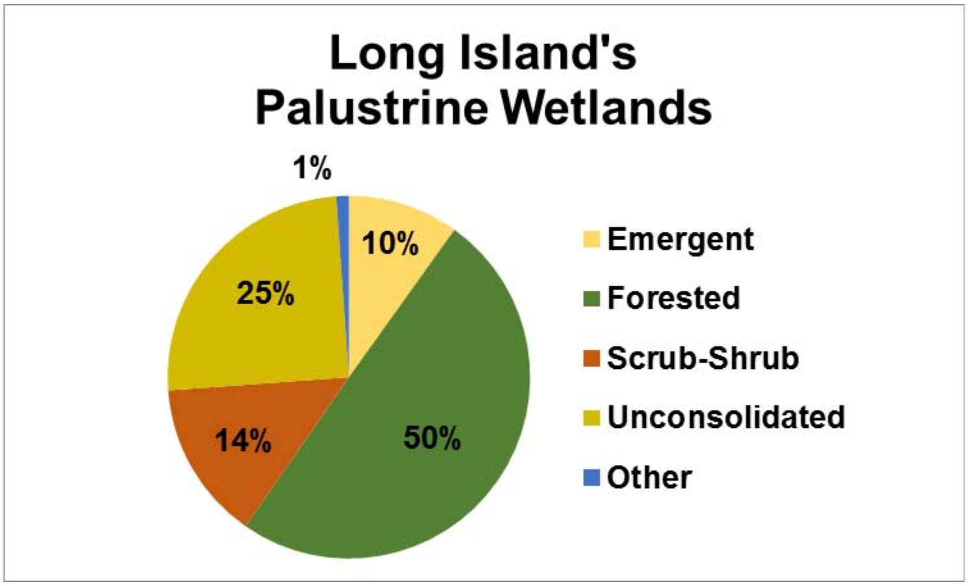


Figure 6. Long Island's freshwater wetlands. See Table 1 for acreages.

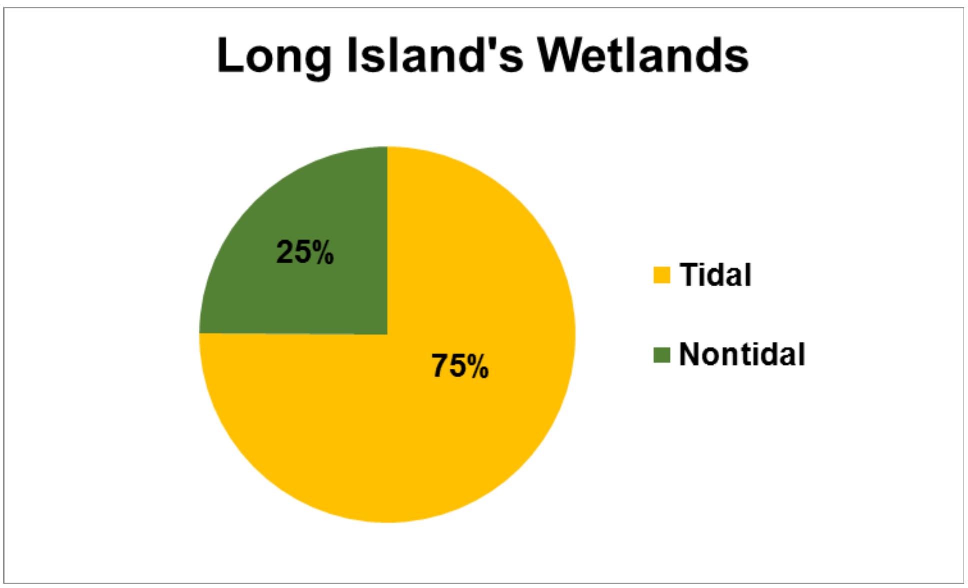


Figure 7. Proportion of wetlands that were tidal or nontidal. See Table 2 for acreages.

Three-quarters of Long Island's wetland acreage is tidal including some freshwater types (Figure 7). Table 2 shows the extent of wetlands classified by water regime according to Cowardin et al (1979) as amended by the Wetlands Subcommittee of the Federal Geographic Data Committee (FGDC) in their wetland classification standard (FGDC 2013).

Table 2. Long Island wetlands classified by water regime. *Includes 19.3 acres of farmed wetland.

Nontidal/Tidal	Water Regime	Acreage
Nontidal	Temporarily Flooded	801.4
	Seasonally Flooded	2,218.7
	Seasonally Flooded-Saturated	4,641.5
	Semipermanently Flooded	797.3
	Permanently Flooded	3,198.2
	Continuous Saturated	114.9
	Seasonally Saturated*	708.0
	Artificially Flooded	10.8
	Total	*12,490.8*
Tidal	Irregularly Exposed	1,808.9
	Regularly Flooded	7,740.1
	Irregularly Flooded	27,112.1
	Seasonally Flooded-Tidal	806.0
	Temporarily Flooded-Tidal	64.9
	Semipermanently Flooded-Tidal	41.1
	Permanently Flooded-Tidal	133.1
	Total	*37,706.2*

Expanded Classification – LLWW Types

The results of the expanded classification of Long Island's wetlands are summarized in Table 3. In the following text, the term "wetlands" is used to refer to "wetland acreage" and not to the number of wetlands, as the number of actual wetlands has not been tabulated.

From the landscape position standpoint, the majority of Long Island's wetlands (64%) are estuarine types found along the Island's many bays and coastal rivers (Figure 8). Freshwater wetlands were located along rivers and streams (10% - lotic) and in headwater locations or away from waterbodies (15% - terrene). The remaining wetlands were situated along the ocean (9% - marine) and were freshwater wetlands along lake shores (2% - lentic).

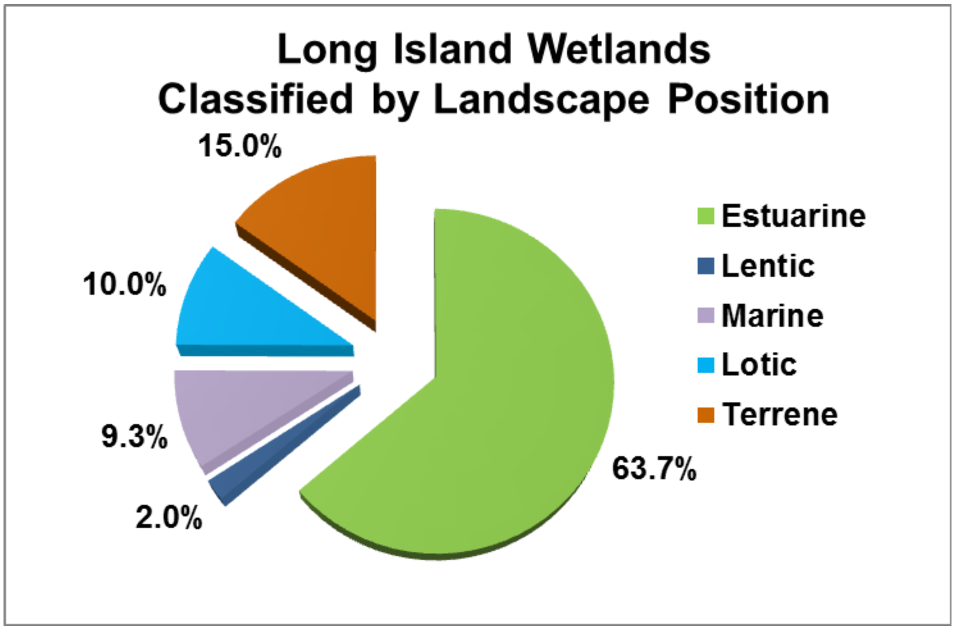


Figure 8. Wetlands classified by landscape position. See Table 3 for acreages.

Table 3. Wetlands of Long Island (including Fishers Island) classified by LLWW descriptors. Note: Any differences in sums relates to computer round-off procedures.

Landscape Position	Landform	Acres	Water Flow Path	Acres
Marine	Fringe	4,669.2	Bidirectional-tidal	4,669.2
Estuarine	Fringe	23,691.0	Bidirectional-tidal	31,991.5
	Island	7,729.0		
	Basin	571.5		
	Total	*31,991.5*		
Lotic River	Floodplain	318.7	Throughflow-perennial	327.8
	Fringe	6.1		
	Pond	3.0		
	Total	*327.8*		
Lotic Stream	Basin	2,857.0	Throughflow-intermittent	293.0
	Flat	611.8	Throughflow-perennial	3,978.8
	Fringe	224.0	Bidirectional-tidal	399.6
	Pond	978.6		
	Total	*4,671.4*		
Lentic	Basin	770.3	Bidirectional-tidal	6.3
	Flat	149.1	Bidirectional-outflow	51.0
	Fringe	88.6	Bidirectional-isolated	38.8
	Island	3.4	Bidirectional-throughflow	216.3
	Pond	1.5	Throughflow-perennial	700.6
	Total	*1,012.9*		
Terrene	Basin	4,025.6	Bidirectional-tidal	125.4
	Flat	810.2	Outflow-intermittent	677.1
	Fringe	155.6	Outflow-perennial	2,495.3
	Island	0.6	Throughflow-artificial	2.8
	Pond	2,532.1	Throughflow-intermittent	8.0
	Total	*7,524.1*	Throughflow-perennial	16.2
			Vertical Flow	4,199.4

Considering landform, over half of Long Island's wetland acreage is represented by fringe types due to the abundance of marine and estuarine wetlands (Figure 9). All of Long Island's marine wetlands are fringe types, while nearly three-quarters (74%) of its estuarine wetlands fringe forms and 24 percent were marsh islands (Table 2). Following the fringe type, basin wetlands were next in abundance across Long Island, with most of these being freshwater wetlands. Wetlands completely surrounded by water – island wetlands - followed in the ranking due to the abundance of marsh islands in estuaries. Flat and floodplain types made up the remaining wetland area (Figure 9).

