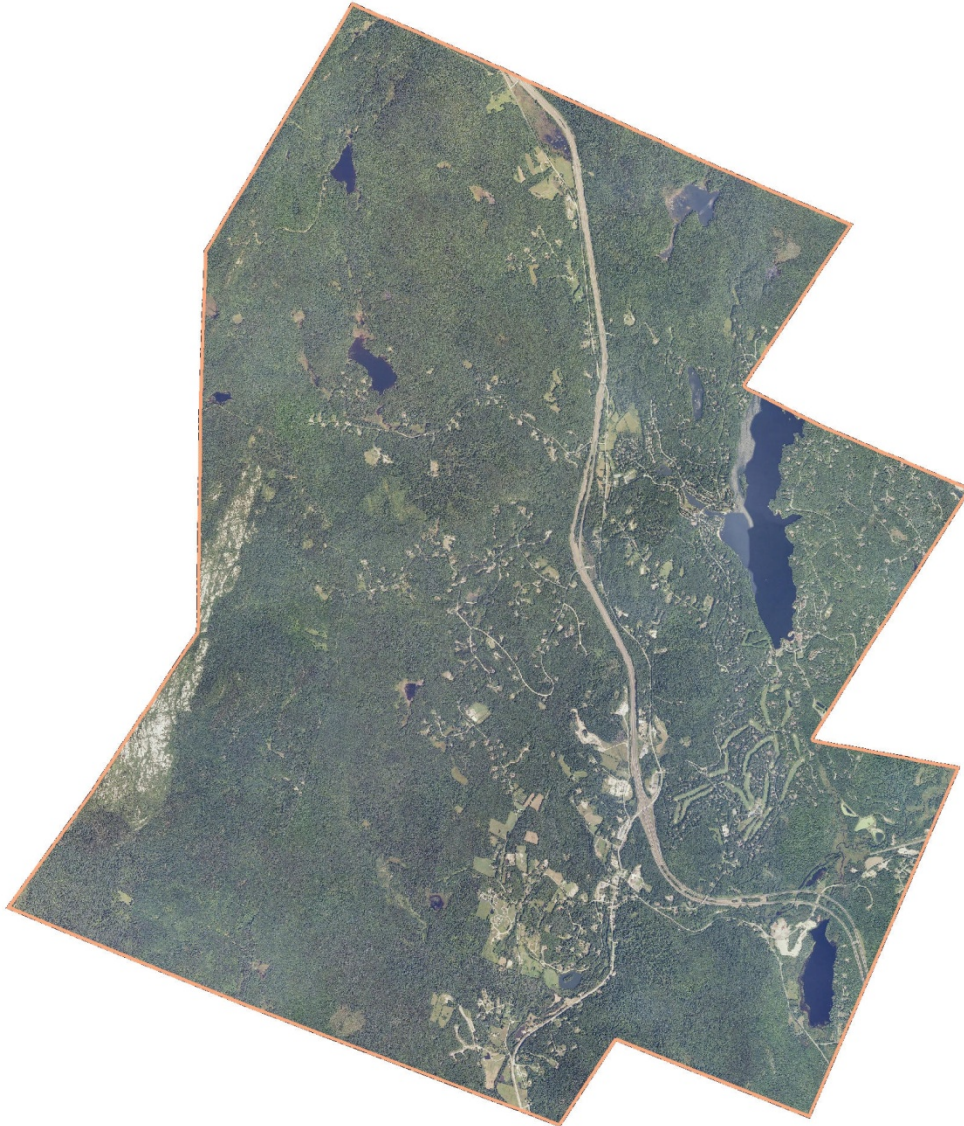


GRANTHAM WETLAND INVENTORY & ASSESSMENT PROJECT

FINAL REPORT

Submitted to the Grantham Conservation Commission



Rick Van de Poll, Ph.D.
Ecosystem Management Consultants
30 N. Sandwich Rd.
Center Sandwich, NH 03227
603-284-6851
rickvdp@gmail.com

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CONTENTS

<i>Executive Summary</i>	<i>i - iv</i>
<i>Acknowledgments</i>	<i>v</i>
I. Overview & Purpose	1
II. Methods	3
A) Project Coordination	3
B) Remote Resource Review	3
C) Roadside Surveys & WEU Identification	5
D) Off-road Surveys	5
E) Wetland Assessment	8
F) Data Analysis & Assessment	9
III. Results / Discussion of Findings	12
A) General Findings	12
B) GIS Data Summary	14
C) Roadside Surveys & WEU Identification	16
D) Off-road Surveys	20
E) Wetland Assessment	21
F) Designation of Prime Wetlands	22
IV. Conclusions & Recommendations	26
V. References	28
Appendices	
A. Maps	
1) 8.5 x 11" included with report	
Grantham Base Map with GPS points	A-1
Waypoint List for Base Map	A-1.1 to A-1.15
Grantham Wetlands Map	A-2
Sample WEU Maps – Butternut Pond	A-3 to A-4
Wetland Ranking Map	A-5
2) 24 x 36" maps included separately	
Grantham Wetlands Base Map – Aerial Photograph Base	
Grantham WEU Base Map – USGS Topographic Base	
Grantham Wetlands Assessment Map – WEU Ranking	
B. Spread Sheets & Charts	
WEU Summary Table	B-1 to B-2
WEU Assessment Scores by Function	B-3 to B-6
WEU Charts by Function	B-7 to B-18
WEU Point Sum Charts	B-19 to B-21
C. Model Wetlands Ordinance (Recommended)	C-1 to C-11
D. Sample Wetland Assessment Data Sheets	D-1 to D-16

List of Tables and Figures

Fig. 1 Shaded relief map of Grantham showing generalized wetland locations	2
Fig. 2. Sample color infrared aerial photo with wetlands outlined	4
Fig. 3 Property Access Authorization Form	7
Fig. 4 Sample NH Method data form question	8
Fig. 5 Grantham water resources map showing major watersheds and drainageways	13
Table 1. Water resource summary by NWI type	14
Table 2. Rivers and streams in Grantham	15
Table 3. List of WEU's	17 - 19
Fig. 6 Landowner Approvals Map	20
Fig. 7 Stocker Pond from Sanborn Hill Road	23
Fig 8. Top-ranked WEU's according to final point tally	24
Fig. 9 Lower Bog Brook as seen from Springfield Road	25
Fig. 10 Upper Stocker Pond from Sanborn Hill Road	27

EXECUTIVE SUMMARY

Between January 2011 and October 2012 a wetland inventory and assessment was completed of the Town of Grantham, New Hampshire. The purpose of the inventory was to identify and classify accurately wetlands and water resources in the town; the purpose of the assessment was to provide information on the location of highly valued wetlands and how they were contributing to the general health and well-being of the town. The Grantham Conservation Commission both commissioned the project and volunteered to help with the inventory and assessment effort, and through their hard work the following summary of the wetlands in Grantham has been made possible.

In order to complete the comprehensive wetland inventory and assessment, several tasks had to be undertaken. First, digital geographic information system (GIS) files were reviewed using ArcGIS software. This included uploading all baseline GIS data housed at UNH Complex Systems Research Center, such as current roads, trails, conservation lands, political divisions, watershed information, water resources data, and the current aerial photography. Secondly, any and all pertinent map and literature data associated with wetlands in the region was reviewed. This included a review of the 2010 Critical Conservation Lands Index report for Grantham, the 2010 update to the Wildlife Action Plan or WAP, and rare and endangered species records from the NH Natural Heritage Bureau. In addition, updated hydric soils data was obtained from the Natural Resources Conservation Service (NRCS) through www.soildatamart.gov.

The third and most-time-consuming task involved the mapping of wetland units using the latest aerial photographs. In 2010, under the auspices of the NH Department of Transportation (NHDOT), color infrared imagery was flown of almost the entire state. This wasn't made available until June 2011, yet it greatly aided the process of digitally mapping each wetland and its cover and soil type. These 1-foot pixel photographs allowed for very accurate mapping of the cooler wetland soils, especially in areas where cover types were conducive for good reflectance of ground conditions. Only in areas of unbroken conifer cover were there interpretation challenges; most of these were overcome by paying attention to the slightly different (i.e. cooler) reflectance from the conifer needles. This 140-hour task was completed by early October 2011.

In advance of the field-based assessments, roadside surveys were conducted to field-test the aerial photo interpretation (API) work. All passable roads were traveled in Grantham as well as adjacent towns where large wetland complexes extended beyond the town boundaries (See map on Page A-1). This work took place between March and June of 2011. The roadside survey work also served the purpose of identifying the individual wetland evaluation units (WEU's) in Grantham, and provided necessary data on road crossings, inflow and outflow streams, shoreline features, and areas of past wetland fill. Digital photographs were also taken during the roadside surveys, many of which helped document the scenic quality of each wetland. In addition, GPS data points were collected at various roadside locations, especially where culverts, arch spans, and bridges crossed the wetland complexes.

