Freshwater Wetland Functional Assessment Study

for the

Town of Yorktown
New York

363 Underhill Avenue, Yorktown Heights, New York

August 31, 2007

Prepared by:

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Table of Contents

Introduction

The work presented in this report has been done with the aid of funding from the Federal Environmental Protection Agency. The scope of work included literature research to find a wetland function evaluation technique that could readily be applied to several wetland study areas within the Town. The results of the literature and study area research were to be incorporated into recommendations for revisions to the existing wetlands regulations.

Wetland Function Assessment Method

The wetland functional assessment choice had several limiting requirements imposed by the grant. It had to be based upon a hydrogeomorphic wetland classification. Because of the intent to apply the chosen assessment method to all sizes of wetlands during wetland permit application review, it was necessary to choose a method that was neither labor nor time intensive. It was also necessary to have a procedure that would allow a comparison between wetlands.

The procedure recommended and approved by the Town was "A Rapid Procedure for Assessing Wetland Functional Capacity based on Hydrogeomorphic (HGM) Classification, February 1998" (manual) by Dennis W. Magee with technical contributions from Garrett G. Hollands. This procedure defines six HGM classes of wetlands, four of which are found in Yorktown. It identifies eight wetland functions and provides indicators, or variables, by which the level of function capacity is determined.

The procedure requires that a Wetland Inventory data form be completed. This details information characterizing the HGM class by information regarding hydrology, soils and vegetation. It also requires the collection of data related to variables, such as Number of Wetland Types and the condition of variables, such as Evenness of Distribution.

Each of the eight wetland functions has a rule-based model. These are made up of variables, variable conditions and relative weights of the variable conditions. Not every HGM class performs all eight wetland functions. There are rule-based models based upon readily available information, matching each model to its purpose and to the quality of available information. These models were designed to compromise between "being simple to point of triviality and too complex to be useful", according to Mr. Magee. The resulting procedure detailed in the manual is quick, easily followed and is highly repeatable.

The information gathered on the field sheets is applied to each of the variables and their conditions according to HGM wetland type or class to determine the appropriate weight. The sum of these variable weights is divided by the maximum potential score to derive a Function Capacity Index (FCI) score. These FCI scores are then compared with the functional indices of other wetlands of the same HGM class in the same region as developed by manual. The Wetland Inventory Data form and Functional Capacity Index calculation forms are provided in Appendix 'A'.

The author of the manual describes seven hydrogeomorphic regions in the contiguous United States. Yorktown is located within the Glaciated Northeast and Midwest region. This encompasses all of New England, south to the limit of the Wisconsin glaciation and west to north-eastern Iowa and central Minnesota. The range of FCI scores for each HGM type was developed by the author of the manual through literature research and the collective experience of the author and cohorts.

Graphic displays have been made of the FCI scores calculated for each of the wetland evaluated. These scores are shown as they relate to the average score for similar wetlands within the base region. These produce a visual presentation of the relative functional capacity, facilitating comparisons. All study area Summary Graphs, completed Wetland Inventory Data and FCI calculation forms are included in Appendix 'B'.

The four HGM wetland types present in Yorktown have distinctly different characteristics, including strengths and weaknesses in performing each of the eight wetland functions:

Slope Wetlands

<u>Characteristics</u>

- Occur on slopes.
- Runoff flows one way through wetland to an outlet or another wetland class.
- Flow through is rapid with little, if any, detention time.
- Do no receive overbank floodwaters.
- Vegetation ranges from forest to emergent marsh, but no aquatic bed or open water.
- Soils range from somewhat poorly drained to histosols.

<u>Modification of Groundwater Discharge</u>

- Predominantly areas of groundwater discharge.
- Surface soils generally have a lower permeability than the underlying aquifer, resulting in a prolonged discharge of groundwater to wetlands.

<u>Modification of Groundwater Recharge</u>

- Lack of runoff retention capability reduces potential for groundwater recharge.

<u>Modification of Stream Flow</u>

- Groundwater discharge wetlands with connection to downslope wetlands or watercourse provide major sources of stream base flow.
- Hydrolic isolation, such as discharge to a Depression wetlands downslope, eliminates potential benefits to stream flow.

<u>Storm and Floodwater Storage</u>

- Least potential of all HGM types to provide this function.
- Dense vegetation cover may provide reduction in rate of runoff water of direct and upslope rainfall.
- Well developed micro relief also aids in retention of runoff water.

Modification of Water Quality

- Sediments with associated pollutants deposited where runoff from steeper upland reaches less steeply sloping wetlands.
- Sediment trapping less than other HGM types due to low time of residence.
- Very low potential for removal of pollutants in solution due to short time of residence.
- Low gradient wetlands have somewhat greater potential for sediment deposition and biochemical water quality improvement.

Export of Detritus

- High potential due to flow through nature of hydrology.
- Low potential if outlet lacking or intermittent.

Contribute to Abundance and Diversity of Wetland Vegetation and Fauna

- Irregular hydrology produces the least development of habitat diverse from adjoining upland.
- Habitat availability to wetland dependent fauna is low.

Depression Wetlands

Characteristics

- May have no outlet, intermittent outlet or perennial outlet.
- Microrelief well developed.
- Generally flat.
- Runoff retention predominant characteristic of no outlet.
- Runoff detention is dominant condition where intermittent or perennial outlet present.

Modification of Groundwater Discharge

- Wetlands intersecting permanent groundwater table.
- Highly variable water table may produce seasonal recharge and discharge conditions in the same wetland.
- Usually occur low in the watershed.

Modification of Groundwater Recharge

- Greatest potential of all HGM wetland types to have groundwater recharge function.
- Usually occur at higher elevations in the watershed.
- Unsaturated hydric oils may absorb all infiltrating runoff preventing recharge.
- Low permeability hydric soil may cause temporary surface ponding, preventing groundwater recharge.

Storm and Floodwater Storage

- Maximum retention capability of all HGM wetland types.
- Outlets, when present, are often restricted, increasing detention.

Modification of Stream Flow

- Unused storage volume of depression may reduce or eliminate outfall stream flow during runoff event.

Modification of Water Quality
- Greatest potential for water quality improvement of all HGM types.
- Runoff retention maximizes water quality improvement function.
- Water quality improvement function increases with detention time.

Export of Detritus
- Least potential for detritus export due to lack of outflow.
- Perennial outflows may provide significant detritus export.

Contribution to Abundances and Diversity of Wetland Vegetation and Fauna
- Maximum water retention time provides growing conditions for wetland dependent vegetation.
- Prevalence of wetland-dependent habitats maximizes presence of wetland dependent fauna.
- Generally high potential for abundance and diversity of wetland flora and fauna.

Riverine Wetland

Characteristics
- Generally occur in valley bottoms.
- Terrain may be broad flat land with few if any large scale topographic features.
- Watercourse ranges from intermittent streams to broad rivers.
- Riverine wetlands are flood plains adjoining stream channels.
- Water flow is oblique from watercourse to Riverine wetland and returning to the watercourse farther downstream.
- Upper limit of wetland determined by 1-5 flood return frequency or vegetation.
- Streamside wetlands not receiving overbank flooding are not Riverine wetlands.

Modification of Groundwater Discharge
- Predominantly groundwater discharge areas.
- Sediments in bottom of larger rivers may inhibit rate of discharge.

Modification of Groundwater Recharge
- Function not applicable to glaciated northeast region.

Storm and Floodwater Storage
- Major factors in function capability are: frequency of flooding, roughness of wetland surface and gradient of wetland surface.
- Frequent flooding maximizes capability.
- Vegetation density and micro relief increases floodwater detention time.
- Low gradient slows runoff rate increasing storage time.

Modification of Stream Flow

- Floodwater storage capacity directly related to modification of stream flow rate, storage and volume of channel flow.
- Groundwater discharge affects stream flow, especially base flow.

Modification of Water Quality

- Overland flow from adjoining lands generally deposits sediments upon entering riverine wetlands which usually have a flatter gradient.
- Velocity of overbank floodwaters deceases as water enters the flood plain, causing transported solids to settle.
- Pollutants associated with sediments are neutralized by biochemical activity and by becoming trapped.

Export of Detritus

- Alternating periods of flooding and exposure facilitate decomposition rate producing detritus available for exportation by subsequent flood waters.

Contribution of Abundance and Diversity of Wetland Vegetation

- Regular flooding provides a stable environment for characteristic flood plain vegetation.
- Flood water regularly disburses propagules downstream as well as introducing new propagules from upstream vegetation.
- High potential for contributing to abundance and diversity of vegetation.

Contribution to Abundance and Diversity of Wetland Fauna

- Highly valuable to wildlife abundance and diversity.
- Spring flooding provides seasonal benefit to migrating waterfowl.
- Provides excellent forage during winter months.
- Regularity of flooding and drying conditions provide a stable floodplain habitat.

Lacustrine Fringe Wetland

Characteristics

- Adjacent to ponds and lakes and dominated by the hydrology of the water body.
- Water movement is essentially up and down as lake level rises and falls.
- Some lateral flow may accompany rise and fall of water level.
- Provide a more water-oriented environment than any of the other three HGM types.
- May include forested, scrub-shrub, emergent and lakeside bog wetlands.
- Surface water driven wetlands may have very stable water levels, with only minor of seasonal fluctuations.
- Groundwater driven wetlands generally have a histosol substrate.

Modification of Groundwater Discharge

- Usually groundwater discharge function is prominent.
- Discharge rate may be reduced by low permeability hydric soils.

Modification of Groundwater Recharge

- May provide recharge as groundwater level falls below Lacustrine Fringe flood waters.
- Underlying histosols may reduce rate of groundwater recharge.

Storm and Floodwater Storage

- Lacustrine fringe wetlands are lake flood plains.
- High potential for floodwater detention and short term storage.
- Low long term water storage potential.

Modification of Water Quality

- Sediments from overland flow deposited.
- Suspended solids from both inflows from waterbody and land settled in still lacustrine fringe floodwaters.
- Detained and retained floodwaters subjected to biochemical activities of stabilization and decomposition.
- High potential for water quality improvement.

Export of Detritus

- Primarily areas of detritus accumulations.
- Lateral flow from wetlands to open water may export detritus.
- Dense vegetation and micro relief may hinder lateral movement of detritus.

Contribution to Abundance and Diversity of Wetland Vegetation

- Potential high due to stable wetland hydrology.

Contribution to Abundance and Diversity of Wetland Fauna

- Highly diverse and stable edge habitat at the wetland-watersedge interface.
- Generally high potential for Contribution to Abundance and Diversity of Wetland Fauna.

Criteria for the separation of wetlands areas are provided in the manual. Wetlands Assessment Areas (WAA) should be evaluated separately for a variety of conditions:

Physical Separation:

- No permanent or seasonal surface connection.
- Assess separately where wetland narrows significantly, i.e. less than 50 ft., unless wetland has a generally narrow configuration.
- Separated by railroad bed, two lane road or similar barrier preventing free interchange of surface water.
- Separated by stream or river wider than the narrowest portion of the wetlands.