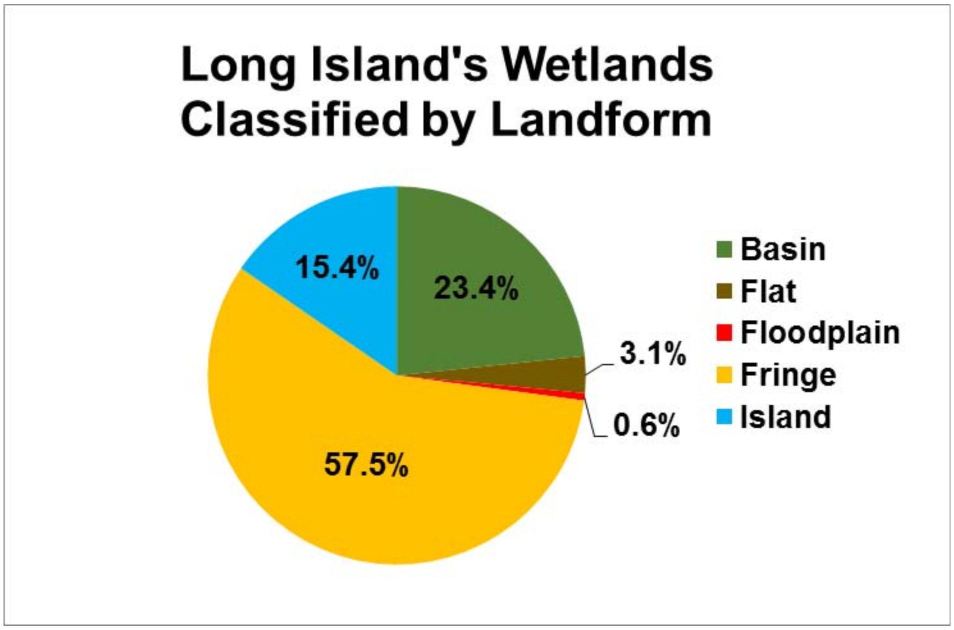


Figure 9. Extent of Long Island wetlands represented by different landforms.

Given the strong coastal influence with the Atlantic Ocean and many large bays on the south side of Long Island and Long Island Sound on the north, it is no surprise that from the hydrodynamic perspective, most of Long Island's wetlands are tidally influenced (Tables 2 and 3; Figure 10). Next in abundance are throughflow wetlands that are largely overflowed periodically by streams or rivers (lotic types). Also associated with lotic wetlands are terrene wetlands that are the sources of streams (terrene basin outflow). Eight percent of the Island's wetlands were classified as having vertical flow, meaning that they appear to be surrounded by nonhydric soils (i.e., no apparent surface water connection to other wetlands) and water levels tend to simply rise and fall from precipitation, local runoff, and site groundwater conditions.

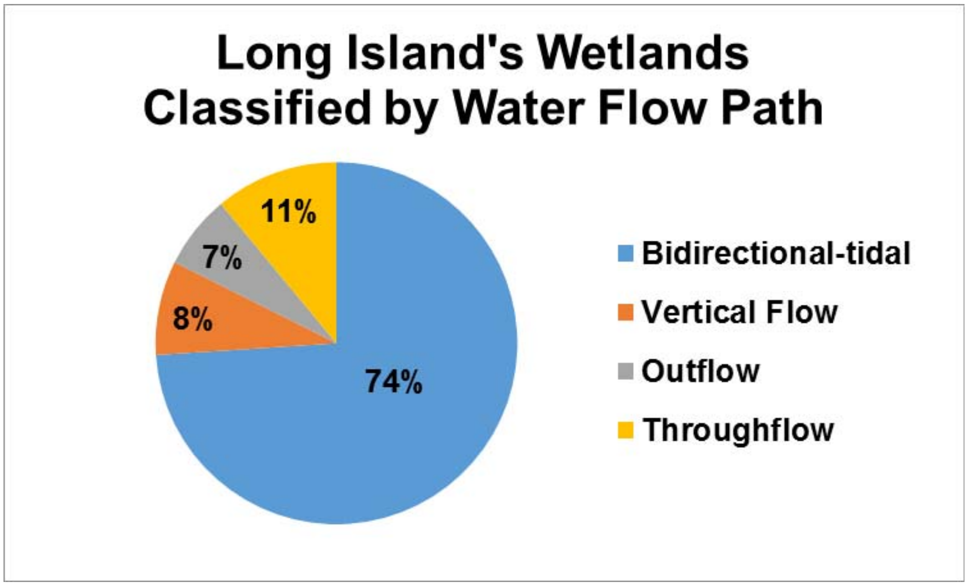


Figure 10. Proportion of Long Island's wetlands by water flow path.

The expanded classification was also applied to ponds which were included as wetlands in the above results. Almost half of Long Island's ponds were excavated, while only a fifth was classified as natural (Figure 11; Table 4). Most of the ponds were geographically isolated (i.e., no apparent surface connection to other wetlands or waters (Figure 12).

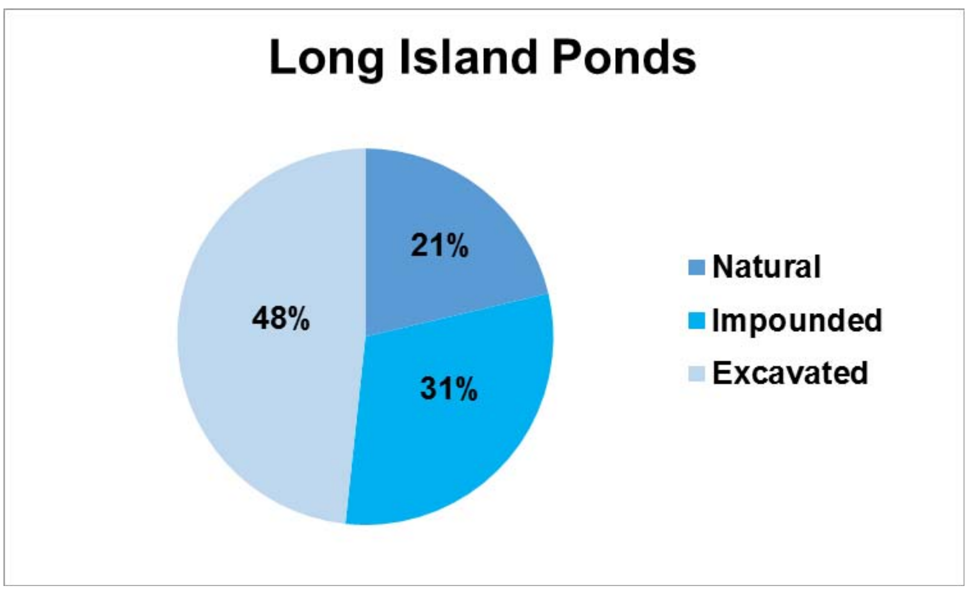


Figure 11. Extent of pond types mapped on Long Island.

Table 4. Pond types and water flow path.

Type	Water Flow Path	Acres
Natural	Bidirectional-tidal	57.3
	Bidirectional-throughflow	1.3
	Outflow-intermittent	34.8
	Outflow-perennial	79.6
	Throughflow-intermittent	31.7
	Throughflow-perennial	186.4
	Vertical flow	357.3
	Total	*748.4*
Dammed/Impounded	Bidirectional-tidal	60.8
	Outflow-intermittent	61.8
	Outflow-perennial	125.0
	Throughflow-intermittent	13.3
	Throughflow-perennial	576.6
	Vertical flow	230.0
	Total	*1,067.5*
Excavated	Bidirectional-tidal	7.2
	Bidirectional-outflow	0.2
	Outflow-intermittent	65.0
	Outflow-perennial	54.6
	Throughflow-intermittent	16.5
	Throughflow-perennial	157.2
	Vertical flow	1,395.8
	Total	*1.696.5*
Other Artificial	Throughflow-artificial	2.8
	Total	*2.8*
All Ponds		**3,515.2**

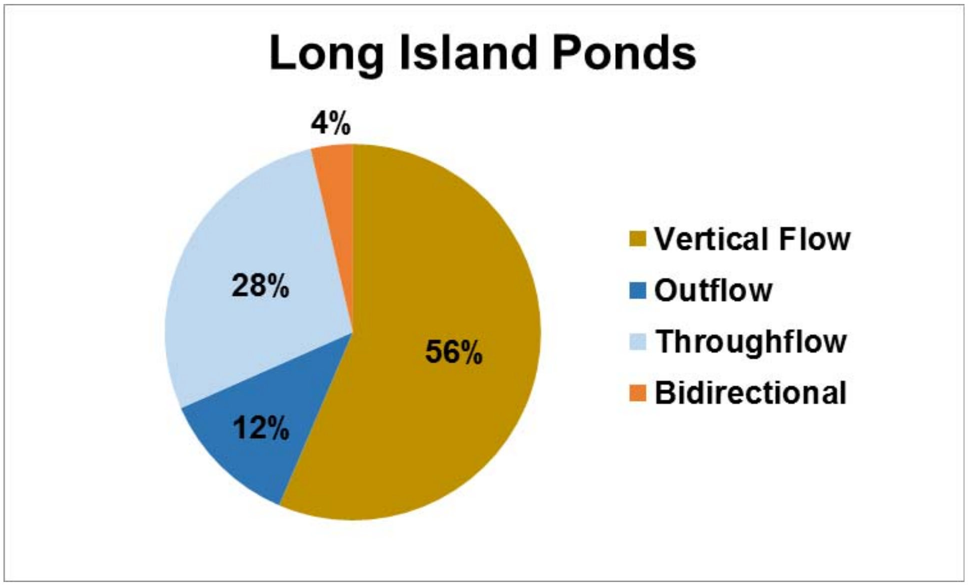


Figure 12. Water flow paths for Long Island ponds.