The off-road field assessment task began by sending out an access request letter to all landowners who owned a portion of the wetlands being evaluated. Request letters were sent out in October 2011, December 2011, and March 2012. Based on the delay in receiving landowner responses and the extended length of time for receiving the aerial photographs and completing the wetland evaluation unit maps, field assessments did not begin in earnest until 2012. Field surveys on

privately held lands where written permission was granted were mostly completed between April and August of 2012.

Field-based assessments of each wetland followed the *Method for Inventorying and Evaluating Non-tidal Wetlands in New Hampshire*, or the 'NH Method' (UNH Cooperative Extension, 2011). The following twelve functional values of wetlands were assessed:

- 1) Ecological Integrity
- 2) Wetland-dependent Wildlife Habitat
- 3) Fish and Aquatic Life Habitat
- 4) Scenic Quality
- 5) Educational Potential
- 6) Wetland-based Recreation
- 7) Flood Storage
- 8) Groundwater Recharge
- 9) Sediment Trapping
- 10) Nutrient Transformation
- 11) Shoreline Anchoring
- 12) Noteworthiness

After each site assessment was complete, field data was transferred by the volunteers to the NH Method data sheets in the office. These were then scanned by members of the Grantham Conservation Commission and forwarded to the principal author. Each set of data forms were checked for accuracy and clarity, and comments were inserted where changes were needed. Wetland evaluation unit (WEU) maps were also revised based on changes noted by the volunteers. Once all of the questions and revisions were addressed, the tally of WEU scores was analyzed for significance. Point ranking of each WEU was based on four principal areas:

- 1) Overall value of each WEU based on mean scores for each function
- 2) Flood storage capability
- 3) Contribution to water supply and water quality
- 4) Wildlife habitat

Points were awarded for the highest scoring WEU's in each of the four categories and then summed for a final result. Those wetlands that exceeded one standard deviation above the mean for the top 50% scoring wetlands were selected as candidate prime wetlands. The following summarizes the overall results of the inventory and evaluation process.

A total of 3918 wetland units were mapped and classified during the aerial photo interpretation (API) phase. This included 2474 acres of wetlands overall, with 76% (1874 acres) found in Grantham alone. Wetland classification followed Cowardin et al. (1979), wherein 397 different, naturally occurring wetland classes were identified. In addition, 7 man-made types (e.g. culvert, ditch, etc.) were also mapped. For each wetland cover type a hydric soil type was assigned based on current soil mapping, field observations, and landform type. Based on a careful review of the configuration of wetlands and their cover and soil types, a total of 54 wetland evaluation units (WEU's) were recognized and isolated for independent evaluation. These 54 units equaled 1859.2 acres (1406 acres in Grantham), or 75% of all of the wetlands that were mapped. WEU sizes ranged from 2.24 acres to 509.7 acres, with a mean size of 34.4 acres. The attached map indicates the name and location of all 54 WEU's.

A total of 279 parcels with 168 distinct owners were identified as containing a portion of the 54 WEU's. Landowner responses to the private property access request were received from 93 of these parcel owners, wherein approvals granted access to 160 parcels.

Of the 37 people who attended volunteer training sessions in May 2011, 22 completed one or more wetland evaluations in 2011 and 2012. Four WEU's were evaluated in October and November of 2011, and the remainder took place between April and August of 2012. Analysis of the 16-page, 88-question data forms took place in September 2012, and final analysis of the revised data in early October 2012.

Thirty-seven of the 54 assessment wetlands contained some amount of fill. Road crossings occurred in all but five of the WEU's, and human activity was present in nearly all wetland buffer zones (500 feet). Ecological Integrity values ranged from 2.5 to 10 (the highest) with a mean of 6.6.

Wildlife habitat was generally ranked very high among the WEU's, particularly those that contained either shallow or deepwater areas. Most of the wetlands away from roads had intact wetland buffers where a variety of large game and birds were free to roam. Average scores ranged from 3.5 to 9.4 with a mean of 6.4. Fish and Aquatic Life Habitat values were generally lower since many of the WEU's were basin wetlands that lacked any significant stream flowages. Average scores for this function ranged from 1.8 to 7.4 with a mean of 4.5.

Flood storage also varied widely among wetland units, with those that fell adjacent to larger streams and rivers accounting for the higher scores. Stocker Pond, Miller Pond, Eastman Lake, and Bog Brook scored the highest values of 7.2, 6.6, 9.0 and 6.1, respectively. Overall scores ranged from 1.1 to 9.0 with a mean of 3.7.

Both Sediment Trapping and Nutrient Transformation provided elevated values for wetlands that were not necessarily pristine, such as Little Brook Gravel Pit and Madore Spruce Fen, since these wetlands have greater opportunity to ameliorate water quality near built environments. Average scores for Sediment Trapping ranged from 2.3 to 8.8 with a mean of 5.1, and Nutrient Transformation ranged from 3.1 to 8.2 with a mean of 6.4.

Noteworthiness encompassed many wetland attributes that are only recognized at the regional level, such as the presence of critical wildlife habitat as deemed by the NH Fish & Game Department, or recognized in regional or statewide priority protection plans, such as the backlands in the western part of the town. This function also recognized unusual or important biological values such as the presence of heron rookeries or rare plant species. While the WEU's in Grantham did not have an abundance of the latter two attributes, several contained historical value such as Mill Pond Dam and Bog Brook. In sum, all but two WEU's had noteworthy attributes ranging from 10 to 60 points with a mean of 21.5.

The final selection of high and very high value wetlands utilized the point system mentioned above. The assignment of points accentuated the framework of functional values deemed important to the town as noted in the above list of four attributes. The greatest contribution to the point tally was derived from the results of the wetland assessment itself, wherein points were awarded by function for each WEU that exceeded the mean score among all WEU's. Additional points were awarded for flood storage, which recognized the highest

scoring WEU's as well as those that were adjacent to 4th or 5th order streams. Water quality points were awarded to all WEU's that exceeded the cumulative mean scores for Groundwater Recharge, Sediment Trapping, Nutrient Transformation, and Shoreline Anchoring. The same approach was used for Wildlife, wherein points were awarded to WEU's that exceeded the mean for cumulative scores in Ecological Integrity, Wetland-dependent Wildlife, and Fish & Aquatic Life Habitat.

The final result was a point tally for each WEU. Those that scored higher than the sum of the mean plus a single standard deviation of the mean were deemed to be the highest value wetlands. When the range of WEU points was normalized across a natural sequence curve, 13 WEU's stood out as either high or very high value wetlands. These included all WEU's that had between 10 – 15 total points.



Grass Pond View from Old Route 10

The final ranking of high and very high wetlands included the following in order of highest to lowest:

- 1) Chase Pond (15)
- 2) Upper Dunbar Hill Beaver Pond (14)
- 3) Bog Brook (14)
- 4) Lily Pond (13)
- 5) Grass Pond West (12)
- 6) Upper Stroing Brook (12)
- 7) Lower Eastman Brook (12)
- 8) Stocker Pond (12)

- 9) Miller Pond (11)
- 10) Leavitt Pond (10)
- 11) Butternut Pond (10)
- 12) Cole Pond (10)
- 13) Eastman Lake (10)

VERY HIGH VALUE

HIGH VALUE

The total acreage of these WEU's is 1292.2 acres, ranging from a minimum of 8.96 acres (Lily Pond) to a maximum of 509.71 acres (Bog Brook), with a mean size of 99.32 acres. These 13 WEU's equal roughly 70% of the wetlands evaluated in Grantham, however, it should be note that many of these wetlands have portions lying outside of the town boundaries. Of the total of 1292.2 acres, just 866.8 acres of these wetlands lie within the town of Grantham, or 4.83% of the entire town. Because of this reason, one high-ranking WEU, Cole Pond, was left off of the list of recommended prime wetlands. All of the remaining 12 WEU's are considered as viable candidate prime wetlands in the town of Grantham.

Acknowledgments

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I. Overview and Purpose

In August 2010, the Grantham Conservation Commission (GCC) initiated a *Wetlands Inventory and Assessment and Prime Wetland Designation Project* (or, Wetlands Inventory and Assessment Project). This project was a direct out-growth of recommendations of the Grantham Critical Conservation Lands Index (CCLI) and the Grantham Master Plan, wherein the values of wetlands were recognized as needing further protection in town. As noted in the 2010 GCC Project Summary statement,

“This project will provide the Town with a vital tool to conserve, protect, and prevent abuse of wetlands. The project is a major step to protect the Town’s critical natural resources, as recommended by Section 2 of the Grantham Critical Conservation Lands Index (CCLI), established in 2009, and as mandated by Sections III and X of the Town Master Plan, adopted by the Planning Board in 2005. Task 7 for Year 2 in Section X of the Master Plan specifically directs the GCC to “...prepare a local wetlands inventory and evaluation, and consider the designation of prime wetlands...” Both documents may be found on the Grantham web site, the CCLI on the Conservation Commission page, and the Master Plan on the Planning & Zoning page.”