Hydrogeomorphic Separation

- HGM classes comprising less than 25% of the total wetland shall not be assessed separately, but with the nearest major HGM class or type.

The Magee Rapid Procedure for Assessing Wetland Functional Capacity was applied to twenty six study areas distributed among five watersheds.

Study Areas

There were several objectives for the choice of study areas. A minimum of 25 areas were to be chosen. These were to be divided evenly among five Town watersheds. Several recommendations were made during the selection phase of the work. Study areas should be on public land where access would not be a hindrance. Saw Mill Brook subshed within the Croton Reservoir North watershed should be specifically evaluated, especially the wetland behind Town Hall, NYS DEC wetland A-21. In addition, the Bailey Brook subshed within the Croton Reservoir South watershed should be the subject of at least one study.

Efforts were made to diversify the study areas in each watershed. Study areas were chosen for their position within the watershed. Headwaters and mid watershed sites predominate. It was also important to include examples of each of the four HGM wetland types in each watershed. This resulted in a wide range of wetland sizes, from study area CRS-2, 0.36 ac., to study area HM-4, 52.3 ac. The average wetland studied was 16 ac.

An initial list of study areas was reviewed by the Town, revised several times and 27 study areas chosen. During the course of choosing the study areas it was noticed that the watersheds as then delineated required revisions. The final choice of study areas and watersheds was somewhat different from the five study areas in each of five watersheds. From north to south the watersheds and study areas chosen are:

Peekskill Hollow Brook watershed.
    Shrub Oak subshed
    Study areas SO-1 through SO-5

    Mohegan Lake Subshed
    Study areas ML-1 and ML-2

Hallocks Mill Brook Watershed
    Study areas HM-1 through HM-6

Hunter Brook Watershed
    Study areas HB-1 through HB-5

Croton Reservoir North[1]
    Study areas CRN-1 through CRN-3

    Saw Mill Brook Subshed
    Study areas SM-1 and SM-2

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[1] CRN-1 was withdrawn from the study at the owner's request after the field work was completed.

Croton Reservoir South
Study areas BB-1 and CRS-1 through CRS-3

These study area locations are shown on the following Wetlands and Watershed map. A full scale copy is included as Appendix 'C'.

Wetland function assessments of the study areas consisted of field and office work. Two foot contour maps, provided by the Engineering Department, were assembled for each of the study areas. These were used for recording field information such as assemblages of vegetation observed, special features observed, wetland delineation and the differentiation of HGM wetland types within each wetland. Wetland delineations were noted as accurately as possible by reference to identifiable physical features, such as stone walls, buildings, topographic features, etc. Special features e.g. springs, seeps and watercourses were also noted.

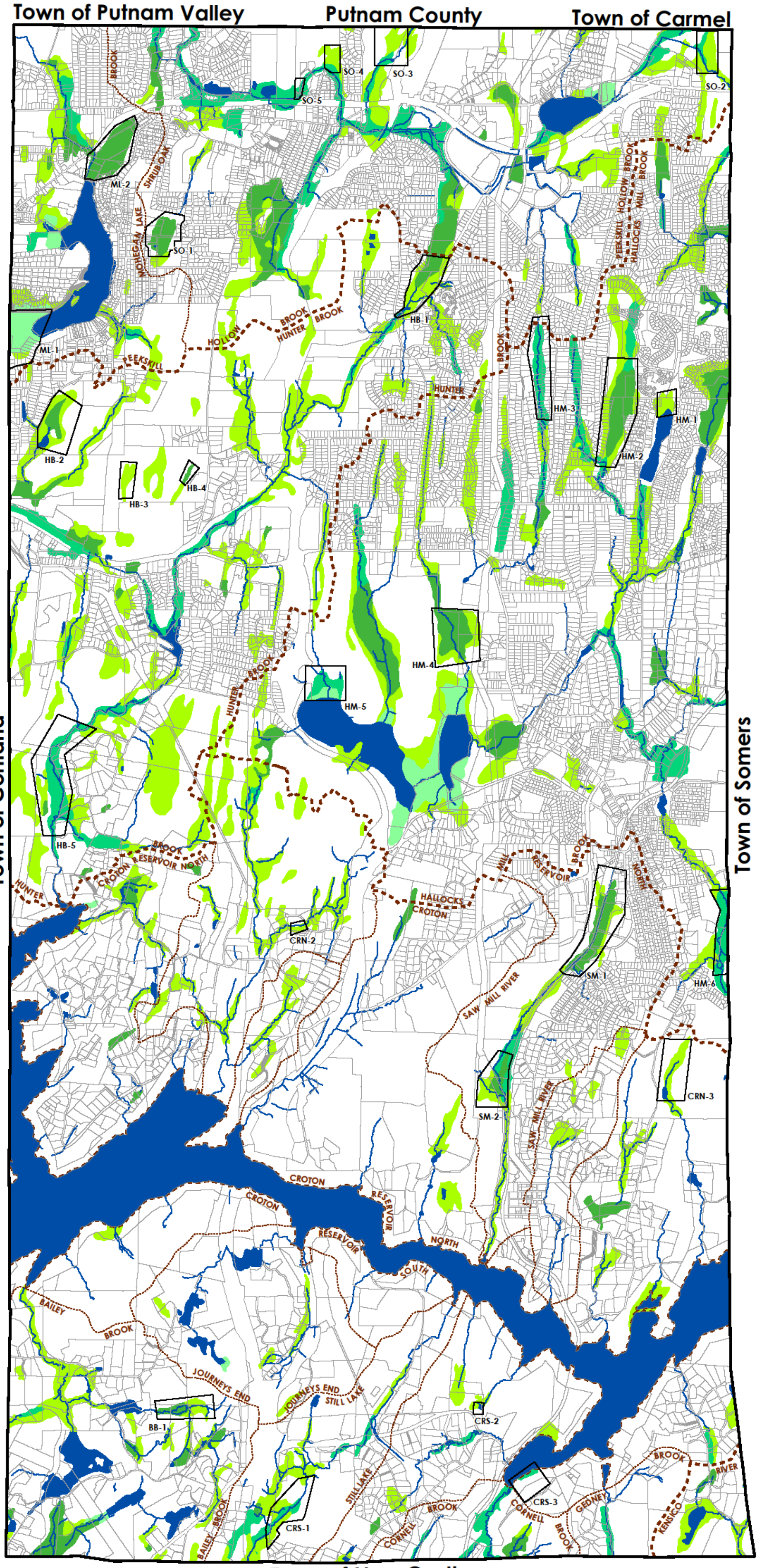
The extent of many of the study areas was refined in the field. Like most development proposals, the study area wetlands were generally a small portion of a larger wetland. Logical cutoff points, such as stone walls, old road or dam crossings, and natural constrictions of the wetlands were noted for use as study area limits.

Field data was recorded in the office in the form of hardlined maps for area calculations and on the Wetland Inventory Data forms provided in the manual. Soils maps, aerial photographs, zoning, open space and other land use information from the Planning and Engineering Departments, Westchester County and NYS DEC GIS databases were also used in completing the Wetland Inventory Data sheets.

Function Capacity Index (FCI) scores were determined for each of the HGM wetland types encountered, following the standards established in the Magee manual. These scores were graphed against the regional average score with similar wetlands in the region. These graphic representations were used in the characterization of the wetlands of each watershed.

Town of Yorktown, New York

Wetlands & Watersheds



Legend

Wetlands by Hydrogeomorphic Type

- Depression
- Lacustrine
- Riverine
- Slope

- Waterbody[1]
- Watercourses[2]
- Watershed[3]
- Sub-Watershed[4]
- Tax Lots[5]
- Study Areas[6] (SO-2)

[1] Derived from the hydric soils presentedin the 2006 USDA NRCS Soil Survey of Westchester County.
[2] Taken from NYS DEC mapping as modified in the Westchester County GIS Database.
[3] Modified from the Westchester County GIS database by reference to 5 ft countour topography and preliminary storm drain mapping provided by the Yorktown Engineering Department.
[4] Taken from the Westchester County GIS database.
[5] Tax Lot data provided by the Yorktown Planning Department, March, 2007.
[6] Areas studied in conjunction with the "Freshwater Wetland Functional Assessment Study, 2007", prepared by Environmental Design Consulting and Stephen W. Coleman.

N W E S

1 inch = 1,600 feet

1,600 0 1,600 3,200 4,800 6,400 8,000 Feet

APPROVED BY TOWN BOARD

DATE:______________________

SUPERVISOR:______________________

MEMBERS:______________ ______________

MEMBERS:______________ ______________

TOWN CLERK:______________________

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As part of the Freshwater Wetlands Functional Assessment Study, 2007.

Additional GIS map production assistance provided by:

JAM GIS CONSULTING
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Reports

Descriptions of selected study areas have been prepared in separate reports. Although not included in the scope of work, these study area reports were prepared to provide demonstrations of how wetland studies made in conjunction with land development applications might be composed. They describe affected wetlands, identify specific functions to be protected or enhanced and provide recommendations to accomplish these goals within the scope of the development proposal. These reports are included in Appendix ‘C’.

Wetland Regulations Review and Revisions

The initial review of the current regulations, Chapter 178, Freshwater Wetlands, demonstrated that previous revisions have been done in a patchwork or stop gap fashion. This has produced ambiguities, overlapping but not meshing sections, and lacked a clear sequence of permit application, review and acquisition. The regulations also contain numerous typographical, grammatical and non-sequential formatting errors.

Goals for the proposed revisions were derived in part from this review. The first is to clean up the patchwork elements, clarify ambiguities and to more sharply define vague definitions and requirements. The second was to ensure sound scientific support for the requirements of this regulation. The third goal was to improve the flexibility of the regulations so that their application could be more easily adapted to site-specific conditions.

Revisions recommended fall into five categories:

- Definitions – many existing terms have been more sharply defined and new terms added. Graphics have been proposed to augment certain definitions.
- Review and Approval process – This is recommended to be a linear sequence of actions where an applicant can receive a “no permit needed” decision or an Administrative Permit from the Environmental Panel, or a referral to the Planning Board for more critical review.
- Variable Buffer – adapt to specific site conditions accounting for different wetland types and buffering capability of the land.
- Mitigation potential – based upon wetland function capabilities of the wetland to be affected and as determined by the specific assessment procedure.

The proposed revisions have been through several rounds with the Planning Department. The latest version of the regulations can be found in Appendix ‘D’.

Watersheds

Watershed - "The whole region or area contributing to the supply of a river or lake; drainage area; catchment basin." New Webster's Dictionary.

Watersheds can vary greatly in size dependent upon the size of the watercourse or water body being considered. For the purposes of this study the Town has been divided into five watersheds. These are, from north to south:

- Peekskill Hollow Brook
- Hallock's Mill Brook
- Hunter Brook
- Croton Reservoir North
- Croton Reservoir South

Several of these have been further divided into subsheds or specific sub watersheds have identified for a specific purpose:

- Peekskill Hollow Brook - subdivided into Shrub Oak Brook and Mohegan Lake subwatersheds which discharge independently into Peekskill Hollow Brook.
- Croton Reservoir North - Saw Mill Brook subwatershed which is significant due to the inclusion of Yorktown Heights commercial/industrial center.