Landscape-level Functional Assessment

The abundance of salt marshes and tidal flats along Long Island's South Shore was a majority reason that a high proportion of the Island's wetland acreage was predicted to perform some functions at significant levels. Well over half of Long Island's wetland acreage was predicted to be important for eight functions listing in rank order: sediment and particulate retention, provision of waterfowl and waterbird habitat, carbon sequestration, coastal storm surge detention, provision of habitat for other wildlife, nutrient transformation, bank and shoreline stabilization, and provision of fish and aquatic invertebrate habitat (Table 5; Figure 13). The remaining functions were predicted to be performed by less than 25 percent of the wetland acreage: surface water detention (freshwater wetlands only), streamflow maintenance, and provision of habitat for unique, uncommon or highly diverse wetland plant communities.

Only 185.1 acres were not rated as significant for one or more functions. These wetlands included 165.8 acres of geographically isolated impounded or excavated ponds and 19.3 acres of farmed wetlands.

Table 5. Wetlands of potential significance for various functions for Long Island, New York. Note: Results include ponds and other shallow water wetlands. Also there is some overlap between surface water detention and coastal storm surge detention in that some freshwater wetlands were designated as significant for coastal flooding.

Function (code)	**Significance**	**Acreage**	**Percent of All Wetlands**
Surface Water Detention	High	4,861.4	9.7%
(SWD)	Moderate	7,286.4	14.5%
	Total	**12,147.8**	**24.2%**
Coastal Storm Surge Detention	High	37,036.0	73.8%
(CSS)	Moderate	1,187.0	2.4%
	Total	**38,223.0**	**76.2%**
Streamflow Maintenance	High	4,315.4	8.6%
(SM)	Moderate	1,399.9	2.8%
	Total	**5,715.3**	**11.4%**
Nutrient Transformation	High	34,239.5	68.2%
(NT)	Moderate	1,631.7	3.3%
	Total	**35,871.2**	**71.5%**
Carbon Sequestration	High	34,115.5	68.0%
(CAR)	Moderate	4,421.9	8.8%
	Total	**38,537.3**	**76.8%**
Sediment and Other Particulate Retention (SR)	High	30,957.8	61.7%
	Moderate	10,317.3	20.6%
	Total	**41,275.1**	**82.3%**
Bank and Shoreline Stabilization	High	25,228.9	50.3%
(BSS)	Moderate	10,549.3	21.0%
	Total	**35,778.2**	**71.3%**
Fish and Aquatic Invertebrate Habitat (FAIH)	High	29,761.0	59.3%
	Moderate	2,199.8	4.4%
	(Subtotal)	*31,960.8*	*63.7%*
	Shading	2,326.6	4.6%
	Total	**34,287.4**	**68.3%**

Table 5 (cont'd).

Function	**Significance**	**Acreage**	**Percent of All Wetlands**
Waterfowl and Waterbird Habitat (WBIRD)	High	34,534.7	68.8%
	Moderate	2,388.0	4.8%
	Wood Duck	3,704.2	7.4%
	Total	**40,626.9**	**81.0%**
Other Wildlife Habitat (OWH)	High	25,706.8	51.2%
	Moderate	10,690.8	21.3%
	Total	**36,397.6**	**72.5%**
Unique, Uncommon, or Highly Diverse Plant Communities* (UWPC)	Regionally Signific.	2,726.4	5.4%
	Locally Significant	114.0	0.2%
	Total	**2,840.5**	**5.6%**

Note that "coastal ponds" were not specifically mapped as unique pond types by this inventory and are, therefore, not represented in these figures.

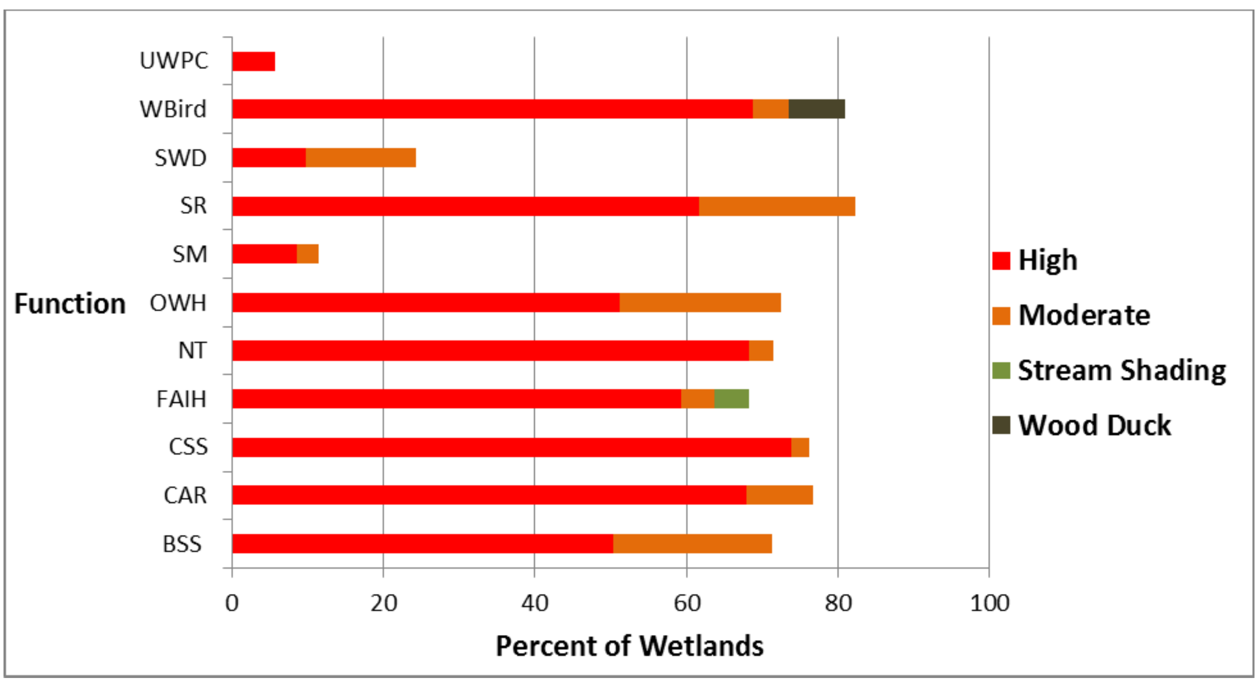


Figure 13. Wetlands predicted to be significant for eleven functions expressed as a percentage of Long Island's wetland acreage. See Table 5 for name of functions.

Special Note on Unique, Uncommon or Highly Diverse Wetlands

Only 5.7 percent of Long Island's wetland acreage was identified as significant for unique, uncommon, or highly diverse wetland plant communities. The wetland types that were identified by this inventory included tidal freshwater marshes and swamps, slightly brackish marshes, low (regularly flooded) salt marsh, Atlantic white cedar swamps, shrub bogs, and semipermanently flooded wetlands. These types had NWI codes that highlighted their uniqueness. All of these types were identified as regionally significant types across the Northeast, while bogs were deemed locally significant given their extremely limited distribution on Long Island. It is important to emphasize that this figure does not include other wetlands that are known to support rare, endangered, or threatened plants. Of particular significance for Long Island are "coastal plain ponds" that were not represented in the reported totals because they were not specifically classified as such by this project. Figure 14 shows the region where these ponds are located. They include Sagaponack Pond, Poxabogue Pond, Little Poxabogue Pond, Slate Pond, Black Pond, Crooked Pond, Long Pond, Little Long Pond, Lily Pond, Little Round Pound, and Round Pond. Contact the state's Natural Heritage Program for information on these and other ecologically significant wetlands (http://www.dec.ny.gov/animals/29338.html/).

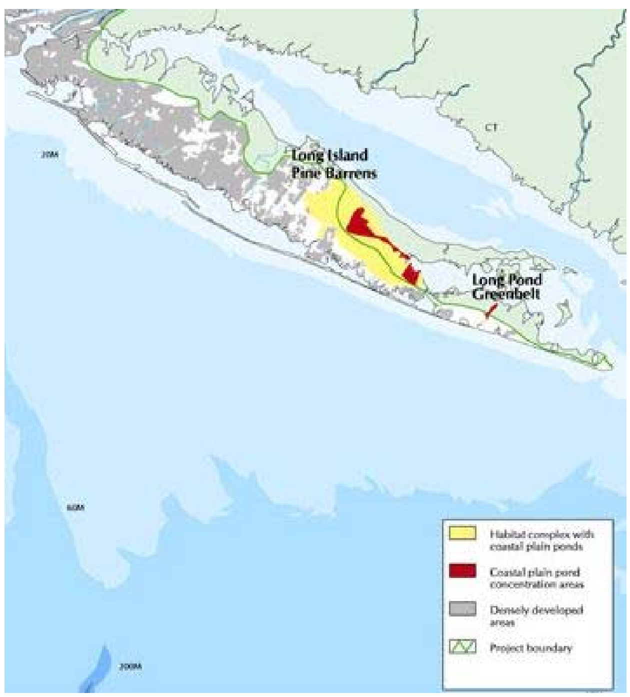


Figure 14. General location where "coastal plain ponds" can be found on Long Island. (Source: U.S. Fish and Wildlife Service, *Significant Habitats of the New York Bight Watershed*; http://nctc.fws.gov/resources/knowledge-resources/pubs5/web_link/text/intr_com.htm#CoastalPlainPonds)

SUMMARY

Wetlands represent nearly six percent of Long Island. Roughly two-thirds (64%) are estuarine types - salt marshes and tidal flats, while the rest are either freshwater wetlands (e.g., mostly forested wetlands and ponds; 27%) or marine types (e.g., ocean beaches; 9%). Wetlands provide many functions and in order to predict wetlands of significance for various functions hydrogeomorphic attributes were added to the original NWI database to create an NWI+ database. The addition of LLWW descriptors was particularly useful for the freshwater wetlands where landscape position and connectivity to other wetlands and waters are important factors influencing several functions. Freshwater wetlands were further separated into those associated with and subject to periodic overflow by rivers and streams (lotic wetlands), those found in lake basins (lentic wetlands), and the rest including many that serve as the source of streams and others that with no apparent surface connection to other wetlands or waters (terrene wetlands).