In January 2011, the Grantham Conservation Commission contracted with Ecosystem Management Consultants to complete the inventory and assessment of Grantham’s wetlands. The primary goal was to identify and evaluate the highest value wetlands in order to designate them as *prime wetlands* according to state standards defined in RSA 482-A:15 and EnvWt Rules Chapter 700.¹ The inventory process was to begin with an aerial photo interpretation (API) review of wetlands in and adjacent to Town, and be followed by a roadside survey to verify cover types and check hydrologic connectivity. The assessment process was to follow the ‘NH Method’ (*Comparative Method for Evaluating Non-Tidal Wetlands in New Hampshire*), and be implemented by a number of town volunteers including members of the Conservation Commission. At the outset, the goal was to complete the work prior to October of 2011, where a new wetland ordinance recognizing prime wetlands could be accepted by the Planning Board and pass on to the voters of Grantham in March of 2012.

While both of the first two tasks were completed in 2011, there were some delays that pushed the timeline for prime wetland designation into 2012-2013. The first delay arose when the final publication of the ‘NH Method’ (now called the *Method for the Inventory and Evaluation of Freshwater Wetlands in New Hampshire*) did not occur until June 2011. The second delay involved the 2010 color infrared aerial photographs, which were also not released until June 2011. Although these photos greatly aided in the inventory and mapping process, the image

¹ RSA’s and Rules can be found at <http://www.gencourt.state.nh.us/>

details were so sharp that the processing was not completed until September 2011 and evaluation maps for each WEU was not finished until late October. By this time, some indicators needed for field evaluations might have been difficult for volunteers to identify, and a number of the trained volunteers had left the area for the winter and so only a handful of evaluations were completed prior to the end of 2011. When the wetland evaluations were finally completed in August of 2012, the QA/QC process of checking the forms began in earnest in order to provide as accurate an analysis as possible. This step was completed in late September 2012 and the final analysis followed soon thereafter.

The following report contains a review of the definitional criteria for wetlands, their cover types, soils types, and the functional values that were assessed by the town volunteers. It also describes the process by which the wetlands were mapped and segregated into discrete *wetland evaluation units* or WEU's. This latter step was critical in order to provide the volunteers with identifiable maps for use in the field. The actual process of completing a wetland evaluation using the NH Method is also described, and a sample set of completed data forms is provided in Appendix D. The analysis phase is also described in detail, as well as its reference to the stated goals of the Grantham Master Plan. Finally, the results of the evaluation are provided with details of the total wetland resources in Grantham, their functional value attributes, and the selection of recommended prime wetlands. The Appendices contain several maps, spreadsheet and chart summaries, and a model Wetlands Conservation District Overlay ordinance for consideration by the Grantham Conservation Commission.

Please note that in spite of the great contributions made by town volunteers in the wetland evaluation process, should it be found that the following report contains errors or omissions, they are the sole responsibility of the author and not of any Commission member or town volunteer.

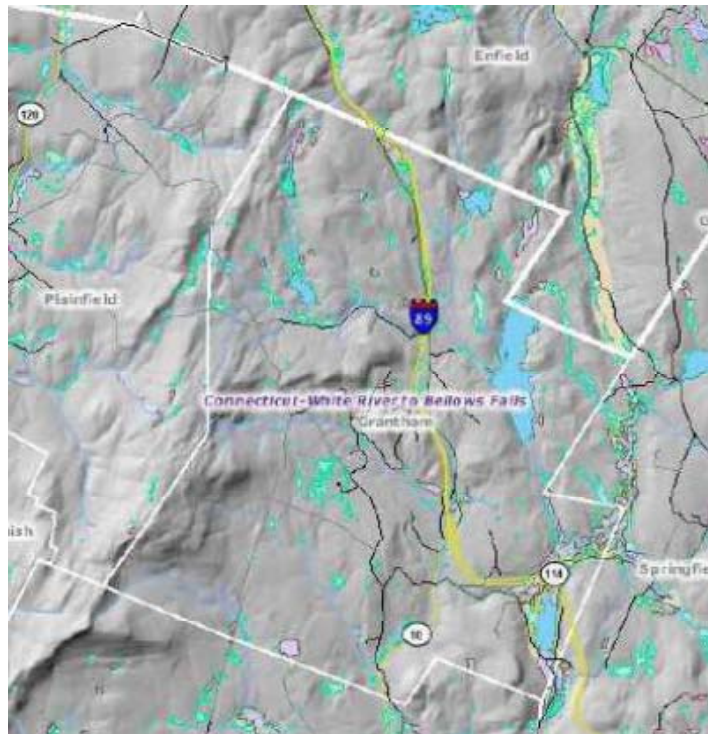


Fig. 1 Generalized shaded relief map of Grantham showing approximate location of wetlands

II. Methods

A. Project Coordination

The Grantham Conservation Commission reviewed and adjusted the scope of work with Ecosystem Management Consultants (EMC) in January 2011. They also coordinated the initial public presentation in February 2011, including posting public notices and sending out an invitation to all landowners whose properties are adjacent to wetlands identified in the Grantham's CCLI that appeared to have the potential to be later identified as a WEU. After drafting a project summary statement and press release for the local papers and the Town web site, the Commission began soliciting volunteers to perform the evaluations later in the spring of 2011. EMC provided four training sessions for those who signed up as well as two maps for each of the 54 wetland evaluation units (WEU's) that were to be evaluated. The two indoor sessions occurred on May 9 and May 14, and the two outdoor sessions took place on May 12 and May 14. Excluding the Commission members, a total of 28 people attended one or more training sessions. Of these, 16 volunteers completed one or more wetland evaluations. Six of the seven Commission members completed between three and 20 evaluations each. Lindsey Lefebvre and Kristina Burgard coordinated the processing of NH Method data forms and map changes and forwarded them to EMC for review and corrections. They also handled communicating pertinent questions back to the evaluators. Further details on the analysis of the data sheets are provided in Section II.F below.

B. Remote Resource Review

The NH GRANIT Program at UNH Complex Systems Research Center (CSRC) offers a variety of remote (GIS) data that was consulted during Task 2 of the project. As listed on their web site, <http://www.granit.unh.edu>, the following resource layers were used to derive the initial wetlands map:

<u>Resource Layer</u>	<u>Date</u>	<u>Description</u>
Digital Elevation Models	1987	From USGS topographic sources
Digital Orthophoto Quads (DOQ)	1998	Best available data
Digital Raster Graphics (DRG)	1987	USGS topographic maps
Landsat land use coverage	2001	Latest satellite imagery
NAIP aerial photography	2003,9	Statewide coverage
National Wetlands Inventory (NWI)	2001	USFWS Wetlands Inventory Data
NH Hydrography Dataset	2010	Streams & rivers, other surface waters
NH Wildlife Action Plan (WAP)	2010	Wildlife habitat & condition ranking
Political boundaries	1996	UNH CSRC
Public Roads	2010	NH DOT
Railroads	1993	UNH CSRC
Soil units, especially hydric	2005	NRCS (available through soil datamart)

Tagged Vector Contours (TVC)	1998	20-foot contour intervals (USGS)
USGS Color infra-red photography	2010	Beginning June 2011
Watershed boundaries	2002	UNH CSRC

The most important resource in the above list of GIS data was the newly processed, 2010 1-foot pixel color infrared aerial photographs flown and distributed by the NH Department of Transportation. These ortho-rectified photographs provided an exceptional view of all areas of Grantham both in standard three-color format and in fourth band near infrared. The latter was reviewed using the recommended CSRC settings, wherein ‘warm’ reflectance objects displayed a pink to red color and ‘cool’ objects displayed various shades of light gray to black. Neutral reflectance appeared white. A sample clip from the aerial photo interpretation (API) map is shown at right.



Fig. 2 Sample color infrared photo showing Stocker Pond

Using the color indications on the map along with visible water features, the edge of each wetland was approximated using a standard mouse cursor on an ArcGIS 9.2 map platform. Each discrete wetland cover type was outlined in yellow, as shown above, and coded according to the apparent National Wetlands Inventory (NWI) ‘Cowardin’ cover type.² Wetland areas were compared with the latest version of the Sullivan County Soil Survey map and appropriate soil types were assigned for each cover type unit. Both the cover types and hydric soil types were checked to the degree possible during the roadside survey process.