Hallock's Mill Brook and Hunter Brook watersheds both contribute to the Muscoot- New Croton Reservoir system. Both were deemed sufficiently significant to be evaluated separately from the more general Croton Reservoir North. Each of these watersheds has a distinct perennial central stream with several tributaries. The entire length of Hunter Brook is located within the Town, including its headwaters. The majority of the length of Hallock's Mill Brook is located within the Town as well as its principal headwaters.

The Croton Reservoir North and South watersheds differ from the other three watersheds which have a central watercourse. The reservoir is the receiving waterbody. Its tributaries are, for the most part, independent watercourses. Several of these were the subject of individual study areas. Saw Mill Brook subshed within the Croton Reservoir North watershed was singled out as being significant due to its position in the Town, its relatively large size, and that its catchment area is entirely within the Town.

The New York City water supply system is the predominant recipient of the Town's surface runoff. Slightly over 83% of the Town drainage contributes to the City's water supply. Most of this is discharged into the Croton Reservoir. Only a small area of about 170 ac., located in the SE corner of the Town, is in the Kensico River watershed to the south. Another 4,300 acres, the Peekskill Hollow watershed drains north and into the Hudson River.

Watersheds and subwatersheds were established from a variety of sources. The New York State Department of Environmental Protection (NYS DEC) digital watercourse information, as amended by Westchester County in its GIS database was further modified using Town-wide 5 ft. contour interval topography and preliminary storm drainage data made available by the Yorktown Engineering Department. Personal knowledge of the investigators and spot field checks also contributed to the watershed location determinations.

Each of the five Town watersheds studied drains about one fifth of the Town's area, minus the reservoir and Kensico River drainage. These range from the smallest, Hunter Brook at 16%, to Croton Reservoir North, the largest at 24%.

- 16% - Hunter Brook (3,926 ac.)
- 18% - Peekskill Hollow Brook (4,301 ac.)
- 19% - Croton Reservoir South (4,458 ac.)
- 23% - Hallock's Mill Brook (5,534 ac.)
- 24% - Croton Reservoir North (5,628 ac.)

Regulatory control over watershed activities is a critical planning issue. None of the studied watersheds fall entirely within the Town boundaries. Only the Saw Mill Brook subwatershed is fully under Town control. The degree of control over the five watersheds varies from 36% to 88% for the Peekskill Hollow and Croton Reservoir North watershed, respectively. The in-town portions of the watersheds are:

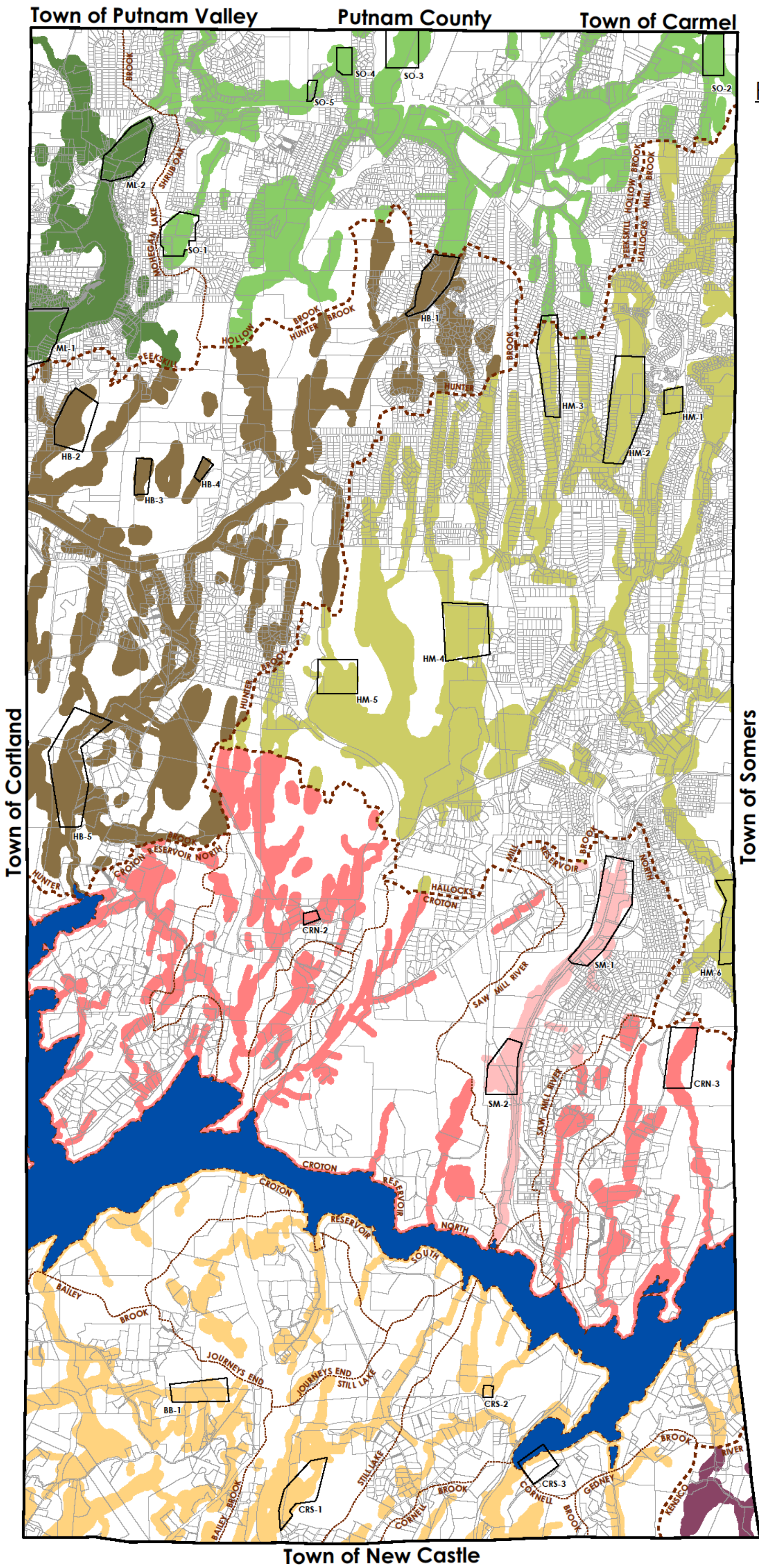
- 36% Peekskill Hollow Brook
  - 11% Mohegan Lake subwatershed
  - 51% Shrub Oak Brook subwatershed
- 56% Croton Reservoir South
- 77% Hallock's Mill Brook
- 82% Hunter Brook
- 88% Croton Reservoir North
- 100% Saw Mill Brook subwatershed

Wetlands regulations currently in effect provide the Town with a land development planning tool different from zoning. Rather than regulating the type of land use, e.g. residential, commercial, industrial, etc., or density e.g. dwelling units per acre or floor area ration, wetlands regulations control locations within specific zones where specified activities may not occur; or where they may occur with specially identified environmental precautions and mitigation.

An estimate of the Town's area that is regulated by the current Chap. 178 was made. The 2006 USDA NRSC Westchester County hyrdic soils and open water areas were used to define wetlands and waterbodies respectively. Information from the Westchetser County GIS database was used to define watercourses. The 100 ft. buffer was used as adjoining jurisdictional land. The Kensico River drainage was excluded. The resulting calculations indicate that 35% of the Town falls within the wetlands regulated areas as shown on the following Freshwater Wetlands, Chapter 178, Regulated Area plan. This percentage of regulated land varies within the watersheds and subsheds examined. The least regulated was the Saw Mill Brook subshed, 19%. The most regulated was the Mohegan Lake subshed, 41%. The following table provides the amount of regulated area in each of the catchments considered.

Town of Yorktown, New York

Freshwater Wetlands, Ch. 178, Regulated Area



Legend

Regulated Area by Watershed[1]

Peekskill Hollow Brook

- Shrub Oak Brook
- Mohegan Lake
- Hallocks Mill Brook
- Hunter Brook
- Croton Reservoir North
- Sawmill Brook
- Croton Reservoir
- Croton Reservoir South
- Kensico River
- Watershed[2]
- Sub-Watershed[3]
- Tax Lots[4]
- Study Areas[5] SO-2

[1] Modified from the the hydric soils presented in the 2006 USDA NRCS Soil Survey of Westchester County and from the NYS DEC mapping as modified in the Westchester County GIS Database.
[2] Modified from the Westchester County GIS database by reference to 5 ft countour topography and preliminary storm drain mapping provided by the Yorktown Engineering Department.
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Area Regulated by Chap. 178, Freshwater Wetlands

Watershed/Subshed	Regulated Acres	Percentage
Town	8,811	35%
Peekskill Hollow Brook	1,574	37%
Shrub Oak	1,133	35%
Mohegan Lake	441	41%
Hallocks Mill Brook	1,982	35%
Hunter Brook	1,507	38%
Croton Reservoir North	1,377	24%
Saw Mill Brook	196	19%
Croton Reservoir South	1,195	27%

These proportions of land regulated under the existing Chap. 178 are somewhat conservative. The minimum soil mapping unit is two acres in size. Hydric soil inclusions within mapped upland soils cannot be shown. Ephemeral or vernal pools are frequently found in upland sols where the period of standard water is not sufficient to produce hyrdric soil conditions. These traits of the soils maps produce an underestimation of wetland area. The watercourse data also has a relatively coarse cutoff. Many regulated intermittent streams are not taken into account. The use of more site-specific data would most likely produce more regulated area in each watershed as well as for the entire Town.

Approximately a quarter of the Peekskill Hollow Brook watershed which is included within the two subsheds studied is located in Putnam County. Practically all is part of the Shrub Oak Brook subshed. Effective land use planning for this important subshed would require close cooperation between the neighboring towns and counties.

Study areas were determined by a combination of criteria. Twenty five areas evenly distributed among five watersheds were a grant requirement. A general preference for the use of publicly owned land and a specific request for the inclusion of the wetland between Saw Mill River Road and Front Street and a site on Bailey Brook was expressed by the Town.

Study areas needed to be representative of each watershed. At the same time it was deemed important to attempt to include each of the four hydrogeomorphic wetland types within each watershed. Examples of headwaters were chosen in all watersheds. Where potential sites were available mid-course sites were chosen.

Twenty seven study areas were proposed. The following table summarizes the characteristics of each study area; its principal watershed; subwatershed, where applicable; study area designation; position within its watershed; anticipated HGM wetland types; and HGM types encountered, with order of predominance within the study area and whether function assessments were performed.