The landscape-level functional assessment predicted that all but 185 acres of Long Island’s wetlands were rated as significant for one or more functions. Those not rated as significant were small, isolated excavated ponds or impoundments and farmed wetlands (19.3 acres). The latter types were excluded from the ratings given their intensive agricultural use. Consequently, nearly all of Long Island’s wetlands were predicted to provide one or more of the eleven functions at significant levels. Since freshwater wetlands are less common than their coastal counterparts, roughly a quarter of Long Island’s wetland acreage was predicted to be important for surface water detention (e.g., inland flood protection) and only 11 percent for streamflow maintenance. These wetlands are vital for storing potential floodwaters and for providing water to support aquatic life in Long Island’s streams.

It is important to remember that this is a landscape-level functional assessment based on remotely sensed data. It, therefore, represents a starting point for wetland assessment and not an end point as more detailed examination of imagery coupled with field investigations are necessary to improve the results and produce a more accurate assessment for individual wetlands of interest. Nonetheless it provides a holistic perspective on Long Island’s wetlands, their connectivity, and expected functions.

ACKNOWLEDGMENTS

Numerous individuals contributed to the mapping of Long Island's wetlands. The results of the most recent update by the Conservation Management Institute (CMI) at Virginia Tech University were published in a 2011 report entitled "Wetlands and Deepwater Habitats of Long Island, New York: Status 2004 – Results of the National Wetlands Inventory" (Tiner 2011). Key personnel on that project were acknowledged in that report. Those results served as the foundation for this characterization and functional assessment in that the enhanced classification was applied to NWI mapped wetlands and waters. CMI did additional wetland interpretation, database construction, and GIS analysis of the data for this project. Kevin McGuckin performed the interpretation with assistance from Jason Herman in applying the LLWW descriptors. Jason Herman did all the database construction and GIS analysis and prepared spreadsheets for summarizing study findings. Ralph Tiner (Regional NWI Coordinator) designed the project, coordinated the inventory, performed quality assurance review of the geospatial data, extracted summary data from spreadsheets, and prepared the report. Special thanks go to Chris and Andrea Pickerell and Steve Sinkevich for providing photos for use in this report. The draft report was reviewed by Bill Wilen, Tim Fannin, and Steve Sinkevich (U.S. Fish and Wildlife Service).

Wetland Classifications: NWI – Estuarine Emergent Wetland, Irregularly Flooded, Partly Drained; LLWW – Estuarine Fringe Microtidal. (Steve Sinkevich photo)

REFERENCES

Bennington, J.B. 2003. New observations on the glacial geomorphology of Long Island from a digital elevation model (DEM). Long Island Geologists Conference, Stony Brook, NY (April 2003). 12 pp. http://people.hofstra.edu/J_B_Bennington/research/long_island/Geology_LI_Bennington.pdf

Brinson, M. M. 1993a. A Hydrogeomorphic Classification for Wetlands. U.S. Army Corps of Engineers, Washington, DC. Wetlands Research Program, Technical Report WRP-DE-4.

Brooks, R. P., D. H. Wardrop, and J. A. Bishop. 2004. Assessing wetland condition on a watershed basis in the Mid-Atlantic region using synoptic land cover maps. Environmental Monitoring and Assessment 94:9-22.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31. http://library.fws.gov/FWS-OBS/79_31.pdf

Federal Geographic Data Committee. 2013. Classification of Wetlands and Deepwater Habitats of the United States. Wetlands Subcommittee. FGDC-STD-004-2013. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013

Mitsch, W.J. and J.G. Gosselink. 2008. Wetlands. Fourth Edition. John Wiley & Sons, Inc., Hoboken, NJ.

Tiner, R.W. 2011. Wetlands and Deepwater Habitats of Long Island, New York: Status 2004 – Results of the National Wetlands Inventory. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA. http://www.fws.gov/wetlands/Documents/Wetlands-and-Deepwater-Habitats-of-Long-Island-New-York-Status-2004-Results-of-the-National-Wetlands-Inventory.pdf

Tiner, R.W. 2010. NWIPlus: Geospatial database for watershed-level functional assessment. National Wetlands Newsletter 32(3): 4-7, 23. http://www.fws.gov/northeast/wetlands/Publications%20PDFs%20as%20of%20March_2008/Mapping/NWIPlus_NWN.pdf

Tiner, R.W. (editor). 2009. Status Report for the National Wetlands Inventory Program: 2009. U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, Branch of Resource and Mapping Support, Arlington, VA. http://www.fws.gov/northeast/wetlands/pdf/StatusReportNWIProgram2009.pdf

Tiner, R.W. 2005a. In Search of Swampland: A Wetland Sourcebook and Field Guide. Revised 2nd Edition. Rutgers University Press, New Brunswick, NJ.

Tiner, R.W. 2005b. Assessing cumulative loss of wetland functions in the Nanticoke River watershed using enhanced National Wetlands Inventory data. Wetlands 25(2): 405-419.

Tiner, R.W. 2003a. Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA. http://library.fws.gov/Wetlands/dichotomouskeys0903.pdf

Tiner, R.W. 2003b. Correlating Enhanced National Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Region 5, Hadley, MA. http://www.fws.gov/northeast/wetlands/pdf/CorrelatingEnhancedNWIDataWetlandFunctionsWatershedAssessments[1].pdf

U.S. Fish and Wildlife Service. 2003. Gulf of Maine Watershed Habitat Analysis. Version 3.1. Gulf of Maine Coastal Program Office, Falmouth, MA. (http://gulfofmaine.fws.gov)

APPENDICES

Appendix A.

Table Used to Identify Potential Wetlands of Significance for 11 Functions

CORRELATION BETWEEN FUNCTIONS AND WETLAND TYPES
(October 20, 2014)

Function (code)	Level of Function	Wetland Types
Surface Water Detention (SWD)	High	LEBA (excluding LE5 and LE6 wetlands and wetlands with "K" water regime unless in a reservoir or dammed lake), LEFR (excluding LE5 and LE6 wetlands and wetlands with "K" water regime unless in a reservoir or dammed lake), LEFL (only in reservoir or dammed lake: LE2FL and LE3FL; not in impoundments), LEIL (not "A", "D" or "K" water regime), LSBA, LRFPba, LSFR (not "A" water regime), LRFR (not "A" water regime), LRIL (not "A" water regime), PDTH, TEFRpdTH, TEBApdTH, TEBATH, TEBATI, PD2c1, PD2d1, PD2e1, PD3c1, PD3d1, PD3e1

Note: The high level should not include any wetlands with "A" or "D" (seasonally saturated, formerly mapped as "B" in some places) water regimes with one exception for LEFL in reservoirs or dammed lakes. Does not include areas now classified as LK that were mapped as PUB_ following NWI mapping conventions. Also should not include any LE wetland associated with an artificial freshwater impoundment completely surrounded by estuarine wetland or water, or any vertical flow (isolated) impounded ponds and associated wetlands.

Special Note: In some regions "B" wetlands include continuously saturated wet meadows and swamps that may be subject to seasonal ponding; they are equivalent to wetlands mapped as "E" in the Northeast and should be rated as High for this function.

	Moderate	LRFPfl, LRFR (other than above), LRPT, LSFL, LSPT, LE1FL, LEIL (other than above, excluding LE5 and LE6 wetlands), LSFR (other than above), TEBA (other than above; excluding vertical flow impounded), PD (other except PD2f , PD2d2, PD2r, PD3d2, PD3f,

		PD3r, and vertical flow impounded ponds), TE__pd (other, excluding slope wetlands TESLpd__), TEFP__, TEFL__ , Other TEFR (excluding vertical flow that are impounded)
	Note: Peatlands along rivers and streams are designated as moderate for this function since they may store water in the acrotelm and in depressions during the summer before releasing water to the stream. In some regions of the country (e.g., Prairie Pothole Region), a great abundance of geographically isolated wetlands collectively are very important for temporary water storage but individually they are rated as moderate since they collect water from small areas. When this assessment procedure is applied to that region and similar situations, the predicted function of these wetlands should be re-evaluated by local specialists.	
	Caution: This function should not include any tidal wetlands, such as E2___, R1US, R1EM, and P___N, R, S, T and V, as their role in water storage is covered under the Coastal Storm Surge function.	
Coastal Storm Surge Detention (CSS)	High	ESBA, ESFR, ESIL, LR5FR, LR5FP, LR5IL, LS5BA, LS5FL, LS5FR, MAFR, MAIL, LE__BT (should exclude diked wetlands and tidal ponds that are impounded and associated tidal wetlands in these categories since the dike prevents storm flowage except during extremes such as hurricanes)
	Moderate	Other tidal wetlands not include above (which includes diked tidal wetlands) and any TE wetland (except SL - slope) or LS1 wetland contiguous with an estuarine wetland (usually marked by “ed” – these are bordering nontidal wetlands subject to infrequent or occasional tidal flooding during storms), TE wetland (except SL – slope) contiguous with marine waters or wetlands (should be marked with “md” or “ow”), TE__tr, TE__td, LS1_td, LS1_tr

	Note: Taking a conservative approach by focusing on lowland wetlands along the estuary and not including similar wetlands in the tidal freshwater reach; also not "ed" wetlands elevated well above the tidal wetland - those having a stream flowing downhill to the estuary or tidal wetland.	
Streamflow Maintenance (SM)		
	High	"hw" wetlands (excluding impounded "h" types)
	Moderate	other "hw" wetlands (impounded "hw" types), LR1FPba (excluding "h" types), LS__BA (excluding "h" and not LS5), TEBAOUds
	Note: While acreage of headwater wetlands may increase due to building ponds in headwater seeps (point features not polygons) and blocking drainageways, these wetlands ("h") do not increase streamflow, yet since they can contribute via overflow and seepage they are rated as moderate for this function.	
Nutrient Transformation (NT)	High	P__(AB, EM, SS, FO and mixes)C, P__(AB, EM, SS, FO and mixes)E, P__(AB, EM, SS, FO and mixes including __/UB and UB/__, etc.)F, P__(AB, EM, SS, FO and mixes)R, P__(AB, EM, SS, FO and mixes)T, P__(AB, EM, SS, FO and mixes)N, P__(AB, EM, SS, FO and mixes)H, P__(AB, EM, SS, FO and mixes)L or V, E2AB, E2EM (and mixes), E2SS (and mixes), E2FO (and mixes), E2RF, M2AB, P__(AB, EM, SS, FO and mixes)Bt (fen) , L2_(AB, EM and mixes)C, L2_(AB, EM, and mixes)E, L2_(AB, EM, and mixes)F, L2_(AB, EM, and mixes)H, L2_(AB,EM, and mixes)N, L2_(AB,EM, and mixes)R, L2_(AB,EM, and mixes)T, L2_(AB, EM, and mixes)V, R_EM_N, R_EM_F, R_EM_E, R_EM_C GA coast – Include PFO3B, PSS3B and mixes of the two since they are continously saturated; but not mixes with other types of "B" wetlands (FO1, FO4, EM, etc.).