A second excellent resource for wetlands information was Denyce Gagne's *Town of Grantham Critical Conservation Lands Index* dated March 2009. This document included maps and descriptive narrative that noted high quality wetlands in Grantham, specifically the Bog Brook complex and Eastman Lake. Additional information in this

² 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. FWS/OBS – 79/31. Washington, D.C.: Government Printing Office.

report listed surface waters, water quality information, wildlife habitat quality, fishing and other recreational uses of wetlands, and ecosystem services such as drinking water supplies. Along with the Town's Master Plan, this document provided excellent guidance and a solid rationale for protecting wetlands through prime wetland designation.

Several other documents were reviewed as a part of this task, including watershed studies of the Sugar River, the Quabbin-to-Cardigan (Q2C) ecoregional study, The Nature Conservancy (TNC) forest matrix block analysis of the state, the Forest Society's Favorable Gravel Well Analysis of the state, and the 2010 update of the Wildlife Action Plan (WAP).

C. Roadside Surveys & WEU Identification

After the initial GIS mapping of Grantham was complete, several roadside surveys were conducted along most of the public thoroughfares of the town. These surveys served the purpose of

- 1) Gathering direct visual information on the wetland resources of Grantham
- 2) Identifying "pinch points" where wetland complexes appeared to be segregated from their upstream and/or downstream counterparts
- 3) Collecting data on culverts, arch spans, and bridges to determine hydrologic connectivity among and between wetland complexes; and
- 4) Determining approximate pre-existing impacts to wetlands

All of these surveys took place during daylight hours and were performed without leaving the edge of the roadway (except on public lands). Using a Garmin 12XL hand-held unit with an average precision of 3.2 to 7.9 meters, GPS points were taken at each culvert, arch span or bridge, as well as the beginning and ending points of any wetland that immediately abutted the roadway. Pertinent photographs were taken of each wetland complex in order to capture salient cover types and soil types as visible from the road. The latter were extremely useful for checking the cover and soil types that were derived from the 2010 aerial photographs described above.

D. Off-Road Surveys

In early February 2011 (and prior to the wetland mapping phase), a letter went out from the Grantham Conservation Commission advising landowners whose properties are adjacent to certain wetlands identified in Grantham's CCLI about the Wetlands Inventory and Assessment Project and inviting them to attend an upcoming public presentation on the project. Once mapping and identification of the fifty-four (54) WEU's was completed in October 2011, a list of properties adjacent to each WEU was

provided to the Commission, and they sent out request letters in a rolling process to landowners of these properties beginning in October 2011 and ending in March 2012. In addition, reminders and status update letters were sent in December 2011 and September 2012. By way of example, the text of the October 2011 request letters was as follows:

The Grantham Conservation Commission (“GCC”) is conducting a prime Wetlands Inventory of Grantham through the use of its Conservation Fund. This Inventory involves mapping and assessment of wetlands greater than one (1) acre in size, and when complete, will increase our knowledge of these wetland resources and how they contribute to critical aspects of our Town, such as water supply and safety, flood storage, and wildlife habitat. Protecting vital wetland resources is a top priority of the Town, and both Grantham’s Board of Selectmen and Planning Board sanction and support completion of the Wetlands Inventory. (For more details, please see the Wetlands Protection Program Summary on the Town’s website at www.granthamnh.net/conservation.)

Using detailed aerial imagery, we have completed mapping and initial assessment of the Town’s wetlands. The next step is to perform ground evaluations in order to further assess the vitality of each identified wetland. Thus, GCC is seeking written permission to cross your lands on the way to and/or from wetland resources located on or adjacent to your property. If granted permission, Grantham volunteers will conduct a field visit to these wetland resources, organized by the project’s principal investigator, Dr. Rick Van de Poll of Ecosystem Management Consultants. The trained volunteers will conduct NH Method visual evaluations of visited wetlands, and will leave no markers, signs, sampling equipment, or any other evidence of their passing. Permission is for foot access only, since many wetlands are land-locked and difficult to reach by road or public trail.

The attached consent letter acknowledges your receipt of this letter and grants permission for GCC Wetlands Inventory volunteers to access and cross your property in order to conduct field visits to wetland resources. You will be contacted prior to any field visit to arrange a mutually convenient time for the visit, and you are welcome to accompany the volunteers should you desire to do so. If you wish to deny access, please sign the appropriate denial section of the form.

We would appreciate receiving your response as soon as possible. If you have any questions or concerns about the Wetlands Inventory, please contact _____.

Thank you very much for your cooperation!

The property access authorization forms that went out with these letters appeared as follows:

PROPERTY ACCESS AUTHORIZATION FORM ¹

Date: February 2011

I hereby authorize Grantham Conservation Commission appointed and trained volunteers to cross my land on foot only in order to complete a wetlands evaluation of wetlands that lie on or adjacent to my property in Grantham, NH. It is understood that they shall leave no markers of any kind during the course of his normal work. This permission also recognizes that these volunteers shall be working under their own authority, and that no personal liability damages shall be levied against me, the landowner, or my tenants at any time.

Signed;

[Print name(s) here:] _____ date

Landowner(s)

[Sign name(s) here:] _____ date

Landowner(s)

Please indicate if you wish to be notified of the approximate date and time of the field visit, as well as an appropriate means of contacting you prior to such visit.

Check one: I DO ___ DO NOT ___ WISH TO BE NOTIFIED PRIOR TO ACCESS

_____ PHONE # _____ EMAIL

PROPERTY ACCESS DENIAL FORM

Date: February 2011

I hereby REFUSE to authorize Grantham Conservation Commission volunteers to cross my property at any time.

Signed;

[Print name(s) here:] _____ date

Landowner(s)

[Sign name(s) here:] _____

¹ QUESTIONS OR COMMENTS? CONTACT: Richard Hoeker, Chair, CHCC at 863-7487

Fig. 3 Property Access Authorization Form

Once private property access permission was received in writing by the Conservation Commission, they alerted each of the volunteer evaluation teams about where they were allowed to go. EMC provided two field map sheets to guide each team as they

approached the Wetland Evaluation Unit (WEU) and followed the wetland boundary around it. One map contained the NWI cover types on a topographic base map that contained the 500-foot buffer line. The other map contained the soil types overlaid on the 2010 aerial photo. Notes were kept on these field sheets by the evaluation personnel, which in certain instances required EMC to revise the base map in the office.

E. Wetland Assessment

Each evaluation team had been previously trained in the use of the ‘NH Method’ and any question about its use was either answered on-line at www.nhmethod.org, or by one of the Conservation Commission members. The data forms included a range of four to 13 questions about each of the following 12 functions:

- 1) Ecological Integrity
- 2) Wetland-dependent Wildlife Habitat
- 3) Fish & Aquatic Life Habitat
- 4) Scenic Quality
- 5) Educational Potential
- 6) Wetland-based Recreation
- 7) Flood Storage
- 8) Groundwater Recharge
- 9) Sediment Trapping
- 10) Nutrient Transformation
- 11) Shoreline Anchoring
- 12) Noteworthiness

For each function, a set of questions was asked of the evaluator wherein points were assigned for each question answered. The point values for each question generally ranged from 1 to 10, with three general choices: 1 point for low value, 5 points for medium value, and 10 points for high value. For example, the first question under function #1) Ecological Integrity asks the evaluator to determine if water quality in the wetland has been compromised because of activities in the watershed above it and if the water shows signs of degradation. The following diagram illustrates this question on the data form:

1 – ECOLOGICAL INTEGRITY

Evaluation Questions	Observations & Notes	Answers	Score
1. Has water quality in the wetland been degraded by land use in the wetland's watershed?		a. No unnatural sediment or nutrient sources in the subwatershed b. Some (1-2 sources) unnatural sediment or nutrient sources in the subwatershed c. Many (more than 3 sources) unnatural nutrient sources in the subwatershed	10 5 1

Fig. 4 Sample NH method data form question

In this particular case, the reviewer circled the letter 'a' and a 10 was entered into the summary spreadsheet. In the case of certain questions, a '0' may have been appropriate as an answer, such as the question asking about the amount of open water when no open water was deemed to be present. Another example where a '0' was common was when the evaluator was asked if there was handicap access to the wetland under function #5) Educational Potential and the answer was no.

In addition, the NH Method allows each evaluator to provide intermediary values when the answer to the question actually fell *between* two values. A common example of this scenario was with function #6) Wetland-based Recreation, where the question about open water and access returned a "1" if there was "no open water and no access," a "5" if open water was present but site was not easily accessed by canoe/kayak, and a "10" if open water was present with easy access. A "7.5" could have been awarded if there was open water and access but the water was not always deep enough for canoes or kayaks; similarly, a "2.5" could have been awarded if there was open water suitable for canoes/kayaks but no access was allowed. Each of these functions and the question that make them up are well defined in Section Three of www.nhmethod.org.