Watershed	Subshed	Study Area Designation	Position w/in Watershed	HGM Wetlands Anticipated [1]	HGM Wetland Encountered[2, 3]
Peekskill Hollow Brook	Shrub Oak Brook	SO-1	Tributary headwaters	S,D	D,S
		SO-2	Upper main stream	S	S,R
		SO-3	Tributary mid stream	S	S
		SO-4	Middle main stream	R	S,R,D
		SO-5	Middle main stream	R	R,S
	Mohegan Lake	ML-1	West end of lake	L	L,S
		ML-2	Upper mid stream	S,D	R,S,D
Hallock's Mill Brook		HM-1	Tributary dammed headwaters	S,D	S,L
		HM-2	Tributary headwaters	D	R,S,D
		HM-3	Tributary headwaters	S,R	R, S, D
		HM-4	Headwaters	D,S	S, D, R
		HM-5	Headwaters dammed	L,S	S, L, D
		HM-6	Tributary Headwaters	D,S	R, S
Hunter Brook		HB-1	Headwaters	D,S, R	S,D
		HB-2	Tributary dammed headwaters	D, S, R	D, S, L, R
		HB-3	Tributary headwaters	S	D, S
		HB-4	Tributary dammed headwaters	D, S	D, S
		HB-5	Mid stream	R, S	S, R, D
Croton Reservoir North		CRN-1	Tributary headwaters	D	Omitted
		CRN-2	Tributary upper mid stream	R, S	R, S,D
		CRN-3	Tributary dammed	S	S, L
	Saw Mill Brook	SM-1	Tributary headwaters	D, S	D, S
		SM-2	Tributary mid stream	D, S,	R, S, D
Croton Reservoir South		CRS-1	Tributary mid stream	R, S	S, R, D
		CRS-2	Tributary dammed headwaters	S, D	S, D
		CRS-3	Receiving waters	L	L, S
	Bailey Brook	BB-1	Tributary headwaters	D,S	S,R,D

1. S = sloping wetlands
   R = riverine wetlands
   D = depression wetlands
   L = Lacustrine Fringe wetlands
2. Wetland types in order of predominance
3. Wetland types for which wetland function assessments were made, i.e. $\geq$ 25% of total study area wetlands are underlined.

Peekskill Hollow Brook
This watershed has several distinguishing features which make it stand out from the other four Town watersheds. It one of the smallest watersheds, only 18% of the Town's area, exclusive of the Croton Reservoir and Kensico River drainage; second only to the Hunter Brook watershed. Just 36% of its catchment area is within Yorktown. It contains

34% of the Town's area of lakes and ponds. It also contains 16% of the Town's stream and rivers.

The wetlands within this watershed have a similar lack of consistency with the watersheds proportion of the Town land:

- 23% of Town wetlands
  - 17% Slope
  - 30% Depression
  - 33% Riverine
  - 33% Lacustrine Fringe

These wetlands figures may be distorted by the exclusive use of soils classification for the wetlands determination within an area that has been largely developed. Many formerly hydric soils have been filled and reclassified as urban soils.

The seven study areas within this watershed are across the full width of the Town and from the northern boundary to the proximity of the adjoining watersheds to the south. All four HGM wetland types were found.

The Peekskill Hollow Brook watershed has been divided into two subsheds: Mohegan Lake and Shrub Oak Brook. Previous Town studies incorrectly refer to the entire watershed as Shrub Oak Brook. Although the Mohegan Lake and Shrub Oak Brook catchments share a common watershed divide within the Town, there is no surface connection between the two watersheds prior to their separate confluence with Peekskill Hollow Brook to the north in the Town of Putnam Valley.

The Shrub Oak Brook subshed is the larger of the two. It contains 75% of the in-Town Peekskill Hollow Brook watershed. Only 19% of the subshed catchment is located within the Town. The Yorktown subshed area contains 34% of the in-Town area of lakes and ponds, 85% of the watercourses and 74% of the wetlands. The proportion of HGM wetland types found within the Shrub Oak Brook portion of this watershed area are:

- 84% Slope
- 74% Depression
- 88% Riverine
- 21% Lacustrine

The Mohegan Lake subshed contains the balance of the resources described for the Shrub Oak Brook subshed. The pond and lake area percentage is largely a product of the difference in size between Lake Osceola, 38 ac., in the Shrub Oak Brook subshed and Mohegan Lake, 102 ac., in the Mohegan Lake subshed.

The seven study areas were intended to represent the Overall Peekskill Hollow Brook watershed as well as the individual subsheds. Together these study areas, SO-1 through SO-5 plus ML-1 and ML-2, included 18% of the in-Town watershed and 77% of the total watershed. All four HGM wetland types are represented at the following proportions:

- 35% Slope (36.7ac.)
- 18% Depression (19.4ac)
- 20% Riverine (21.1ac.)
- 21% Lacustrine (28.0ac.)

The wetland function capacity assessments performed on these seven study areas follow the guidelines set forth in the manual. In order to be assessed individually, a wetland area must be at least 25% of the total wetland area being evaluated. Consequently, several areas were not assessed separately, but combined with the nearest wetland type. Approximately 0.5 ac. of depression wetland in study area SO-4, 0.4 ac. of slope wetland in study area SO-5, 1.5 ac. of slope wetland in study area ML-1 and 3.7 ac. of depression wetland in study area ML-2 were combined with adjoining wetland types. The following watershed plan presents the eleven sets of graphs, grouped by study area, illustrating how each of the wetland types generally has above average capabilities to perform at least seven of the eight wetland functions.

Slope type wetland are uniformly well above average in the function of Modifying Groundwater Discharge. This is a reflection of the prevalent glacial till soils with a frangipan layer. This produces a seasonally perched water table which surfaces in the form of seeps. The presence of seeps and springs is a direct indicator of this wetland function.

Flood and Stormwater Storage capability is generally below average in the slope wetlands assessed. This is due to the relative steepness, greater than a 2% gradient, of the sloping wetland present. This has the effect of greatly reducing the storage potential as runoff flows through the wetland more rapidly than it does through nearly flat sites.

Depression wetlands were found in three of the seven study areas, but only assessed in one area, SO-1. The presence of deep organic soils underlying this wetland type in this watershed prevents any significant groundwater exchange, although seeps were found in on depression type wetland in study area ML-1.

Riverine wetland types within the study area scored well above average for the ability to Modify Water Quality. This appears to be due largely to the presence of sediment deposits present in almost all of the riverine wetlands.

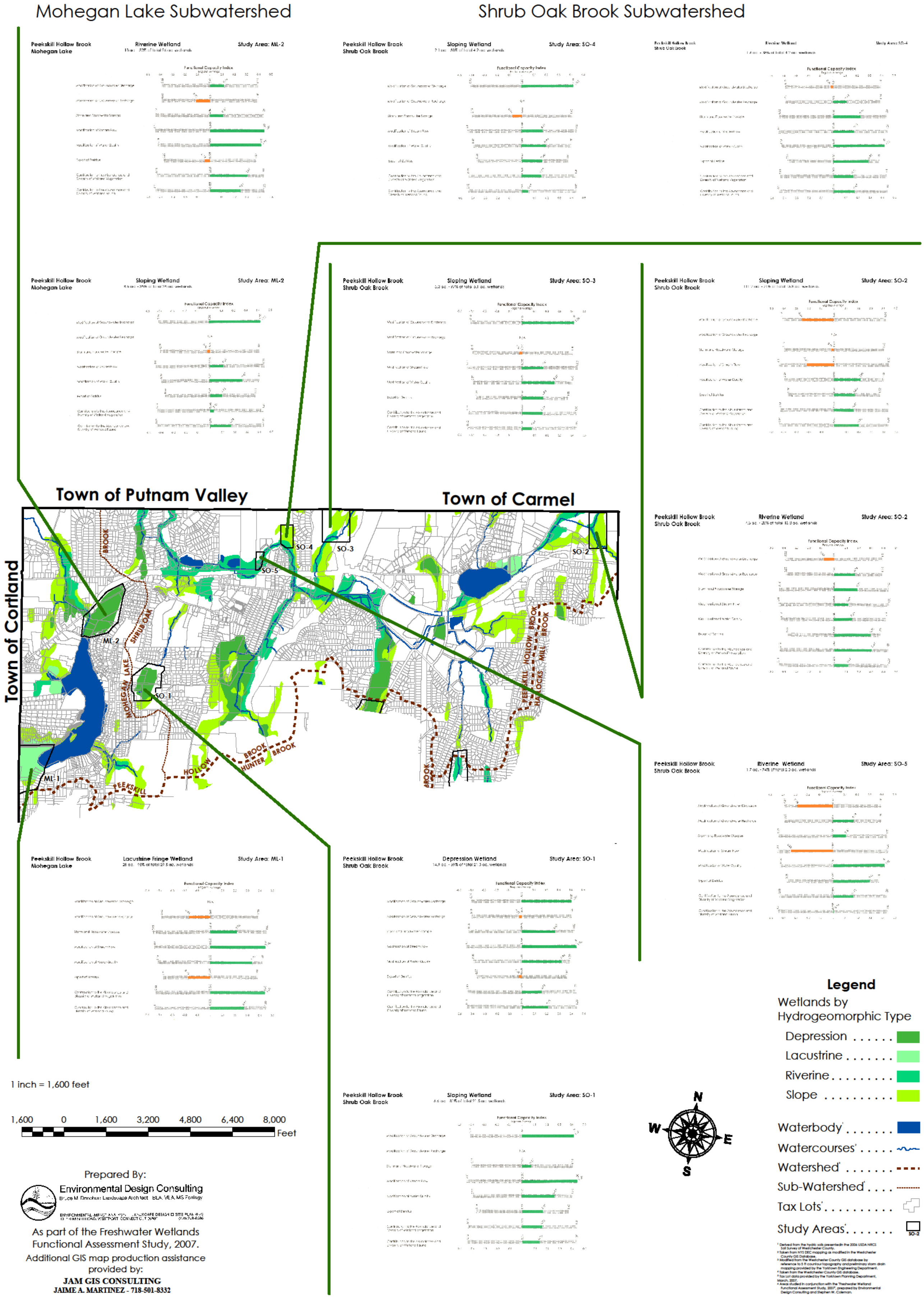
The capability of the riverine wetlands in the middle reaches of their respective watercourses to Modify Stream Flow and Storm and Floodwater Storage appears to be unusually high. Typically these functions decrease proportionately as the watercourse increase in size relative to the adjoining wetlands. These above average capabilities may be due to a common combination of low gradient wetlands with fluctuating water levels with high density vegetation and frequent flooding characteristics.

Lacustrine type wetlands were only found in study area ML-1, at the west end of Lake Mohegan. These wetlands have very high capabilities of performing all but two of the evaluated functions. The underlying deep organic muck soils prevent any substantial water exchange between surface waters and the permanent regional water table.

Town of Yorktown, New York

Wetland Functional Assessment Study

Peekskill Hollow Brook Watershed



The Export of Detritus is predictably below average. The water flow regime in this type of wetland is generally back and forth from normal shoreline to flood line and up and down as the water level rises and falls. Neither water motion generates lateral flow to move significant amounts of detritus out of the Lacustrine fringe wetland.