		MN (northern Midwest bog region) – Include "B" (continuously saturated) that are not "a" (bogs) since this water regime is equivalent to "E" used in the Northeast and includes wooded swamps and fens (P___t) that are important for this function. Again if "a" (acidic) exclude.
	Note: In relevant regions, try to separate fens from bogs as the former are nutrient-rich sites while the latter are nutrient-poor sites: use circumneutral modifier "t" to identify fens EM1_t, SS__t, FO__t from bogs PSS__Ba, PFO__Ba (the "a" modifier), for example. Also exclude PFO5 and PSS5 from high; they are typically shallow ponds dominated by dead trees).	
	Moderate	P__(AB, EM, SS, FO and mixes)D, P__(AB, EM, SS, FO)A, P__(AB, EM, SS, FO and mixes)S, P__(AB, EM, SS, FO and mixes)K, L2EM_A, PUS/__(mixed with vegetation classes excluding FO5 and SS5), PUB/__(mixed with vegetation classes)H, L2EM_S, PFO5/other vegetated, PSS5/other vegetated; Other P-vegetated (AB, EM, SS, FO and mixes; excluding FO5 and SS5), R_EM_A
	Note: Commercial cranberry bogs – PSSf – are not rated as significant for this function, nor are other farmed wetlands – Pf or wetlands associated with active dredged material disposal impoundments ("da").	
Carbon Sequestration (CAR)	High	P__ (AB,EM, SS, FO, and mixes)E, P__ (AB,EM, SS, FO, and mixes)F, P__ (AB, EM, SS, FO, and mixes)H, P__ (AB, EM, SS, FO, and mixes)C, P__ (AB, EM, SS, FO, and mixes)T, P__ (AB, EM, SS, FO, and mixes)R, P___Ba (and mixes), P_____g (=wetlands on organic soils), E2EM (and mixes), E2SS (and mixes), E2FO (and mixes), R1EM, R_EMC, R_EME, R_EMF, L2EM_H, L2EM_F, L2EM_E, L2EM_C, L2AB_F, L2AB_H, P__B (*continuous saturated* types; bogs noted with "a"), L2AB_G, L2AB_V, R_AB_F, R_AB_G, R_AB_V, R_AB_H, PAB_V, PAB_G, PAB_H, PAB_K, PEM_K, M2AB3

GA coast – Include PFO3B, PSS3B and mixes of the two since they are permanently saturated; but not mixes with other types (FO1, FO4, EM, etc.).

Note: Bogs and other continuously saturated wetlands and wetlands with organic soils should be rated as high for this function. Exclude AB1, PFO5 and PSS5 from ‘High’.

	Moderate	P__ (AB, EM, SS, FO, and mixes)A, P__ (AB, EM, SS, FO, and mixes)D (seasonally saturated; continuously saturated “B” types should be rated as High), P__ (SS, FO, and mixes)K, P__ (AB, EM, SS, FO, and mixes)S, E2AB, R_EMA, L2EM_A, E2US (including mixes dominated by nonvegetated class; focus on mudflats and organic flats for purely nonvegetated types and exclude sand flats/beaches and other substrates; not E2US_P), R1US (and mixes dominated by nonvegetated class; focus on mudflats and organic flats for purely nonvegetated types and exclude sand flats/beaches and other substrates), PUB (and mixes; and not PD2 b,c,d,e1,and f or PD3 b,c,d,e1, f and j1; also exclude vertical flow impounded ponds), PUS/vegetated, and L2US/vegetated, L2UB/vegetated, PFO5 (excluding vertical flow and impounded), PSS5 (excluding vertical flow and impounded)

Note: Mixes for vegetated wetlands are those where vegetation is the dominant class, while mixes for nonvegetated wetlands are those where the substrate is the dominant class. Commercial cranberry bogs – PSSf – and other farmed wetlands P__f are not included; also “mixes” should include nonvegetated wetlands where vegetated types predominate and vegetated wetlands where nonvegetated types predominate. If mapping includes any H, G or V wetlands that are vegetated by vascular plants other than aquatic bed species – not dead trees, they too should be rated as high for this function. Also exclude M2AB1__ and E2AB1__ as these types are typically associated with rocky shores as mapped.

Sediment and Other Particulate Retention (SR)	High	ES__(vegetated and mixes), LEBA, LEFR (vegetated and mixes, not “fm”- floating mat), LEIL (veg and mixes, not “fm”), M2AB3__, LSBA, LRBA, LSFP, LRFP, LRFR (veg, not “fm”), LSFR (veg, not “fm”), LRIL (veg, not “fm”), PDTH, TE__pdTH (including __pq), PDBT, TE__pdBT, TEBATH, TEBATI,

TEFRpdTH, PD2c1, PD2d1, PD2e1, PD3c1, PD3d1, PD3e1, PD2r, PD3r

Moderate

E2__(US, SB, RF, excluding RS), LEFR (nonveg), LEFL (veg), LSFL (not P___D_), LRIL (nonveg), LRFR (nonveg), LSFR (nonveg), M2US, M2RF, Other TEBA (not P__D_), PD1, PD2 and PD3 (not c, d, e, f, g, j types), PD4, TEFLpd (not P__D_), TEFP__ (not P_B_), TEFL__ (P__A, not P__D_), TE__pdOU, TE__pdIN, Other TEFRpd__

Note: No "D" (formerly "B") wetlands should be identified as significant for this function; only flooded types: A, C, E, F, H, R, S, T, R, N, M, and L should be rated. This will exclude bogs (PT and "a") but should include fens (possibly PT but lacking an "a") and "B" wetlands on muck soils (e.g., Minnesota and northern Midwest region).

Bank and Shoreline Stabilization (BSS)

High

E2__(AB, EM, SS, FO and mixes; not IL), E2RS (not ESIL), E2US_P (not ESIL), M2RS(not MAIL), M2AB1N (not IL), LR_(AB, EM, SS, FO and mixes; not LRIL and not "fm"), LS_(AB, EM, SS, FO and mixes and not "fm"), LE__(AB, EM, SS, FO and mixes; not LEIL and not "fm"), R_RS, L2RS

Moderate

E2US_N or M (not IL), M2US (not IL), TE__pd (AB, EM, SS, FO and mixes), TE__OUhw (AB, EM, SS, FO and mixes), E2RF (when occur along a shoreline), M2RF (when occur along a shoreline), TE__OIhw (AB, EM, SS, FO and mixes)

Note: Exclude IL wetlands from this function since they are not shoreline features. Be sure to also exclude US and UB wetlands in nontidal areas.

Fish and Aquatic Invertebrate Habitat (FAIH)

High

E2EM (including mixes with other types where EM1 or EM2 predominates; excluding E2EM5P__ and mixes where EM5 predominates and mixed communities dominated by E2FO or E2SS), E2US_M, E2US_N, E2RF, E2AB, E2RS/AB, L2_F, L2_H or G, L2AB, L2UB/__(AB, EM, SS, FO), LE__ (vegetated; AB, EM, SS, FO) and NWI water regime = H (permanently flooded), M2AB, M2RS/AB, M2US_M, M2US_N, M2RF; P__F and adjacent to PD (PD1, PD2 a3,b,and h, PD3b and h, and PD4 only), LK, RV (all except LR4), or ST (all except LS4) waters; P__F and __FRsl or __BAsl (slough), PAB (not excavated or impounded), PUB/__(AB, EM, SS, FO), P__(EM, SS, FO)H, PEM__(N,R,T, or L, except EM5), PSS_T, PFO_T, PD (PD1, PD2 a3,b,and h, PD3b and 3h, and PD4 only) associated with P__(AB, EM, SS, FO)F, R1EM, R1AB, R1US(except S), R2AB, R2EM, PD (PD1, PD2a3, 2b, 2h, PD3b, and 3h, and PD4) associated with P__(AB, EM, SS, FO)H

Note: M1AB3L = submerged eelgrass – important habitat but is not wetland so it is not included above; reports will note this. L2__K wetlands were not rated due to unknown management.