The use of the NH method included questions that could be best answered in the office as well as those that were best suited for the field. Office-based questions typically involved questions about the context of the wetland itself, such as the size and condition of the watershed above the wetland, the number of occupied buildings within 500 feet of the wetland, and the number of times a road crossed or bordered the wetland. Most of these questions could be answered by looking at the field maps sheets, although several required the use of the on-line data mapping service provided by UNH Complex Systems Research Center. The latter, known as the GRANIT Data Mapper, provided an easy-to-use way to review remote GIS data about the wetland in question. Using the various function tools of the Mapper, areas could be calculated, buildings could be counted, and road crossings observed. Field-based questions addressed some of the details of each function, such as the amount of open water (which may have varied since 2010), the presence of invasive species, the average width of the waterway associated with the wetland, and the number of cover types. A sample set of completed data forms for Butternut Pond is included in Appendix D for review.

F. Data Analysis & Assessment

Once the data forms were filled out by each team of volunteers they were submitted to select members of the Grantham Conservation Commission, who conducted a preliminary review for completeness and then scanned each data form before forwarding them to EMC. They also scanned any photographs and sketch maps that

were submitted by the evaluation teams and included them in a single pdf for final checking. Beginning in July and ending at the end of August 2012, all of the WEU data forms were checked for completeness, scanned, and forwarded to EMC. As of September 20, 2012, all 54 WEU data forms were comprehensively reviewed and sent back with comments to the Grantham Conservation Commission. Over the course of the next week, all outstanding questions were answered by members of the Conservation Commission, and the final analysis proceeded ahead.

The file "Grantham WEU Summaries.xlsx" was created to analyze the final results of the data form entries and to derive a meaningful way to prioritize the highest value wetlands for potential designation as *prime wetlands*. The first step was to come up with a fair, mathematically sound system of ranking each WEU according their salient attributes. This was accomplished by awarding a single point to each WEU every time its average score exceeded the mean for a particular function. For example, for the function #1) Ecological Integrity, the mean score for all 54 WEU's was 6.6, and so every WEU that had a value above 6.6 for Ecological Integrity was awarded a single point. In this way, a maximum of 12 points could have been awarded for any single WEU.

The second basis for awarding points to each of the WEU's arose from the actual wishes of the Grantham Conservation Commission as reflected in the Town's Master Plan and the Critical Conservation Lands Index (CCLI) report of 2009. In both reports, and as summarized by the GCC during the initial town wide presentation in February 2011, the following three attributes of wetlands were recognized as being of paramount importance:

- 1) Flood storage capability
- 2) Contribution to water supply and water quality
- 3) Wildlife habitat

For this reason, additional points were awarded for the top-scoring wetlands in those functions that provided these values to society. Flood storage points were initially determined on the basis of each WEU exceeding the mean of 3.4 for all 54 WEU's. Secondly, points were awarded for the very best flood storage wetlands since these have a greater likelihood of providing critical downstream damage remediation. WEU's that had scores that exceeded two standard deviations above the mean were awarded points. Lastly, WEU's that were within the floodplain of 4th and 5th order streams were also awarded points. This addition allowed certain WEU's to have greater value even though their flood storage value was minimized by the size of the watershed above them. The Cote-Reney Complex and Lower Sawyer Brook were two classic examples of valuable flood storage wetlands that otherwise scored low because of their small size in relation their watershed.

Water supply and water quality value was estimated to be best determined by the average scores for four functions: #8) Groundwater Recharge, #9) Sediment Trapping, #10) Nutrient Transformation, and #11) Shoreline Anchoring. Those WEU's that exceeded the mean of the sum of scores for all of these four functions were awarded a single point.

In a similar fashion, wildlife habitat was estimated to be best determined by function #1) Ecological Integrity, #2) Wetland-dependent Wildlife Habitat, and #3) Fish and Aquatic Life Habitat. As with water quality, a point was awarded to each WEU that cumulatively scored higher than the mean of the sum for all three of these functions.

Points were then summed across all 54 WEU's and ranked in descending order. Those point scores that exceeded a single standard deviation above the mean sum of all points were determined to be the highest value wetlands. This was confirmed statistically by plotting the point scores on a normalized curve using a 5-class Jenks natural breaks system. The two highest classes in this system were identified as **high value wetlands** and **very high value wetlands**. The results of this analysis is described below and illustrated in Map A-5 and in the separate, large format wetlands ranking map. In both maps, the high value and very high value wetlands are outlined in red.

III. Results / Discussion of Findings

A. General Findings

As noted in the CCLI, the Town of Grantham was found to contain a number of high and very high value wetlands that provide multiple millions of dollars in services to the residents of the town and its downstream neighbors. By preventing flooding and damage to personal property, ensuring adequate wildlife habitat, and providing safe drinking water supplies to over three thousand residents, the wetland complexes of Grantham have and will continue to serve the needs of the community as long as they are conserved and not abused. As noted in the Vision Statement of the Grantham Master Plan,

“To provide stewardship for natural resources and serve the needs of conservation, Grantham should:

- Strongly pursue a variety of measures that will conserve and protect scenic natural resources, natural areas, *wetlands*, and surface and ground waters”

Most of the wetland complexes in Grantham, particularly the high value ones, lie along the central valley comprised of Sawyer Brook, Skinner Brook, Stony Brook and the North Branch, as well as the main lateral drainage of Bog Brook and Stocker Brook. As depicted on the map on the next page, many of the western highland tributaries form upper watersheds to these perennial streams. Grantham contains over 50% of the upper North Branch watershed and therefore plays a critical role preventing downstream flooding along the North Branch and the Sugar River in Croydon, Newport, and Claremont.

The principal water-bearing aquifers in Grantham underlie Bog Brook and Stocker Brook. The Bog Brook and Stocker Brook wetland complexes (#32 and #50, respectively) lie directly above these high yield, drinking water supply sites and therefore play a critical role in protecting the quality and quantity of water that is available to the residents of Grantham. While past land uses in this area has not necessarily been favorable to groundwater protection, future protection of these critical recharge areas could ensure a reasonable expansion of drinking water demand in the town.

Roughly two-thirds of the highest value wetlands lie in roadless areas that provide exceptional habitat for wildlife, yet only 14.6% of these WEU's are protected in perpetuity. In areas such as Miller Pond and Upper Dunbar Hill Road the threat of further development could compromise the habitat values that these areas currently enjoy. A great deal of recreational value is invested in the continuance of intact wildlife habitat, as attested by the number of trail systems that crisscross these remote areas.

Greater land protection efforts in combination with sensible regulations that prevent the destruction of wetlands and their buffers would help ensure the long-term viability of these invaluable services that the wetlands of Grantham provide their residents.