Land development differs substantially between the two subwatersheds. The Shrub Oak Brook parallels Rt. 6 and Mill Street. Both are important and heavily trafficked thoroughfares. Rt. 6 is a combination of old and new roadways along which substantial commercial development has occurred. It is one of three such areas in Town and second only to Yorktown Heights in size. Newer commercial development centers around the Jefferson Valley area east of the Taconic State Parkway. The Shrub Oak hamlet is an older community center, complete with churches, schools and library as well as retail businesses. This occurs primarily along East Main Street, the original 'Rt. 6'.

Mohegan Lake watershed has its own Rt. 6 commercial area, but it has been almost fully developed residentially. Originally as small seasonal cottages oriented to Mohegan Lake. The building lots are small, providing some of the densest single family detached neighborhoods in Town.

Future planning efforts should recognize the different forms of development prevailing in each of these watersheds. This will be made more complicated by the amount of the watershed, 81% for the Shrub Oak Brook subshed, which is located in other municipalities.

Hallock's Mill Brook
This watershed occupies the east central third of the Town north of the reservoir. It spans the eastern Town boundary from Rt. 6 in the north to the Hanover-Hilltop Farm in the south. It extends west to the Wilkens Farm. It contains headwaters wetlands as diverse as the NYS DEC wetland A-2, just south of Rt. 6, Mohansic Lake and Golf Course in the west and NYS DEC wetland A-22, south of BOCES Access Road. The in-Town watershed area is 23% of the Town's area.

Hallocks Mill Brook watershed contains over 7,200 ac. of which 5,534 ac, 77%, are located within the Town. The Town's portion of the watershed contains 22% of the Town's streams and 36% of its area of lake and ponds. This latter figure is exclusive of the Croton Reservoir and Kensico River watershed, but does include Mohansic Lake and Crompond, which together make up 141 ac. of the watershed's 178 ac. of waterbodies.

Wetlands constitute 19% of the in-Town watershed. These in turn are made up of the following HGM wetland types and their respective proposition of the total watershed wetlands.

- 44% Slope (507 ac.)
- 23% Depression (238ac.)
- 20% Riverine (203 ac.)
- 9% Lacustrine (92 ac.)

Six study areas were chosen to represent this watershed. They are designated HM-1 through HM-6. Together they contain 51% of the in-Town Hallocks Mill Brook watershed but only 14% of the wetlands. The watershed percentage is inflated by the inclusion of the full Lacustrine watershed for two large waterbodies, Mohansic Lake and Crom Pond. The Mohansic Lake watershed is substantial in size. These two Lacustrine watersheds contribute 21%.

The 150 ac. of study area wetlands are comprised of:
- 40% Slope (61 ac.)
- 17% Depression (25 ac.)
- 38% Riverine (57 ac.)
- 5% Lacustrine (7 ac.)

The representative intent of the study areas is a mixed success. The proportion of wetland to upland is similar, 19% for the full watershed and 14% for the study area watershed. There is only a range of similarity between distributions of HGM wetland types. Slopes account for the largest portion of wetlands and Lacustrine the least. This apparent disparity may be more a product of the remote determination of HGM types than a bias due to the choice of study areas.

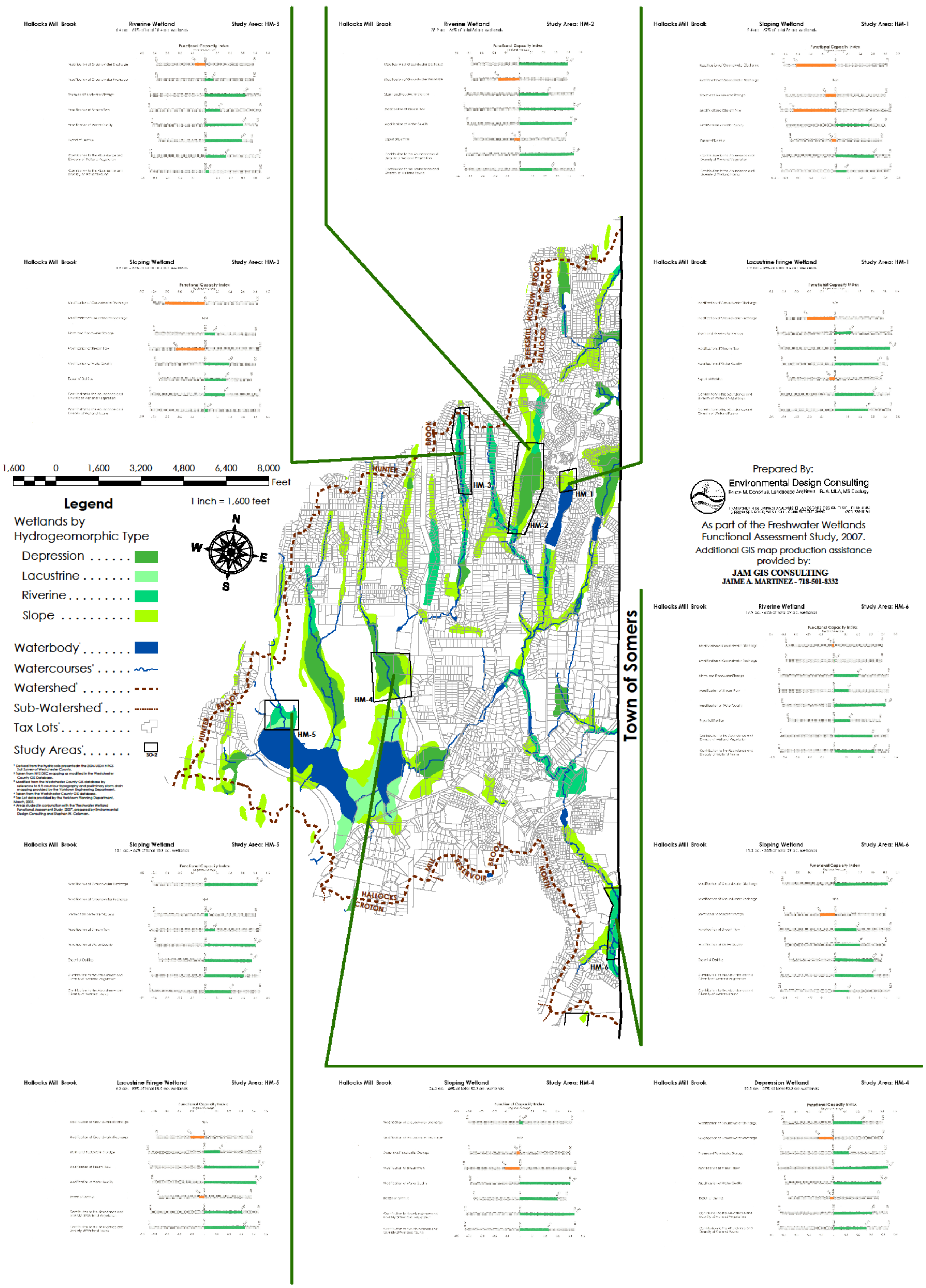
The Hallocks Mill Brook watershed is illustrated in the previous page along with their respective study areas. The graphic representations of the wetland Function Capability Index (FCI) scores as they relate to the average scores of similar wetlands in the region are also shown.

The wetland function capacity assessments were performed on these six study areas following the guidelines established in the manual. Consequently, four wetland areas, three depression types and one riverine, were not assessed separately. Only wetland types that are at least 25% of the studied wetlands are assessed individually; if less, they are included with the nearest wetland type that does exceed this threshold.

The extend to which these six study areas are characteristic, the assessments of the wetland function capacity of the Hallocks Mill Brook watershed are generally very good. Especially high FCIs were found for the Modification of Stream Flow and Water Quality. Contributions to the Abundance and Diversity of Wetland Vegetation and Fauna are generally high.

Not all wetland function capabilities were found to be above the regional average. Groundwater Recharge and Storm and Floodwater Storage and the Export of Detritus capabilities were frequently found to be low. This is due to a combination of existing conditions. The most dominant wetland type is Slope with a high gradient, greater than 2%. Consequently, the residency time of surface runoff is relatively short, resulting in little detention. Deep muck soils generally underlay the low gradient wetlands of this watershed. Consequently, where runoff is detained for any significant time, it is unable to be transmitted through this low permeability soil.

Town of Yorktown, New York
Wetland Functional Assessment Study
Hallock's Mill Brook Watershed



Planning, implementation and enforcing the efforts in the future could conscientiously work to provide protection for existing levels of wetland functions and seek improvements wherever feasible. Wetlands adjacent to and downstream from commercial, industrial and institutional development appear to be subjected to a greater accumulation of urban debris as well as encroachment. The debris and encroachment associated with residential development tended to be limited to yard expansion and yard waste deposition. Wetlands immediately downstream from roads generally have noticeable sediment deposits in watercourse beds and flooded areas. The most likely sources are storm drain discharges from roads.

Planning

- Decrease allowable land use intensity, impervious surface increase, increase in runoff.
- Revise existing Town regulations for stormwater management and erosion control to match State standards.
- Create overlay zone to accentuate the preservation of the existing high water quality and stream flow functions and improve Groundwater Recharge and Storm and Floodwater Storage functions.

Implementation

- Approved limited use wetlands and buffers are set as deed restrictions
- Limits of development within properties are physically monumented to avoid future disputes
- Staged development be disallowed within wetland regulated areas, e.g. backyard swimming pools in buffer areas.
- Approved development should reflect all reasonable potential needs of the intended land use, e.g. residential lots should have usable outdoor space with an appropriate relationship to the residence.
- Base stormwater management minimum requirements on site specific testing as described in the NYS Stormwater Management Design Manual.

Enforcement

- Rigorously control Limits of Disturbance lines established during the permit process.
- Follow through with annual inspections during warrantee period. Utilize on-site inspections to detect nearby unapproved infringements.

Hunter Brook

This is the smallest of the five major Town watersheds. It is approximately 4,797 ac. in size, 82% of which are located in Town. The remainder is to the west in the Town of Cortlandt. The Town's portion of the watershed is roughly triangular in shape. The northern line of the watershed enters from Cortlandt just south of Mohegan Lake. From these it continues in an easterly direction to the vicinity of Quinlen Road near Court Street and Radcliffe Drive. From here the watershed line proceeds in a generally south westerly direction to the intersection of Baptist Church and Hunter Brook Roads, near the north shore of the Croton Reservoir.

The Hunter Brook watershed located within the Town occupies 16% of the Town's five major watersheds, with the areas of the reservoir and the Kensico River drainage deducted. This part of Town contains:

- 4% of the Town's area of ponds and lakes, as determined by the 2006 NRCS soil survey
- 16% of the Town's streams, as determined from the Westchester County GIS data base.
- 24% of the Town's wetlands as determined by hydric soils.