Moderate	LE__ and PEM1E (contiguous with waterbody; no mixes), LR__ and PEM1E (ontiguous with waterbody; no mixes), LS__ and PEM1E contiguous with waterbody; no mixes), PEM5F and adjacent to LK, RV (except LR4), or ST(except LS4) waters, E2EM5N (and mixes), PEM5N (and mixes), E2EM5/1P, E2EM5P__ and adjacent to the estuary (and mixes, but not "interior" E2EM5P_), E2FO/EM__ (not EM5), E2SS/EM__ (not EM5), LR5__ and PFO/EM_R or T (not EM5), LS5__ and PFO/EM_R or T (not EM5), LS5__ and PSS/EM_R or T (not EM5), PD (≥ 1 acre in size and PD1, PD2 a, b, h, PD3 a3, b, h, PD2e2, PD2e3, PD2a4, PD2a5, PD2p, PD2p1, PD2p2, PD2q, PD2q1, PD2q2, PD3a4, PD3a5, PD3e2, PD3e3, PD3p, PD3p1, PD3p2, or PD4), TEFRpd (along these ponds), PAB (impounded or excavated and ≥1 acre and not associated with PD2 c,d,e,f,and g or PD3 c,d,e,f, and g), LR_FPba

Note: Ponds one acre or greater and certain types were selected as moderate. Including PEM1E under Moderate is an attempt to include some marshes that may be classified as

		"E' wetlands rather than "F". Exclude wetlands and ponds associated with active dredged material disposal impoundments ("da").
	Stream Shading (Shade)	LS (not LS4 or not LS__pd) and PFO, LS (not LS4 or not LS_pd) and PSS (not PSS_Ba or not PSSf); excluding FO5 and SS5; TE_OUhw and PFO or PSS (not PSS_Ba or PSSf)
	Locally Significant	Example: Lake Champlain - seasonally flooded LE__ wetlands (important for spring spawning); possibly add LR__ and LS__ wetlands with an E or C (water regime for spawning)
	Note: Shrub bogs should be excluded from all the above, e.g., PSS3Ba and commercial bogs = PSSf.	
Waterfowl and Waterbird Habitat (WBIRD)	High	E2EM1 or E2EM2 (includes mixes where they predominate), E2EM5N, E2US__ M, N, P, and T water regimes (not S water regime), E2RF, E2AB, E2RS, L2_F (vegetated, AB, EM, SS, FO and mixes with nonvegetated), L2AB (and mixes with nonvegetated), L2US_(F,E, C, R, or T), L2UB_F, L2_H (vegetated, AB, EM, SS, FO and mixes with nonvegetated), M2AB, M2RS (excluding jetties and groins – M2RSPr), M2US, M2RF, P__F and adjacent to PD (PD1, PD2a3, 2h, PD3h, and PD4 only), LK, RV(not LR4) or ST (not LS4) waters or along a slough ("sl" modifier); PAB (not excavated or impounded, except those associated with wildlife impoundment – "wi"), P__T, P__H (vegetated, EM, SS, FO including mixes with UB), PEM1Eh and adjacent to LK, RV(RV1 RV2, RV6b, and RV6c only), ST (ST1 and ST2 only), and certain PD (PD1, PD2a3, 2h, PD3h, and PD4 only), PEM1Eb; PUS_F (not PD3), PUS_E (not PD3), LS__ and PEM1E (including mixes; not LS4), LR__ and PEM1E (including mixes; not LR4), TE__ hw and PEM1E (including mixes); LE__ and PEM1E (including mixes); PEM_N (and mixes), PEM__R, (includes mixes, but excludes

	Phragmites-dominated EM5), P__/EM_N, and P__/EM_R (not EM5), PD2h, PD3h, PD4, PD1 associated with P__(AB, EM, SS, FO)F, PD associated with P___T, PD1 associated with P__(AB, EM, SS, FO)H, PUB__b, R1EM, R_EMF, R1US (except S water regime), TE_pd and PEM1E (including mixes)
Moderate	E2EM5P (and mixes) and contiguous with open water (not "interior" marshes), E2SS1/EM1P6, E2SS1/EM1Ph, E2EM5/1P, PEM5__E,F, R, or T and adjacent to PD, LK, RV(not LR4), or ST(not LS4), other L2UB (not listed as high), Other PD (≥ 1 acre in size and PD1, PD2 a, h, PD3 a, h, or PD4), Other P__F (vegetated wetlands and >1 acre), PAB (impounded or excavated and >1 acre), LS4 and PEM1E (> 1 acre in size), TEBA and PEM1E (> 1 acre in size), other PEM1Eh
Wood Duck	LS(1,2, or 5)BA and P__ (FO or SS and mixes; not PSS3Ba or PSSf – commercial cranberry bog), LS(1,2, or 5)FR and P__ (FO or SS and mixes; not PSS3Ba or PSSf), LR(1,2, or 5)FPba and P__(FO or SS and mixes; not PSS3Ba or PSSf), LRFPba and PUB/FO; PFO_R, T, or L (and mixes) and contiguous with open water, PSS_R, T, or L (and mixes) and contiguous with open water, LEBA and P_(FO or SS and mixes; not PSS3Ba or PSSf) and contiguous with open water, TEBAOUhw and P_(FO or SS and mixes; not PSS3Ba or PSSf)

Note: All waterfowl impoundments and associated wetlands that should be marked with "wi" should be rated as high for this function. Ponds used for aquaculture (2b, 3b) are excluded since management will likely deter use of these ponds; associated wetlands should also be excluded as should wastewater treatment, industrial, and commercial ponds and lakes and associated wetlands. Shrub bogs, e.g., PSS3Ba, commercial bogs = PSSf , and farmed wetlands: P__f should be excluded in Northeast, but check use of farmed wetlands in Prairie Pothole and elsewhere. Also exclude wetlands and ponds associated with active dredged material disposal impoundments. For wood duck, there should be no wetlands along intermittent streams designated as important.

Comment: PEM1C wetlands along waterbodies may also be important for this function in some regions, but in the Northeast these may be wet meadows rather than marshes; these wetlands are recognized as important for “Other Wildlife.”

Other Wildlife Habitat (OWH)	High	Any vegetated wetland complex $\geq$ 20 acres, wetlands 10-20 acres with 2 or more vegetated classes (excluding EM5), certain ponds (PD1a, b, c, d, e, f, h, i, j, k, l, m, n, o, p, q1, q2, q3, q4) , freshwater wetlands (P___ or L2____ and not EM5 - *Phragmites*) on undeveloped portions of barrier islands or beaches, small permanently flooded or semipermanently flooded wetlands (including PUBH and PUBF) within a forested wetland or upland forest (can use specific PD types to identify these), other forested or scrub-shrub wetlands within 100m of these permanently flooded or semipermanently flooded wetlands
	Moderate	Other vegetated wetlands

Note: Vegetated wetlands should focus on EM, SS, and FO; exclude AB from the size determination of a vegetated wetland complex, but include AB mixes with EM, SS, and FO (e.g., AB/FO, EM/AB) except FO5 and SS5. Mixes of subclass (e.g., FO1/4 or SS3/1 do not qualify as a mixed class; a mixed class wetland is comprised of two different classes (e.g., FO/SS, EM/SS). This function requires merging of polygons so that complexes are identified for the acreage determination, then recompile and look within the complex for more than one class or mixed class wetlands for the rating. Exclude wetlands and ponds associated with dredged material disposal impoundments (“da”).

Unique, Uncommon, or Highly Diverse Wetland Plant Communities (UWPC)

Typically apply this function only where region has designated special types for this function or where this has been done locally.

Regional significant (Northeast U.S.)

E2EM1N, E2EM1P6, R1EM, R1US (only where vegetated in summer), PEM1N, PEM1R, PEM2N, PEM2R, PSS_R, PSS_T, PFO4__g and PSS4__g (Atlantic white cedar; including mixtures), P___t (fens – EM, SS, FO), PFO2__ and PSS2__(bald cypress; DE and MD), E2AB__ (eelgrass and SAV beds-not algae), LS__FR (excluding PFO5 and SS5), LR__FR excluding PFO5), *PD1m (woodland vernal pool), *forested wetlands within >7000-acre forest (limit to Mid-Atlantic Region and Coastal Plain only), karst ponds and associated wetlands, E2EM1N6, PEM1T

Certain coastal wetlands along the Great Lakes (e.g., Presque Isle, PA; will need to be designated on a case-by-case basis)

**Comment*: Can't easily do, would need to hand pick or do additional GIS analysis.

Note: Exclude any altered wetland – x, h, td, and tr – plus any "d" wetland that is channelized or extensively ditched; also exclude any EM5 wetland or wetland mixed with EM5 unless it is native *Phragmites*. R1US wetlands only where mapped on leaf-off imagery and no summer image was available; otherwise should be mapped as R1EM2 where vegetated in summer with emergents.