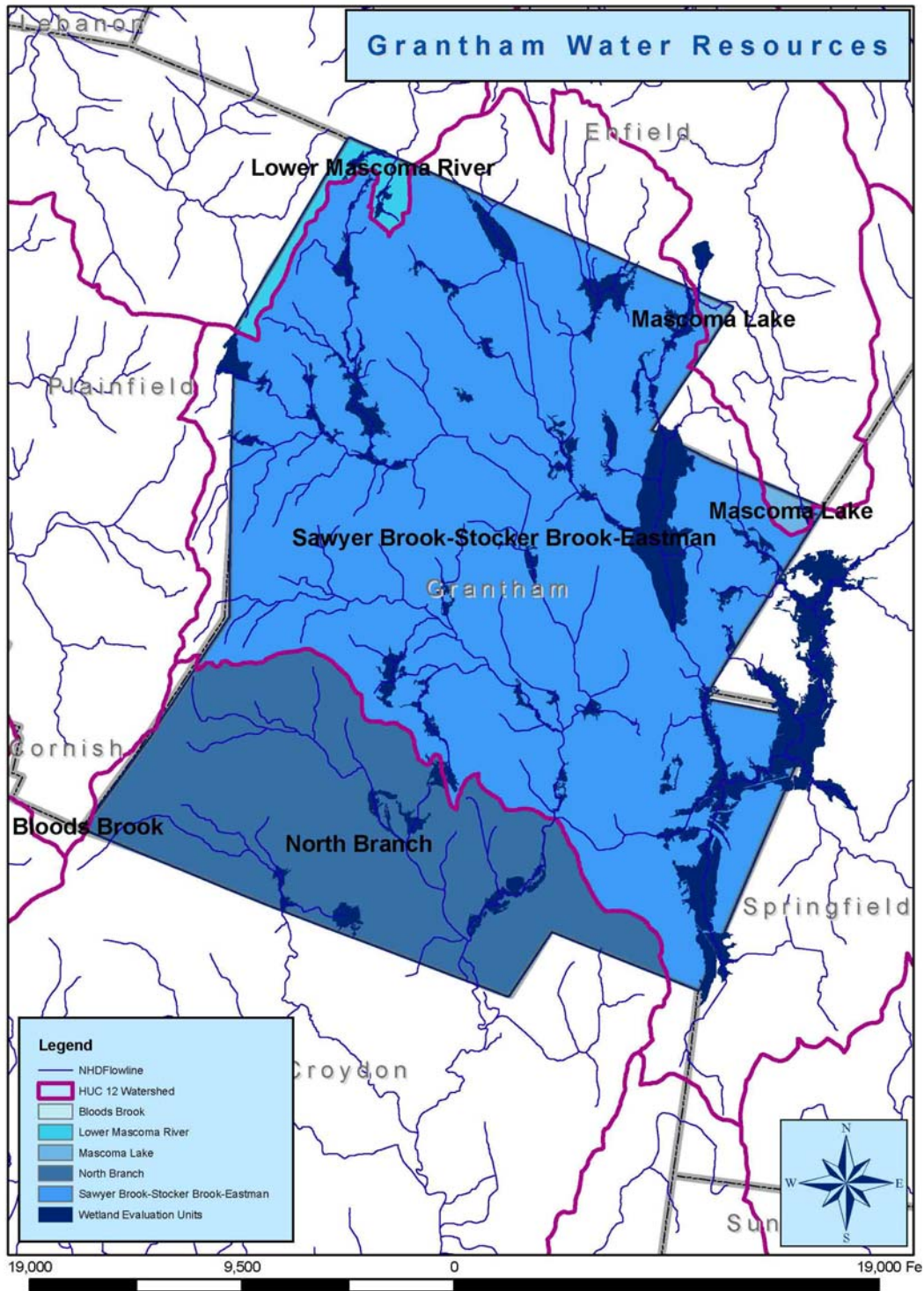


Fig. 5 Grantham water resources map showing major watersheds and drainageways

B. GIS Data Summary

The initial GIS data review calculated a total of 723.9 acres of wetlands in Grantham according to the National Wetlands Inventory (NWI), or 4.0% of the town. This does not include all “great ponds,” or those open water bodies larger than 10 acres, which comprises about 510.7 acres according to the NWI maps. Hydric soil data from the Natural Resource Conservation Service (NRCS) included a total of 1677.6 acres of poorly and very poorly drained soils, plus 552.9 acres of water for a total of 2230.5 acres, or 12.4% of the town. The Wildlife Action Plan (WAP) identified 439.04 acres of marsh & shrubland, plus 50.7 acres of peatland, for a total of 489.74 acres of wetland, or 2.7 % of the town. The latter figure does not include the forested floodplains and hemlock-hardwood-pine forests that are recognized as containing some wetland forests.

Based on the above data, it was clear that there were some large discrepancies on the amount of wetlands and open water in Grantham. The 140-hour effort to map all water resources in Grantham using the 2010 color infrared aerial photographs helped reconcile these inconsistencies and resulted in the following:

Water Resource Type	Number of NWI Units (total)	Total Acres	Grantham Only	% of Town	% of Total Water Resources
Lakes	16	437.72	423.56	2.36	17.69
Ponds	167	208.1	154.34	.86	8.41
Deep Marshes	25	19.38	12.89	.07	.78
Shallow Marshes	396	264.40	181.22	1.0	10.69
Scrub-Shrub Marsh	607	335.74	223.72	1.25	13.57
Moss-Lichen Bed	1	.34	.34	.002	.01
Forest Swamp	1792	989.47	713.01	3.97	39.99
Riverine	230	152.74	129.35	.72	6.17
Upland Islands	222	59.43	33.42	.19	2.4
Man-made ³	462	7.03	6.55	.04	.28
TOTAL	3918	2474.35	1878.40	10.46	99.99

Table 1. Summary of Grantham water resources by water resource type (based on API)

A total of 3918 water resource units were identified and mapped,⁴ each of which are depicted on the large format aerial photo base map of wetlands that accompanies this

³ Man-made wetlands included areas covered by bridges, culverts, ditches, drop basins, and tunnels.

⁴ “Water resource units” are herein broadly defined to include areas of deepwater habitat as classified by the NWI as well as shallow water wetlands. Deepwater is defined as any permanently inundated area with an average depth of > 6.6 feet.

report. The smallest unit included a .00013 acre drop basin and the largest was the 327-acre Eastman Lake, with a mean size of .63 acres per unit. Wetlands varied among the cover classes listed above, with open water representing 33% of the naturally occurring water resources, and marsh, scrub-shrub and forested wetlands representing most of the rest. A total of 462 upland island inclusions were identified within the water resource boundaries, representing 59.43 acres or 2.4% of the total water resources that were mapped.

Among the riverine system there were 230 units identified, 210 of which were entirely within the town. Riverine wetlands varied from intermittent streams (N = 80) to first order perennial streams (N = 113) to second order and larger streams (N = 37). Most of the latter streams were named, such as Sawyer Brook, Stony Brook, Skinner Brook, Stocker Brook, Stroing Brook, and Bog Brook. Virtually all of these larger streams had some type of vegetated wetland alongside the stream bank and were therefore included in the designation of wetland evaluation units. According to the New Hampshire Hydrography Dataset (NHHD), the following attributes characterize the named streams in Grantham:

Stream name	Number of Reach Length Units	Stream Order⁵	Total Reach Length (mi)	% of Total Stream Resources
Ash Swamp Brook	6	2	1.56	1.72
Bog Brook	14	3	2.87	3.17
Butternut Brook	11	2	2.69	2.97
Colcord Brook	3	2	.39	.43
Eastman Brook	14	3	4.53	5.00
Little Brook	1	1	.72	.79
Littlefield Brook	11	2	3.94	4.35
North Branch	4	5	2.24	2.48
Sawyer Brook	16	4	4.73	5.23
Skinner Brook	28	4	5.84	6.46
Stocker Brook	8	4	1.95	2.16
Stone Brook	1	1	1.78	1.97
Stony Brook	13	3	4.00	4.42
Stroing Brook	8	2	1.55	1.71
Unnamed	249	2	51.96	57.44
TOTAL	387	5	90.46	100.3

Table 2. Rivers and streams in Grantham

⁵ Stream order is given for the highest level achieved in Grantham. In terms of designation, the uppermost perennial stream in a watershed is called a first order stream; if two first order stream join they become a second order stream; if two third order stream come together they become a fourth, etc.

C. Roadside Surveys & WEU Identification

Between March 17 and June 3, 2011, a total of seven roadside surveys were completed along 92.5 miles of the 110.7 miles of roads in Grantham.⁶ A total of 738 GPS points were taken, mostly at road crossings and the roadside edge of wet. Notes were kept on the hydrologic connectivity between wetland units on either side of the road. Failed or partly failed culverts were highlighted. Roughly 28% of the culverts observed were either under-sized or in full or partial failure. These notations were critical in the determination of the beginning and ending points of a wetland evaluation unit or WEU.

In general, any road crossing that involved a failed or partly failing culvert represented a break point between two wetland complexes. This was the case regardless of the size of the road. For two-lane paved roads, a similar break was determined if the culvert was deemed to be either failing or undersized. For a four-lane road (i.e. Interstate 89), all wetlands on either side of the highway was deemed to be a separate WEU. The only exception to this was Stocker Brook Median, which lay between the north and southbound lanes of the highway.

Other conditions that forced a break between otherwise connected wetlands included a significant change in wetland type – e.g. Miller Pond and its outflow brook, and certain dam structures, such as the old mill dam above Mill Pond on Skinner Brook. WEU's were also separated when basin wetlands narrowed into a long stretch of perennial stream, such as at Miller Pond West and Lower Sawyer Brook. Occasionally, linear wetlands that lay alongside a stream were kept as one unit, such the North Branch Floodplain. And in one instance, the WEU break occurred at an arbitrary location based on the separation of two distinct watersheds. This took place at Lower Eastman Brook, which was separated from Bog Brook on account of the very different land use pattern upstream of both units. This also took place between Upper Stocker Pond and Stocker Pond.

In sum, a total of 54 Wetland Evaluation Units or WEU's were identified. These wetland complexes all exceeded the minimum size set by the Grantham Conservation Commission of two acres. They ranged in size from 2.24 acres (Old Route 10 North) to 509.7 acres (Bog Brook), with a mean of 34.43 acres. The total acreage of the 54 WEU's was 1859.2 acres, or 75% of the 2474.35 acres mapped during the API mapping process. Of these WEU acres, 75% of them fell within Grantham. When considering just the area of WEU's in Grantham, the size range was between .62 acres (Cole Pond) and 322.45 acres (Eastman Lake), with a mean of 25.79 acres.