Only three of the four HGM wetland types occur in these 782 ac. of wetlands:

- 77% slope (603 ac.)
- 7% depression (53 ac.)
- 16% riverine (127 ac.)

The study areas were intended to represent their watersheds. These five study areas, HB-1 through HB-5 collectively include 89% of the in-Town portion of the Hunter Brook watershed, but only 8% of the watershed's wetlands. This apparent disparity is due to the sequential nature and positions of the study areas within the watershed. Study areas HB-1 through HB-4 are located high in the watershed with little or no wetland area upstream. HB-5 is located along Hunter Brook, near the reservoir. Consequently, most of the Hunter Brook wetlands fall within its watershed, but were not included within the study area.

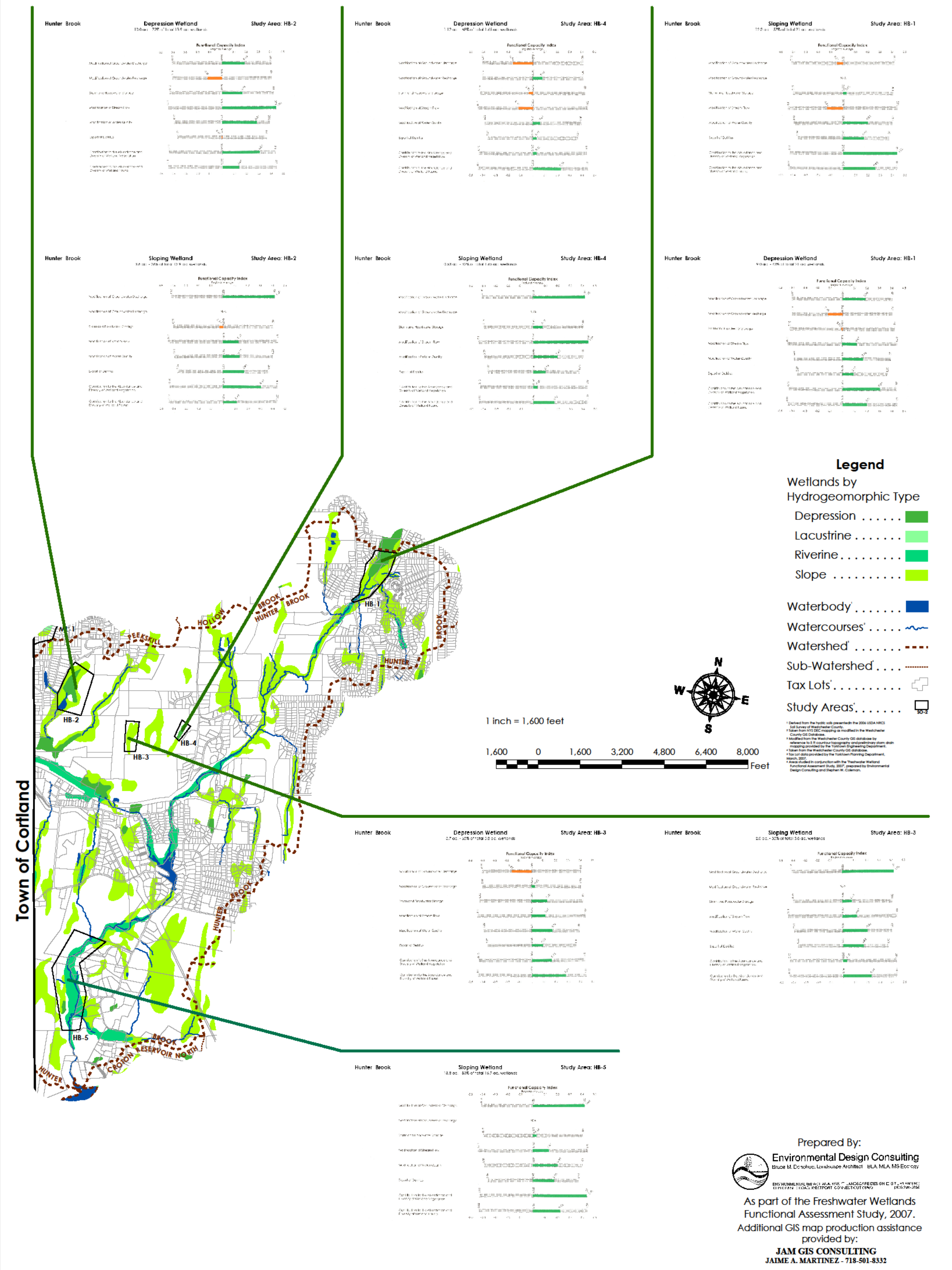
The 59 acres of study area wetlands contain all four HGM wetland types:

- 54% slope (32 ac.)
- 44% depression (23 ac.)
- 5% riverine (3 ac.)
- >1% Lacustrine (0.4 ac.)

The wetland functions capacity assessments performed on the wetlands of the five Hunter Brook study areas followed the guidelines set forth in the manual. HGM wetland types which do no comprise at least 25% of the wetland under investigation are not evaluated separately. Their field data is combined with the nearest qualifying wetland type and are jointly assessed for wetland function capacities. Consequently, four of the thirteen distinct HGM wetland areas found were too small to be evaluated separately HB-2 study area has both Riverine and Lacustrine Fringe wetland types not evaluated independently. HB-5 has both Depression and Riverine wetlands types not treated separately from the predominant slope wetland type.

The Hunter Brook watershed is illustrated on the following page along with their respective study areas. The graphic representations of the wetland Function Capability Index (FCI) scores as they relate to the average scores of similar wetlands in the region are also shown.

Town of Yorktown, New York
Wetland Functional Assessment Study
Hunter Brook Watershed



The FCI scores for these study areas are generally above the respective regional averages. Some functions scored well above while others were below average. The lower scores are likely to be a product of the headwaters locations of study areas HB-1 through HB-4. These are situated at the end of wetland/watercourse systems and do not having an upstream connection. This condition lowers the calculated FCI for Contributions to Abundance and Diversity of Wetland Vegetation and Fauna, despite the relatively undeveloped nature of watershed. On the other hand, these headwaters wetlands provide for the maintenance of downstream base flow and the maintenance of perennial streams. Groundwater Recharge capability generally was also found to be below average. This is a product of the relatively steep gradient, greater than 2%, of these areas and the low permeability deep muck soils underlying the two largest areas, HB-1 and HB-3.

The wetlands of the lower reaches of Hunter Brook, as represented by study area HB-5, maintain well above average levels of Contribution to the Abundance and Diversity of Wetland Vegetation and Fauna. Although present throughout this study area, the Riverine type wetlands are consistently very narrow, apparently the result of a relatively rapid process of entrenchment that leaves old stream-side flood plains as terraces elevated above the current stream flood levels. The result is a below average capability for the Modification of Stream Flow.

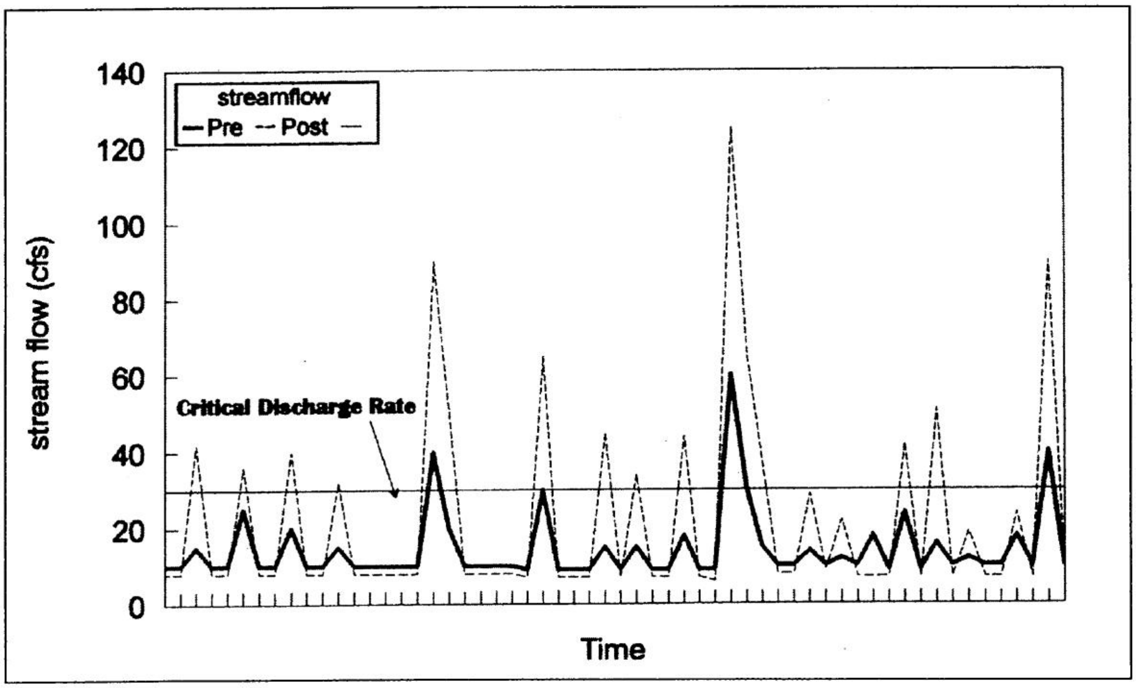
Planning efforts in the future should take advantage of the existing beneficial characteristics of the Hunter Brook watershed.

- The entire length of Hunter Brook is within the Town
- 82% of the watershed is within the Town boundaries
- Open Space and infrastructure land includes approximately two thirds of the five miles of water course, the east branch being the longer of the two.
- Undeveloped land includes many large parcels.
- Development has been predominantly residential, with the exception of the Rt. 202-35 commercial corridor.

In short, this natural resource remains relatively intact and control over most of the contributing catchment area is within the ability of the Town.

Planning efforts should emphasize the preservation of the existing hydrology. Urban development and the accompanying increased impervious surface and piped storm drainage tends to produce a 'flashy' hydrology. A larger proportion of rainfall runs off due to increased impervious surfaces and other changes in ground cover which produce more surface runoff, such as lawn replacing woodland. This effectively reduces the amount of rainfall that is absorbed into the ground. This, in turn, reduces the groundwater available to maintain stream flows and pond levels between runoff events. The increased volume of runoff also creates downstream channel erosion. Without runoff management post development stream flow more frequently exceeds the critical rate of flow at which erosion begins, as shown in the following diagram.

Increased Frequency of Erosive Velocities After Development



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Stormwater management practices limited to no increase in pre-development peak flow rates may not increase the number of runoff events that exceed critical erosion velocity but will increase the duration of each such event that does occur. Stormwater management methods that minimize the adverse effects of development could be emphasized in the regulations and their application vigorously pursued by the permitting authorities.

Open space acquisition along the stream should be a priority. Future additions to the existing public lands should have two essential characteristics. It should be suitable for a pedestrian trail and it should offer privacy, both visual and physical both from and to adjoining land use, most of which will be residential.