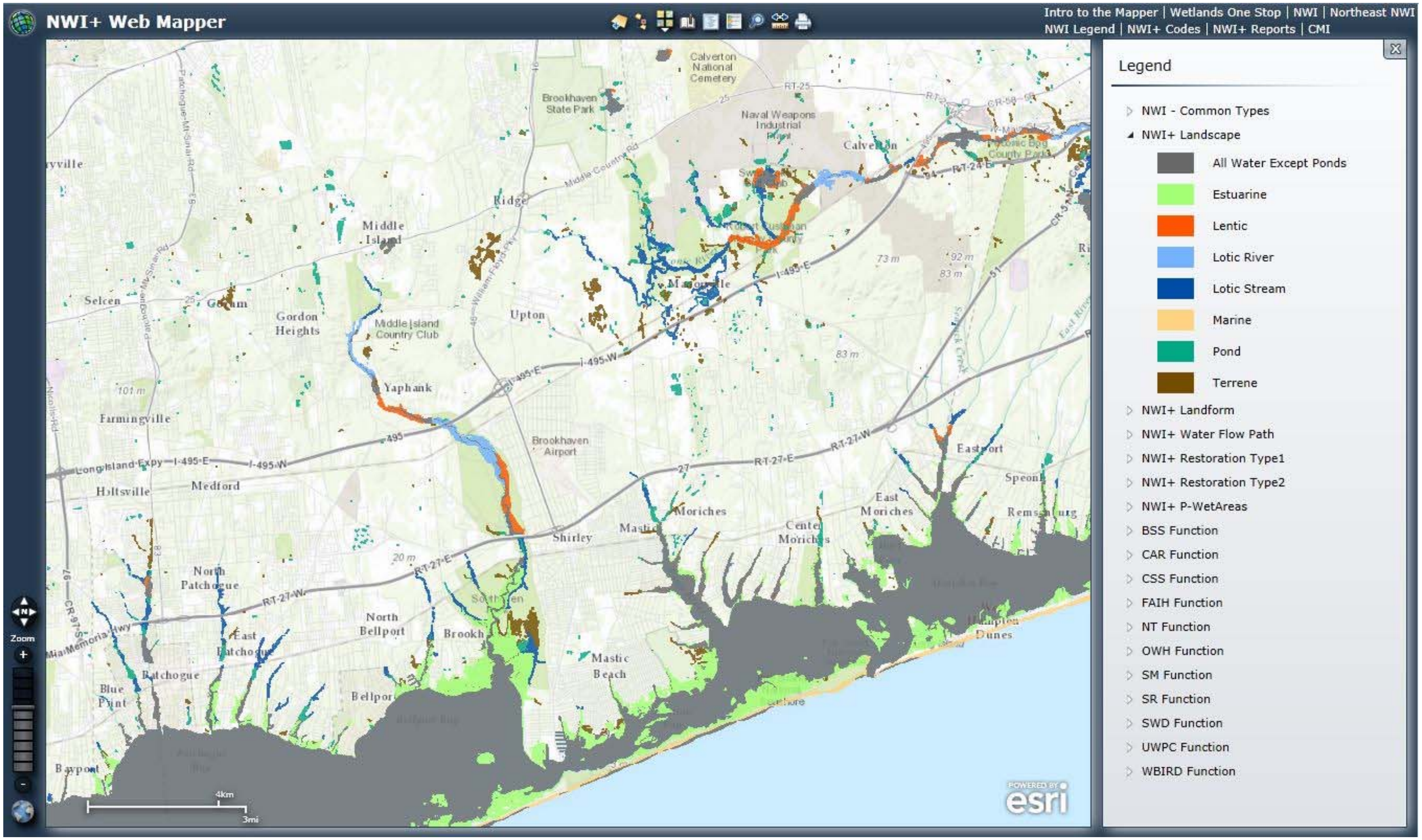
Locally significant (case-by-case; Northeast U.S.)

PFO2__ (larch), PSS2__(larch), PSS3Ba or PSS1Ba (and mixes; shrub bog), northern white cedar swamps, hemlock swamps, Atlantic white cedar swamps, E2EM1N and P (some areas), LEFR with EM/AB and AB/EM vegetation, other uncommon types in an individual watershed

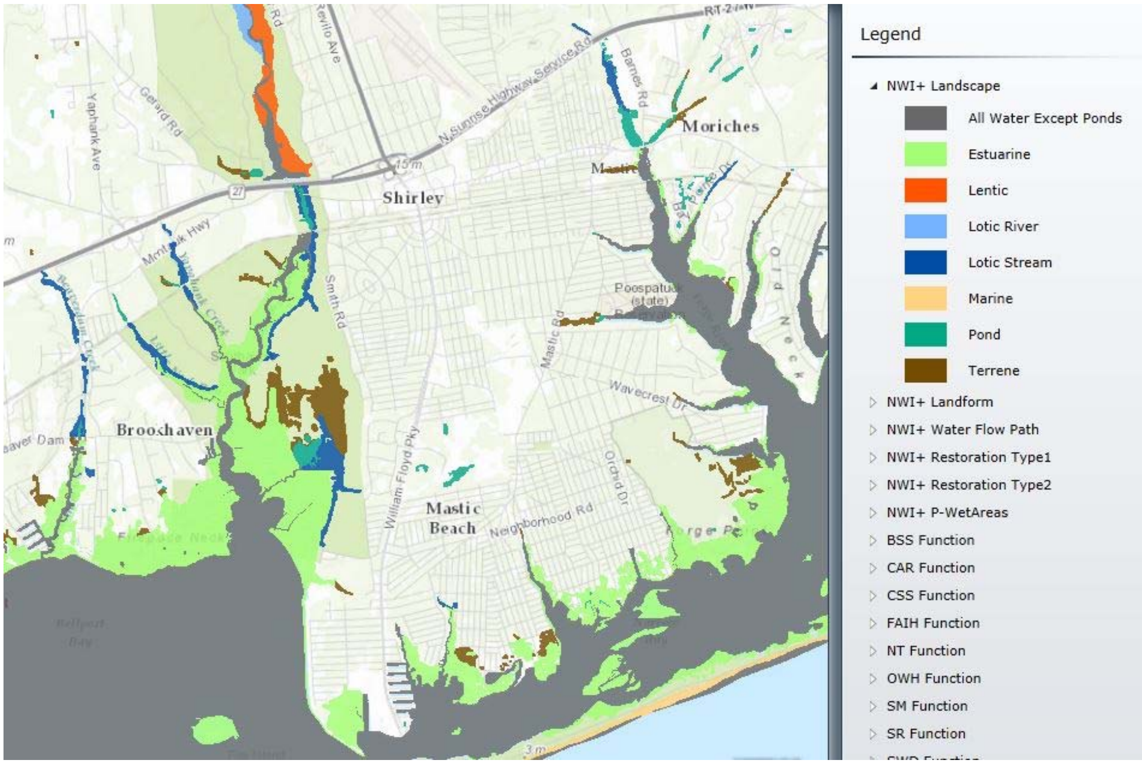
Appendix B.

Examples of Online Maps Copied from the NWI+ Web Mapper

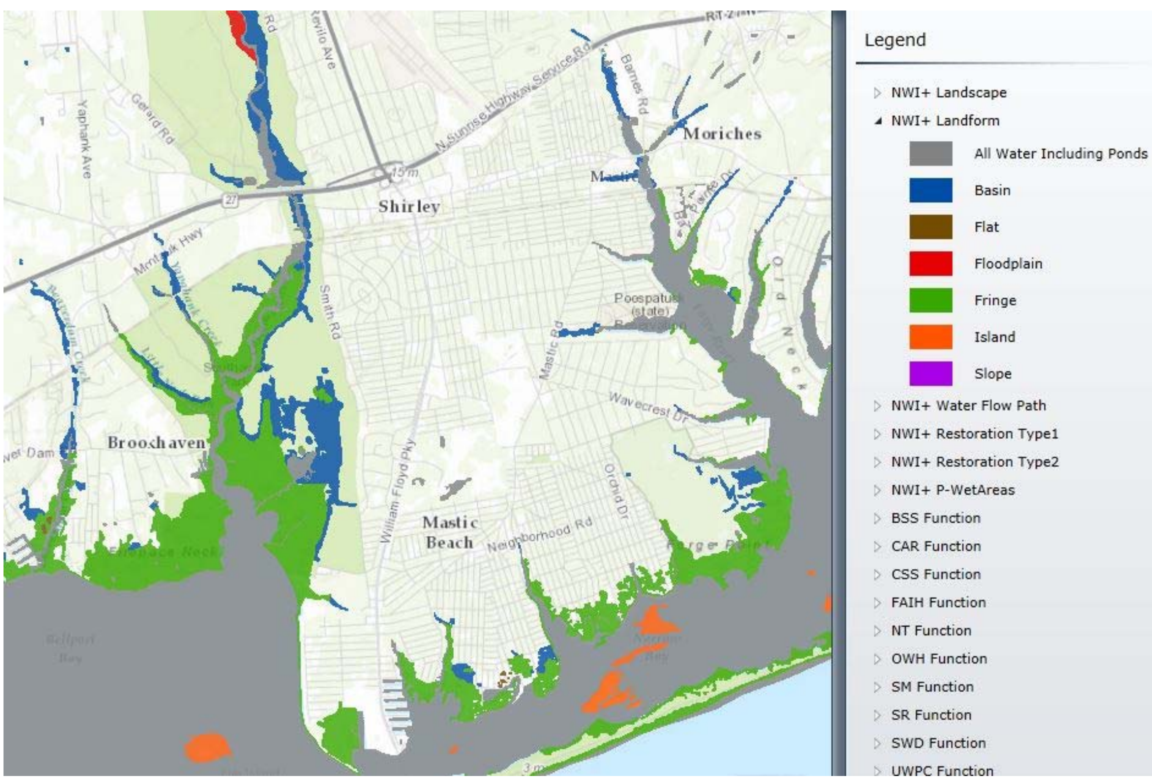
(Note that legends are opened)



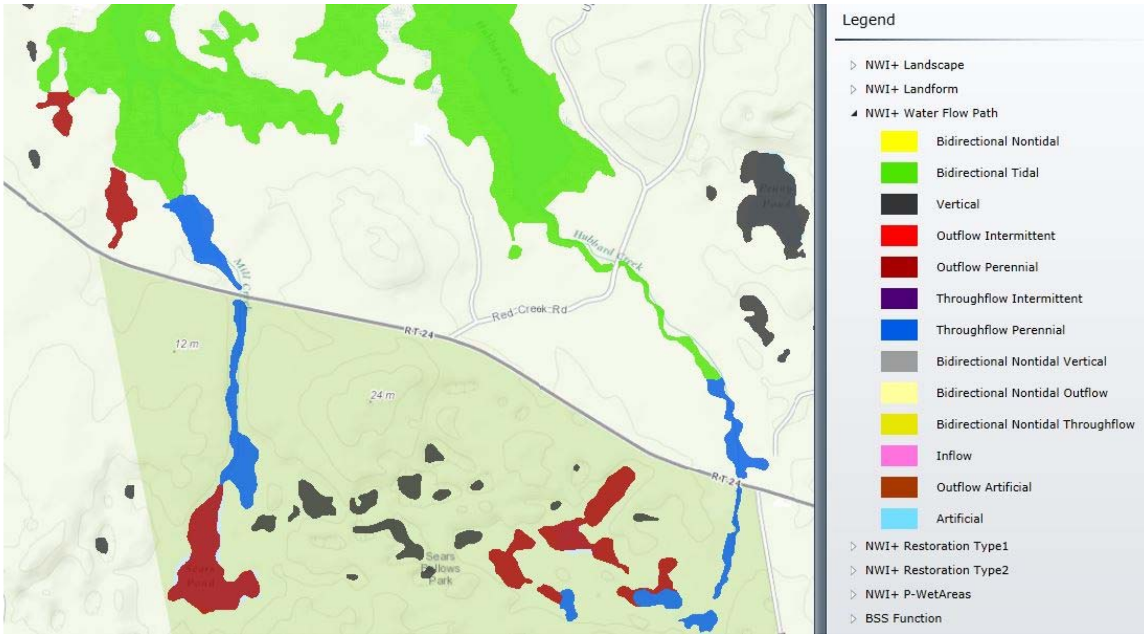
View of entire web page with Landscape Position shown and legend opened to show different types.