⁶ Road miles were derived from the 2010 NHDOT road data, which includes publicly accessible, privately maintained roads such as those in Eastman.

Grantham Wetlands Inventory and Assessment Project

The following list summarizes the name, number and size of each WEU:

GRANTHAM WETLANDS INVENTORY & ASSESSMENT PROJECT - WEU LIST

Wetland name/code	Date Evaluated	Investigators	Wetland Acres	Wetland Acres in Grantham	Watershed Acres
WEU#1: Chase Pond	10/23/2011	K.Burgard R.Hocker	36.14	22.13	224.00
WEU#2: Chester Rd Pond	7/17/2012	R.Hocker R.Gustafson	4.16	4.16	185.60
WEU#3: Hartshorn Road	{not written}	L.Lefebvre B.Lefebvre	22.55	22.55	44.80
WEU#4: Hogbox Pond	7/15/2012	K.Burgard R.Hocker	14.11	14.11	134.40
WEU#5: Leavitt Pond	5/6/2012	M.Connelly A.Hoffman	24.59	24.59	428.80
WEU#6: Leavitt Pond North	5/21/2012	A.Hoffman M.Connelly R.Gustafson	4.49	4.49	102.40
WEU#7: Leavitt Pond NE	5/13/2012	M.Connelly R.Gustafson R.Hocker	8.77	8.77	57.60
WEU#8: Lily Pond	10/23/2011	R.Gustafson A.Hoffman M.Connelly	8.96	8.32	76.80
WEU#9: Lower Chase Pond	10/23/2011	K.Burgard R.Hocker	5.93	5.93	294.40
WEU#10: Lower Mill Pond	5/3/2012	V.Schmalhofer J.Watts	5.55	5.55	2598.40
WEU#11: Meadowbrook Rd North	8/14/2012	R.Gustafson R.Hocker	3.88	3.88	224.00
WEU#12: Meadowbrook Rd South	7/6/2012	R.Hocker R.Gustafson	13.09	13.09	198.40
WEU#13: Mill Pond	4/30/2012	V.Schmalhofer J.Watts	11.01	11.01	2464.00
WEU#14: Miller Pond	7/19/2012	J.Watts D.Wood	62.38	62.38	1011.20
WEU#15: Miller Pond West	7/19/2012	J.Watts D.Wood	19.27	19.27	1068.80
WEU#16: New Aldridge Rd NW	7/20/2012	R.Hocker R.Gustafson	4.64	4.64	230.40
WEU#17: Northwest Corner	6/1/2012	R.Hocker R.Gustafson	11.10	9.61	115.20

Grantham Wetlands Inventory and Assessment Project

Wetland name/code	Date Evaluated	Investigators	Wetland Acres	Wetland Acres in Grantham	Watershed Acres
WEU#18: Old Rt 10 North	7/31/2012	M.Schotanus K.Burgard	2.24	1.17	211.20
WEU#19: Sherwood Forest Iso.	8/19/2012	R.Hocker R.Gustafson	4.68	4.68	87.20
WEU#20: Upper Dunbar Hill Beaver Pond	7/6/2012	R.Hocker R.Gustafson	32.29	32.29	224.00
WEU#21: Anderson Pond	{not written}	G.Schmidt R.Tober L.Dixon	20.12	20.12	70.40
WEU#22: Butternut Pond	7/3/2012	R.Tober G.Schmidt	67.46	60.94	1152.00
WEU#23: Cole Pond	5/6/2012	S.Burbidge R.Ruppel	20.27	0.62	147.20
WEU#24: Eastman Lake	7/24/2012	J.Underhill E.McArt D.Wood	338.23	338.23	5120.00
WEU#25: Grass Pond	7/16/2012	K.Burgard R.Hocker R.Gustafson	46.27	46.27	1062.40
WEU#26: Grass Pond West	7/23/2012	R.Hocker R.Gustafson D.Wood	12.68	12.68	170.00
WEU#27: Lower Stony Brook	8/12/2012	R. Gustafson R.Hocker	27.49	27.49	3520.00
WEU#28: Lower Stroing Brook	5/31/2012	C.McArt D. Wood	20.49	20.49	550.00
WEU#29: Mill Pond Dam	8/16/2012	K.Burgard R.Hocker	6.82	6.82	3539.20
WEU#30: Upper Stroing Brook	6/21/2012	C.McArt D.Wood	29.97	29.28	204.80
WEU#32: Bog Brook	11/6/2011	A.Hoffman M.Connelly R.Gustafson	509.71	148.91	22880.00
WEU#33: Deer Run North	8/14/2012	R.Hocker R.Gustafson	10.86	10.86	38.00
WEU#34: Eastman Access NW	8/16/2012	L.Lefebvre B.Lefebvre	2.59	2.42	416.00
WEU#35: Little Brook Gravel Pit	8/14/2012	D. Wood Andy Kargacos	6.05	5.93	57.00
WEU#36: Logging Trail	5/7/2012	C.Rand S.Kessler	17.84	17.84	390.40

Grantham Wetlands Inventory and Assessment Project

Wetland name/code	Date Evaluated	Investigators	Wetland Acres	Wetland Acres in Grantham	Watershed Acres
WEU#37: Lower Eastman Brook	4/28/12 & 5/7/12	C.Rand S.Kessler	44.22	40.02	5619.20
WEU#38: Lower Stocker Brook	7/23/2012	M.Schotanus K.Burgard	8.75	8.75	1747.20
WEU#39: Hastings Road South	7/7/2012	D.Wood T.Crawford	7.92	7.92	224.00
WEU#40: Stocker Brook Median	7/31/2012	M.Schotanus K.Burgard	4.74	4.74	1696.00
WEU#41: Wellfield West	8/13&14/2012	D.Wood Andy Kargacos	5.31	5.31	57.60
WEU#42: Ash Swamp East	8/9/2012	M.Schotanus K.Burgard	24.47	24.47	89.00
WEU#43: Cote-Reney Complex	7/23/2012	M.Schotanus K.Burgard	19.75	19.75	23072.00
WEU#44: Eastman North Entrance	7/20/2012	M.Schotanus K.Burgard	9.19	9.19	172.00
WEU#45: Greensward Drive East	5/30/2012	C.McArt D.Wood	10.10	10.10	62.00
WEU#46: Lower Sawyer Brook	8/20/2012	K.Burgard R.Hocker	10.24	10.24	2393.60
WEU#47: Madore Spruce Fen	8/8/2012	M.Schotanus K.Burgard	29.58	14.19	1363.20
WEU#48: North Branch Floodplain	07/14&15/12	M. Schotanus	52.40	52.40	4290.00
WEU#49: Olde Farms Road-Skinner Brook	8/11/2012	R.Hocker K.Burgard	13.89	13.89	3731.20
WEU#50: Stocker Pond	7/25/2012	M.Schotanus K.Burgard	104.41	104.41	1670.40
WEU#51: Stony Brook Floodplain	8/8/2012	M.Schotanus K.Burgard	10.96	10.96	30982.40
WEU#52: Upper Ash Swamp	8/15/2012	R.Hocker R.Gustafson	14.71	9.63	1376.00
WEU#53: Upper Stocker Pond	7/25&31/2012	M. Schotanus K.Burgard	28.30	7.00	1363.20
WEU#54: Yankee Barn North	8/20/2012	K.Burgard R.Hocker	3.75	3.75	217.60
WEU#55: Hogbox West	8/9/2012	M.Schotanus K.Burgard	17.87	17.87	1555.20
SUM			1857.24	1406.11	130980.80

Table 3. List of Wetland Evaluation Units (WEU's) in Grantham

D. Off-Road Surveys

Off-road surveys took place only after written landowner permission had been received by the Grantham Conservation Commission. Of the 168 landowners (270 parcels) that were contacted, 84 approved access (160 parcels, 59%) and 9 denied access (14 parcels, 5%). A total of 75 landowners did not respond (96 parcels, 36%). In three instances on-site access to a WEU was completely prevented as a result of landowner access denial, though in one of those instances portions of the WEU were visible from a public road. In all other cases, on-site access or visibility from accessible land or public roads was available to at least a portion of the WEU. The following map summarizes the responses from the landowner request.