The reviewing and permitting authorities could develop procedures which would remain sufficiently flexible to be able to respond appropriately to conservation efforts that would contribute to the stated goals of the overlay zone.

<u>Planning</u>

- Revise development standards to include criteria that would reduce disturbance to sensitive natural resources
  - Use a net minimum building lot size that deducts disturbance-sensitive areas, such as wetlands, all or part of wetland buffers, steep slopes, major rock outcrops.
  - Require a Tree Preservation plan which details a variety of tree protection techniques and which establishes a replacement value for each tree that is to

1 NYS Stormwater Management Design Manual, August 2003

remain according to the approved site development but which is subsequently severely damaged or removed.
  - Require a building specific site plan which includes an earth work balance or written statement of disposition of any excess volume, or volume unsuited for fill needed, e.g. blasted rock from foundation excavation is unsuitable for septic field or lawn area fill.
- Review and revise all environmental regulations and bring them into conformance with existing and future versions of NYS DEC Phase II standards, especially ch. 248, Stormwater Management and ch. 165 Erosion and Sediment Control. Current regulations do not fully utilize the standards set forth in the "New York State Stormwater Management Design Manual, August 2003" and the "New York State Standards and Specifications for Erosion and Sediment Control", respectively.
- Town Master Plan and Open Space plans should indicate the intention of the Town to acquire land through a combination of dedication, easement or permission, and to construct and maintain a drainage basin wide system of trails and wildlife refuge land for the use and enjoyment of residents, both human and animal.
- Create a Conservation Overlay zone for the Hunter Brook watershed that would modify the applicable land use regulations in order to achieve development goals specific to the watershed. Such goals might include:
  - Continuous riparian protection from development
  - Trail system from the reservoir to Shrub Oak with connector trails, eg. to Franklin D. Roosevelt State Park, Sylvan Glen Park Preserve, and Shrub Oak Brook.
  - Continuous wildlife corridor interspersed with larger tracts of a broad range of wildlife habitats, from open field and marsh to hardwood forest and swamp.
  - Maintain and enhance the aquatic habitats of Hunter Brook, including its trout fishery.
- The mechanics by which recreation fees and open space lands are acquired by the Town could be revised, at least within an overlay zone.
  - Land specifically identified to meet specific goals would take precedence over fees or even larger, but less suitable land.
  - Open Space land improvements should be to Town-specified standards e.g. walking trails, bicycle paths, stream and wetland crossings.

The reviewing and permitting authorities could develop procedures which would remain sufficiently flexible to be able to respond appropriately to conservation efforts by property owners that would contribute to the stated goals of the overlay zone.

<u>Implementation</u>

- Planning Board Should develop standard procedures for encouraging future land development to include protection of highly valued natural resources from the initial pre-application design phase.
- Approved limited use wetlands and buffers are set as deed restrictions
- Limits of development within properties are physically monumented to avoid future disputes
- Staged development be disallowed within wetland regulated areas, e.g. backyard swimming pools in buffer areas.

- Approved development should reflect all reasonable potential needs of the intended land use, e.g. residential lots should have usable outdoor space with an appropriate relationship to the residence.
- Base stormwater management minimum requirements on site specific testing as described in the NYS Stormwater Management Design Manual.

Enforcement

- Rigorously control Limits of Disturbance lines established during the permit process. Follow through with annual inspections during warrantee period. Utilize on-site inspections to detect nearby unapproved infringements.

Croton Reservoir North (CRN)

The area of Town north of the reservoir to a latitude of the Yorktown Heights commercial district, exclusive of the Hunter Brook watershed, has been designated the Croton Reservoir North watershed. This area conveys runoff to the remaining body from 11 subwatersheds[1] via watercourses of varying reliability.

The Croton Reservoir North watershed, including the Saw Mill Brook subshed is 5,628 ac., 22% of the Town area. Within this watershed are: 13 percent of the Town's wetlands as determined by the hydric soils of the 2006 NRCS soil survey.

- 4% of the Town's waterbodies, as determined by the 2006 NRCS sol survey
- 24% of the Town's streams

All four of the Town's HGM wetlands types are included within the 445 acres of wetlands in this 5,628 ac. watershed.

- 79% slope (354 ac.)
- 16% depression (73 ac.)
- 4% riverine (17 ac.)
- >1% Lacustrine (1.4 ac.)

The study areas were intended to represent their watersheds. Collectively, these four study areas, CRN-2, CRN-3, SM-1 and SM-2, included 19% of the in-town watershed and 15% of the watershed wetlands. All four HGM wetland types were found within the study areas at the following proportions:

- 26% slope (17ac.)
- 44% depression (29 ac.)
- 30% riverine (20 ac.)
- >1% Lacustrine (0.3 ac.)

[1] Subwatersheds were taken from the NYS DEC watercourses as amended by Westchester County in tis GIS database and were further modified by the Yorktown 5 ft. contour interval topography and preliminary storm drainage data made available by the Engineering Dept.

The two study areas within the Saw Mill Brook subwatershed included 18% of the watershed and 23% of the watershed wetlands. The HGM wetland types comprising this wetland are:

- 23% slope
- 48% depression
- 30% riverine

The representative nature of the wetlands studied is mixed. A comparison of the data generated, the proportion of wetland to watershed, is a good match. Saw Mill Brook wetlands studies are 18% of the contributing subwatershed. The Croton Reservoir North combined study areas comprise 15% of the watersheds wetlands. However, the relative proportions of the HGM wetland types within the combined study areas differ from those found throughout the watershed. This is a reflection of the difference in definition between on-site investigation and inferred definition based upon soils, aerial photographs and coarse topography.

The wetland function capacity assessments performed on these four study areas followed the guidelines set forth in the manual. Consequently, the Lacustrine Fringe wetland type present in study area CRN-3 was not assessed separately. Similarly, study area SM-1 has both slope and depression wetland types, as well as riverine, but neither is present within the study area at 25% or greater proportion of the wetlands assessed. The following six sets of graphs illustrate how each of the wetland types, regardless of location, generally have above average capabilities to perform seven of the eight wetland functions.

Slope type wetlands fall below average in their ability to provide the storm and floodwater storage function. This is caused by the relatively steep terrain associated with these wetlands. More gently sloping land would be more capable of providing a greater amount of this function.

Riverine wetlands offer both above average and below average capability to Modify Groundwater Discharge. The very high capability index score attained in the assessment for riverine type wetlands is a result of lumping the slope wetlands into the riverine due to the less than 25% rule. There are several springs located within the slope wetland areas.

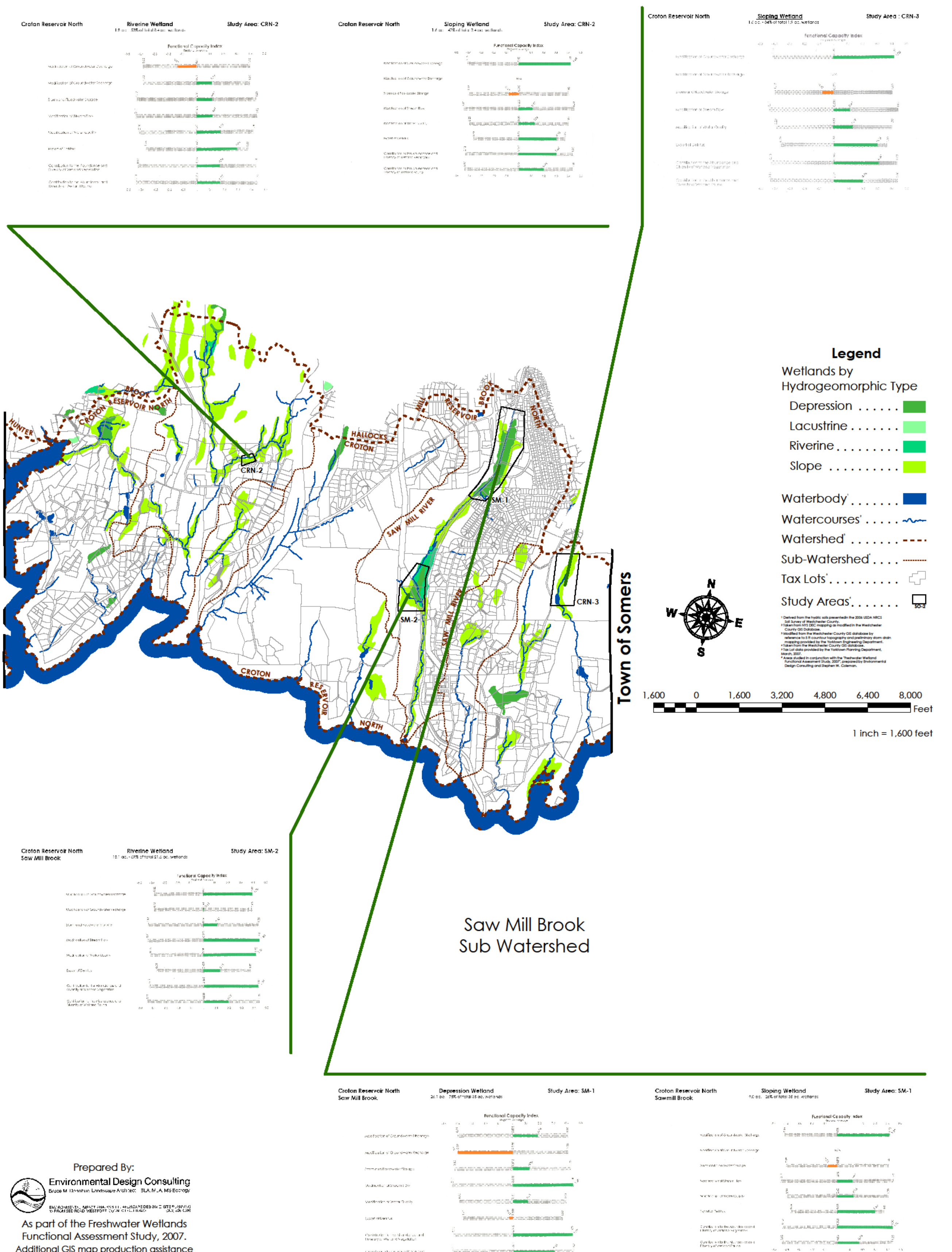
Depression wetlands assessed in study area SM-1 appear to have below average capability for the capability to Modify Groundwater Recharge and the Export of Detritus. The capability to modify groundwater discharge was eliminated by the lack of a perennial inflow stream and the presence of a perennial discharge stream. This infers that there are springs in the permanently flooded areas. However, because they were not observed, they do not have the affect of improving the Groundwater Discharge index score. The low Export of Detritus score is a product of the restricted outflow from this basin of permanently flooded, highly organic soil.