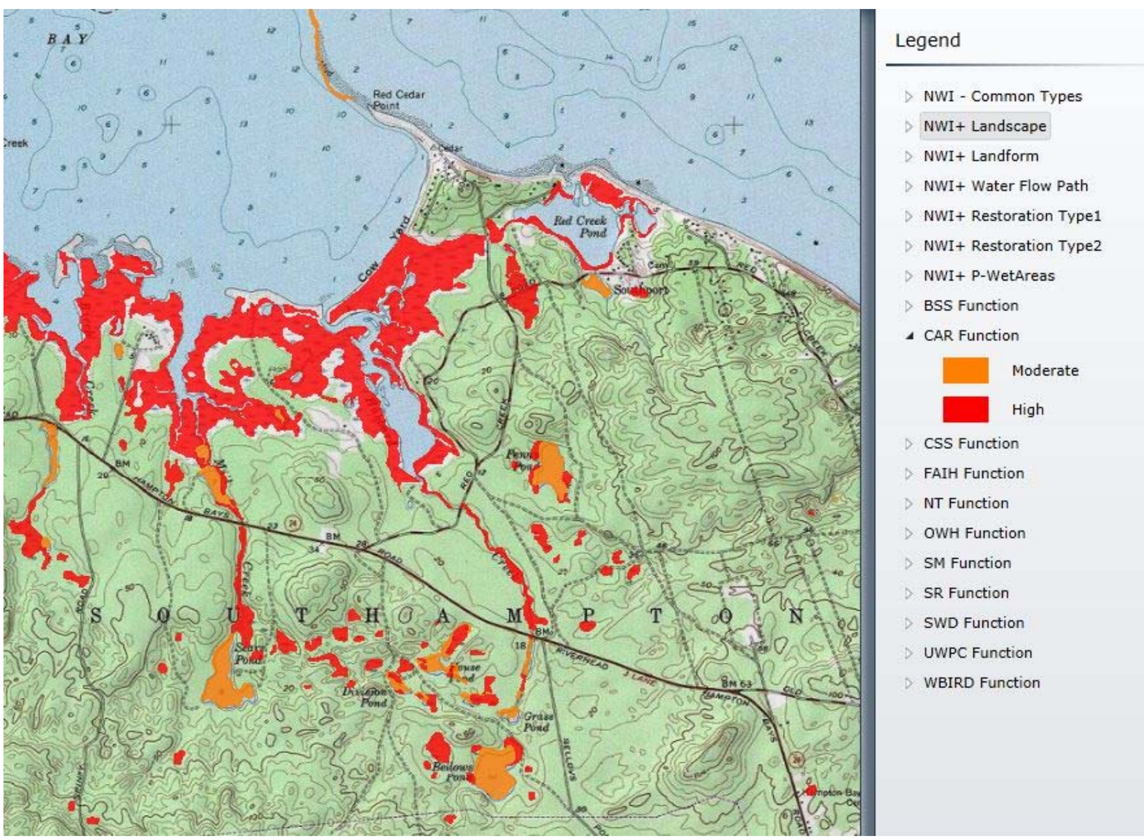
Portion of online map showing wetlands classified by landscape position.



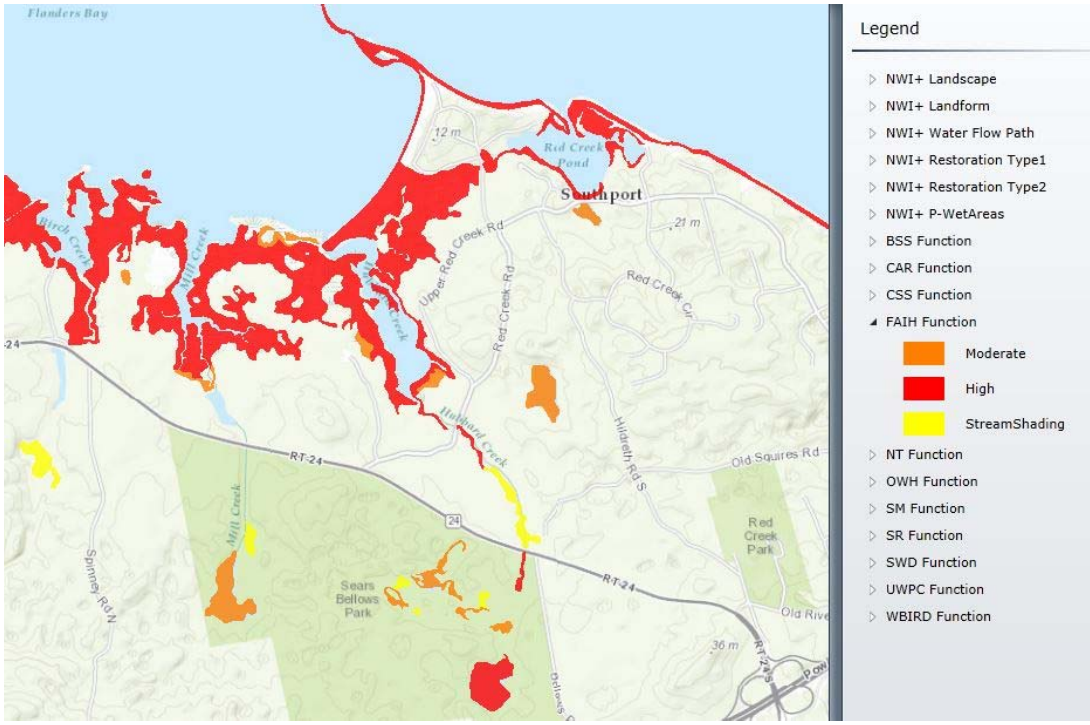
Portion of online map showing wetlands classified by landform.



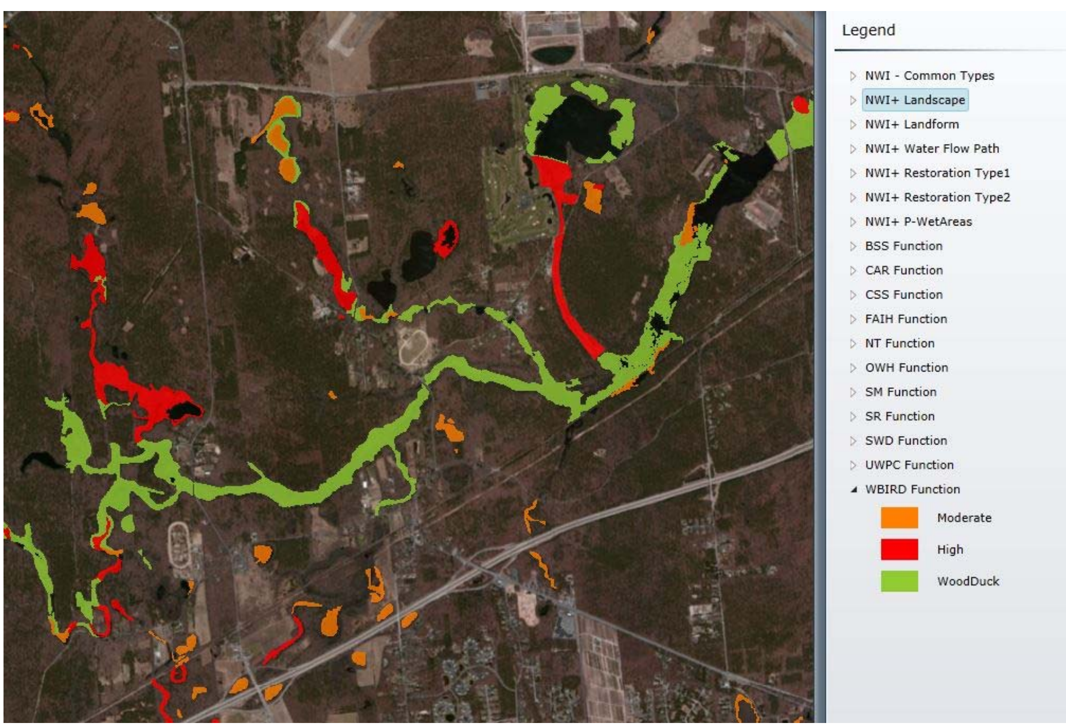
Portion of online map showing wetlands and waters classified by water flow path. (Base map – generalized topographic map)



Portion of online map showing potential wetlands of significance for carbon sequestration. (Base map – U.S.G.S. topographic map)



Portion of online map showing potential wetlands of significance for the provision of habitat for fish and aquatic invertebrates. Wetlands providing shade for streams were highlighted since their woody vegetation helps moderate water temperatures.



Portion of online map showing wetlands of significance for provision of habitat for waterfowl and waterbirds. (Base map - aerial image)

U.S. Department of the Interior
Fish and Wildlife Service

http://www.fws.gov

February 2015