Several of the wetland function capabilities of the study areas assessed, and presumably of the watershed as a whole, are well above average. The Modification of

Town of Yorktown, New York

Wetland Functional Assessment Study

Croton Reservoir North Watershed



Prepared By:
Environmental Design Consulting

As part of the Freshwater Wetlands Functional Assessment Study, 2007.
Additional GIS map production assistance provided by:
JAM GIS CONSULTING
JAIME A. MARTINEZ - 718-501-8332

Groundwater Discharge is especially important to the maintenance of stream base flows and pond water levels between rainfall runoff events. This high potential for the Export of Detritus are important for the contribution to downstream food chains.

Contributions to the Abundance and Diversity of Wetland Flora and Fauna are also high. This is due in large part to being interconnected with other wetlands. Such areas of highly diverse and dense vegetation often harbor unusual species; some which inhabit wetland ecosystems, others for which the wetland environment is essential to part of their life cycle.

Future planning efforts to preserve and enhance specific wetland functions within the Croton Reservoir North watershed cold occur in several areas. The perennial watercourses are relatively small and short. They have a broad range of flow rate.

The capability to Contribute to the Abundance and Diversity of Wetland Vegetation and Fauna area also high. This is due in part to being interconnected with other wetlands. Such areas of highly diverse and dense vegetation often harbor unusual species. Some of these may require the wetland ecosystems. For others wetlands may be essential to part of their life cycle, either as breeding grounds or as migration way stations.

Planning efforts to preserve or enhance specific wetland functions within the Croton Reservoir North watershed should recognize the strengths and weaknesses of the existing conditions. The perennial watercourses are relatively short, with correspondingly small subwatersheds. They experience broad ranges of flow between storm runoff and the intervals between runoff events. Catchment areas completely within the Town are free of outside influences. Wetland functions that could be supported by regulation, application and enforcement are:

- Groundwater Recharge and Discharge
    - Dampen volatility of stream flows
    - Reduce flash-flow erosion of dry streambeds
    - Maintain aquatic habitats
- Storm and Floodwater Storage and Modification of Stream Flow
    - Reduce flash flows
    - Reduce flooding
    - Increase runoff holding time in wetlands where feasible without possibility of adversely affecting wetland habitats
- Water Quality
    - Protect NYC water supply
    - Reduce industrial/commercial pollutants overtaxing natural cleansing capacities of wetlands
- Contribution to Abundance and Diversity of Wetland Vegetation and Fauna
    - Secure buffers
    - Protect and increase interconnection of wetlands
    - Permanently protect wetlands and watercourses

Croton Reservoir South
The Town land south of the Croton Reservoir is generally referenced as the Croton Reservoir South watershed. There are 170 acres in the SE corner which drain to the Kensico River rather than the Croton Reservoir.

The Croton Reservoir South is the median size of the five Town wetlands. It occupies 19% of the Town's five major watersheds, not including the reservoir and the Kensico River catchment. Approximately 7,986 ac. drains into the Yorktown portion of the south shore of the reservoir. However, only 56%, 4,458 ac., of the entire drainage basin lies within the Town.

This part of Town contains:
- 17% (350 ac.) of the Town's wetlands
- 21% (23 miles) of the Town's watercourses
- 21% (101 ac.) of the Town's area of lakes and ponds

All four HGM wetland types are found in this watershed. Their proportions of the watershed wetlands within the Town are;

- 63% Slope (219 ac.)
- 16% Depression (58 ac.)
- 20% Riverine (69 ac.)
- 1% Lacustrine Fringe (4.4 ac.)

The Croton Reservoir South watershed is similar in nature to the Croton Reservoir North watershed. It lacks a central perennial watercourse. It consists of approximately nine sub-sheds of various sizes. Seven have a principal watercourse. The remaining two are small narrow watersheds bordering the reservoir. These discharge runoff from several small intermittent watercourses. These subsheds vary in size from 1,760 ac., Bailey Brook, to 181 ac, a small shoreline watershed between Journey's End and Still Lake subsheds.

Four study areas were chosen to represent this watershed. Each study area is located in a separate subshed. One, CRS-3, is located on the shoreline of the reservoir. The other three are located in subsheds with a central perennial watercourse.

Combined, these study areas include 8%, 376 ac., of the contributing in-Town portion of the Croton Reservoir South watershed and 10% of its wetlands. All four HGM wetlands types occur within the study areas in the following proportion:

- 61% Slope (21.3 ac.)
- 5% Depression (1.8 ac.)
- 33% Riverine (11.5 ac.)
- 1% Lacustrine Fringe (0.4 ac.)

The wetland functions capacity assessments performed on these four study areas follow the guidelines set forth in the manual. In order to be assessed individually, a wetland type had to be at least 25% of the total wetland area being evaluated. Consequently, two areas of Depression wetlands, occurring in study areas BB-1 and CRS-1, were not evaluated separately. These areas were combined with the adjoining Riverine wetlands for the functional assessments. The following plan of the Croton Reservoir South watershed shows the location of the four study areas and the graphed results of the wetland function assessments. The full Inventory Data sheet, Characterization of Model Variables, and results graphed relative to the regional mean for each wetland function capacity assessed are found in Appendix A.

The FCI scores for these four study areas are much more irregular than generally found in the other watersheds. Although generally above the regional averages for most wetland function capacities, the Storm and Floodwater Storage function falls below average in six of the eight HGM wetlands evaluated. The capacity to Modify Groundwater Discharge and Stream Flow were also below the regional average. These sporadic results are most likely a product of each study area representing an isolated and frequently small segment of entirely different watersheds. As a group they illustrate the diversity of wetlands to be found in the watershed. Wetland BB-1 is a middle reach wetland located in an old failed man-made pond on a Bailey Brook tributary. CRS-2 is a semi-landscaped wetland adjoining, but not flowing into, a man-made pond. An old farm truck creates the Depression wetland area and seepage from the pond contributes to one are of Slope wetlands. Both of these CRS-2 wetlands are tributary to the principal subshed stream. CRS-1 is a middle reach wetland complex along the central subshed stream. CRS-3 is along the edge of the receiving Croton Reservoir. Its only watercourse is a road storm drain intermittent discharge.

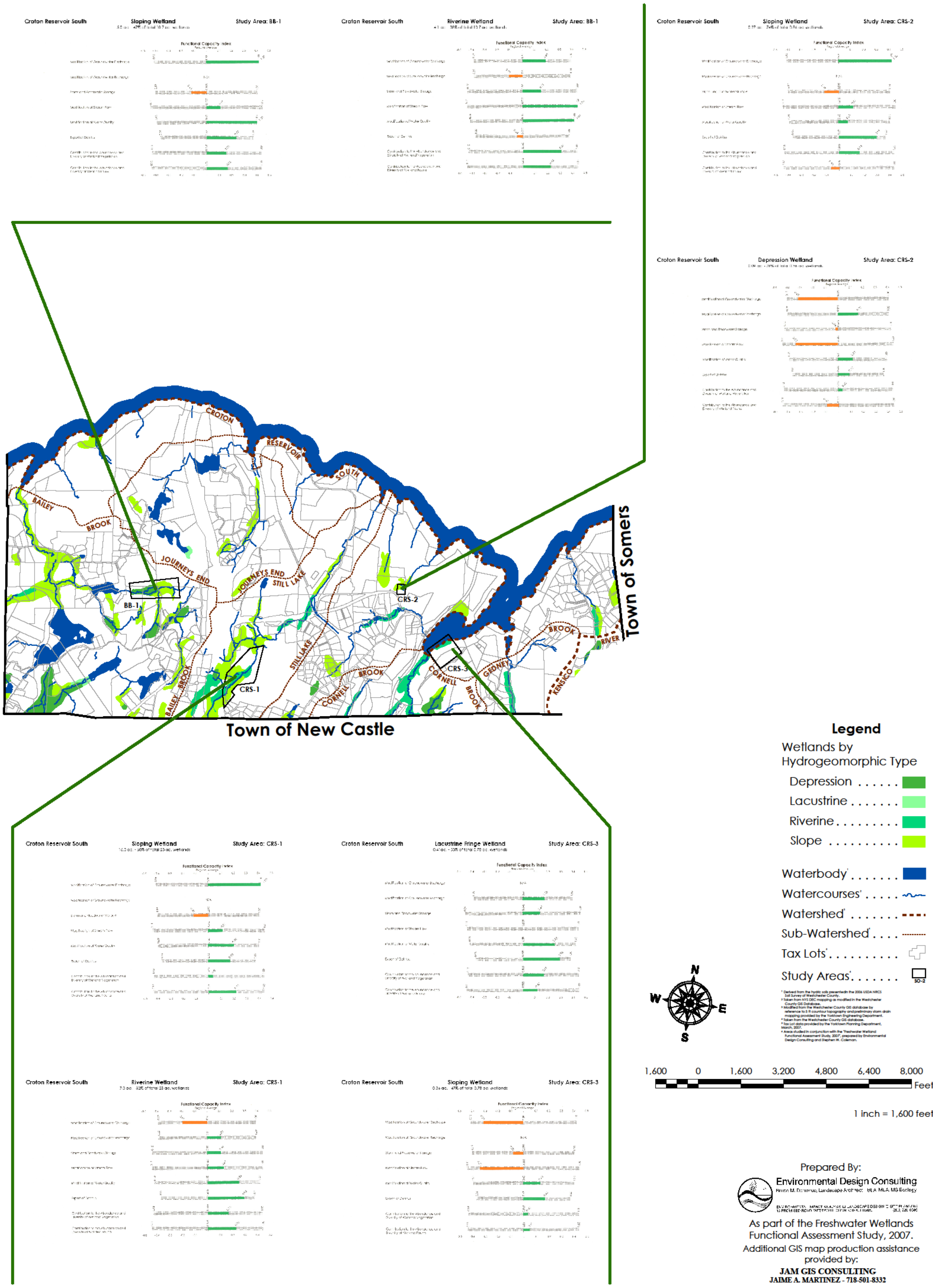
Planning efforts in this watershed should actively protect the high quality of several of the subsheds. The Bailey Brook subshed, including study are BB-1, is already protected as part of the Teatown Reservation. The lower two thirds of this subshed are in Yorktown. The entire drainage area passing through study area BB-1 is located in the Town. Although substantially protected by the Teatown Reservation, adjoining land use activities are inhibiting the natural ameliorating effects of buffer areas and contributing pollutants to the surface runoff. At this time corrective enforcement of the existing regulations should be adequate to remedy the existing situation.

The Still Lake subwatershed is three-quarters within the Town. The middle reaches, where study area CRS-1 is located, is currently protected by conservation easements on the IBM property. The lower end of the subshed is protected as NYC DEP property, and lands of the Brooklyn Botanical Garden Research Center at Kitchawan.

Town of Yorktown, New York

Wetland Functional Assessment Study

Croton Reservoir South Watershed



Appendix A
Wetland Inventory Data and Functional Capacity Index calculation forms & graphs

Appendix B
Summary Graphs, Wetland Inventory Data and Functional Capacity Index calculation forms for study areas

Appendix C
Sample Wetland Assessment Report (SO-2)

Appendix D
Final Draft Revised Wetland Regulations
(bound separately)