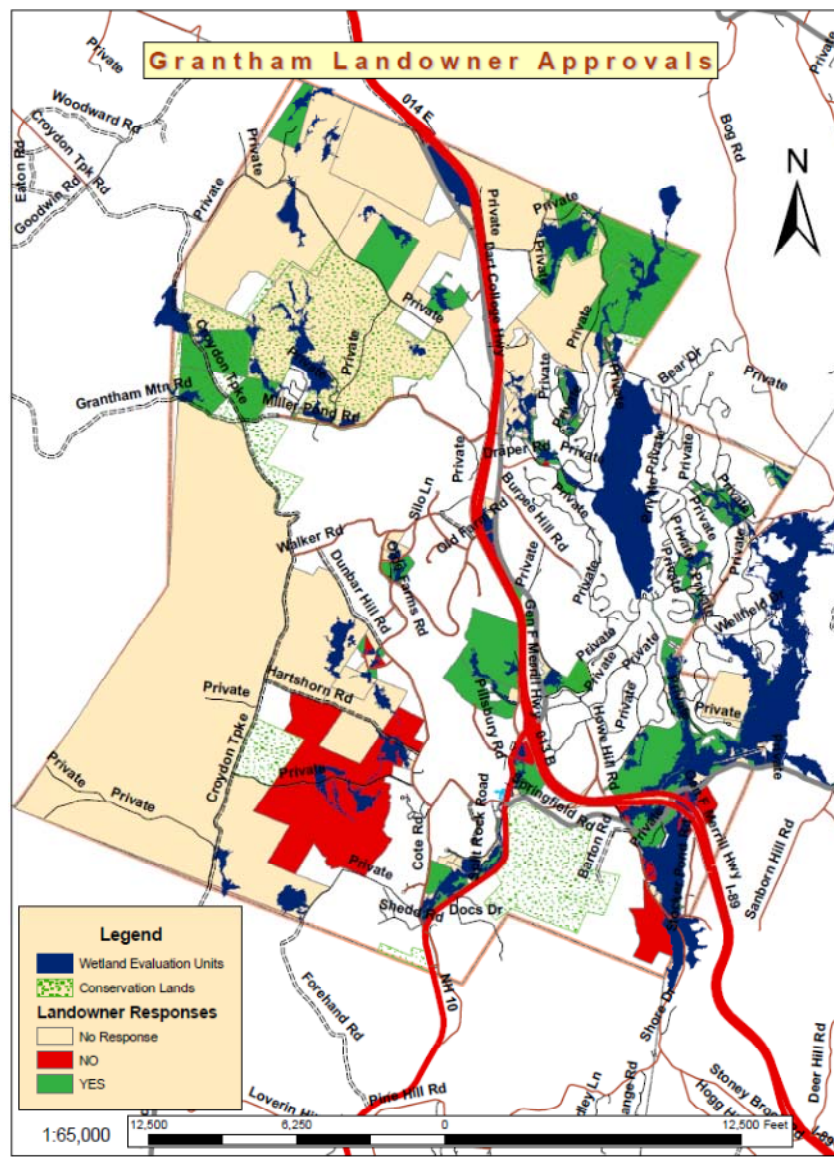


Fig. 6 Landowner approvals map showing different responses and location of WEU's

A total of 22 volunteers, including six of the seven members of the Grantham Conservation Commission, completed surveys using the NH method wetland assessment technique. Volunteers completed between one and 20 different evaluations in teams of two or three. They filled out the wetland assessment data forms both in the office and the field, but in the field the focus was on verifying NWI cover types, identifying scenic vista points, and establishing sites for educational potential. Notes were also kept on any changes to the maps that were provided them. Five evaluations were completed in 2011, but owing to the lateness of the year, most volunteers chose to complete the evaluations in 2012. These were restarted in late April and finalized by mid-August.

E. Wetland Assessment

Each volunteer filled out the 16-page set of data sheets according to guidance provided in Section Three of the NH Method. All 88 questions were answered with a ranked score of 1, 5, or 10, with a "0" inserted for an absence of condition. At times, notes were jotted down as to the rationale for answering a particular question, especially for those answers that entailed a mid-point rank such as 2.5 or 7.5 as allowed by the method. The series of answers were then summed for each function and the average score provided at the bottom of each data sheet. These scores were then entered into a master spreadsheet by one or more Grantham Conservation Commission members and forwarded to EMC for review. This QA/QC step was critical in order to 1) ensure accuracy of the answers given, and 2) to provide consistency among the responses for particular questions. For example, if the WEU had open water, the difference between the amount of *shallow* water and *deepwater* was checked using aerial photography. Since several answers critical to wildlife habitat depend on this answer, both leaf-on and leaf-off photography was reviewed. When in doubt, queries were made to the evaluators and a final response was obtained.

Another common concern with the evaluation answers was whether or not a particular WEU had public or private access. The attribute was important when answering questions about #4 Scenic Quality, #5 Educational Potential, and #6 Wetland-based Recreation. Access was deemed possible for #4 Scenic Quality if the WEU was alongside a Class VI or better roadway even if the landowner had denied access to the land. Access was also assumed to be possible for education or recreation if the landowner had not posted the land and permission to access the property had not been denied. Access was not deemed possible for functions #5 and #6 however, if the landowner had posted the land or had denied access to the wetland evaluation team. In these cases, low values for these functions were returned.

The types of soils in and adjacent to the wetland evaluation unit were critical when considering groundwater recharge. Many respondents thought that if the wetland had poorly drained soil (along with the wetter very poorly drained soil) then the WEU would support groundwater recharge. The NH Method provides distinct guidance on those soils that meet the definition of “coarse” according to NRCS soil standards. For the 100-foot upland buffer, the soils are listed in Table 3 of Section Three of the NH Method. For soils within the wetland itself, the list of more porous soils are listed in Table 4. Coarse soils in wetlands, particularly during drier times of year, have a greater capacity to absorb precipitation and infiltrate water into underground aquifers. If the coarse soils happen to lie above a state-recognized stratified drift aquifer then the WEU gets extra points. If they are not above a NHDES-mapped aquifer but have coarse soils, they still receive point under question 8.3 and 8.4 since they will contribute to underground water recharge more readily than those wetlands that have fine-textured soils.

The Noteworthiness function (#12) was also challenging for most respondents. Question 12.1 asks if the wetland included what the NH Fish & Game Departments calls “critical habitat,” namely marsh and shrub wetland, floodplain forest, or peatland. If the WEU contained map units that reflected these conditions, notably NWI codes PEM, PSS, or PML, then they were deemed to have critical habitat. This was also the case for the few WEU’s that contained forested swamps with the water regime modifier “Ba,” since this meant that saturated *peatland* soils were present. A second concern arose over question 12.4, which asked if the WEU had local or regional significance. Those that were cited by Grantham’s CCLI were given a ‘Yes’ answer to this question. Finally, since respondents may not have been aware of the top ten largest WEU’s, the answer to question 12.3 was checked against the master list provided above.

F. Designation of Prime Wetlands

One of the principal goals of the Grantham Wetlands Inventory and Assessment Project was the identification of high value or *prime* wetlands. According to state statute, these wetlands are those that,

“...because of their size, unspoiled character, fragile condition, or other relevant factors, make them of substantial significance. A prime wetland shall be at least 2 acres in size, shall not consist of a water body only, shall have at least 4 primary wetland functions, one of which shall be wildlife habitat, and shall have a width of at least 50 feet at its narrowest point. “

RSA 482-A:15 I-a

The state also provides explicit rules in Env-Wt Chapter 700 about how to designate prime wetlands in any municipality. The principal difference between a prime wetland and a non-prime wetland is the fact that any project work that is proposed for a prime

wetland – and that goes through the standard process of applying for a wetlands permit – must include a public hearing in Concord before being approved by the Department (Wetlands Bureau). The Bureau effectively “raises the bar” on activities in a prime wetland, and assists the municipality in screening out unwanted activities that could otherwise compromise the functionality of these wetlands. The designation of prime wetlands must go through a local hearing process wherein any affected landowner must be notified in writing by the municipality at least 30 days in advance of a public hearing on the merits of designating the wetland as prime. Further, a second public hearing must be held if there are any serious concerns, questions or contentions to the designation of a particular prime wetland. Finally, the town must approve the designation as a warrant article at a regular town meeting and submit such evidence to the state as the Chapter 700 rules require. The latter includes maps of certain specifications and documentation that proves that a proper evaluation and analysis has been completed by the town. This report provides the basis for documenting the verity of the high value wetlands in Grantham as candidate prime wetlands, however, final map work must be completed once certain prime wetlands are voted on and approved at town meeting.



Fig. 7 Stocker Pond, along Sanborn Hill Road, provides exceptional wildlife habitat and lies above an aquifer

Data Analysis Results

Of the 54 wetland evaluation units that were identified and assessed, thirteen (13) wetlands achieved the rank of high or very high value wetlands according to the procedures described above under Section II. F. In descending order of point rank totals, these include the following WEU's:

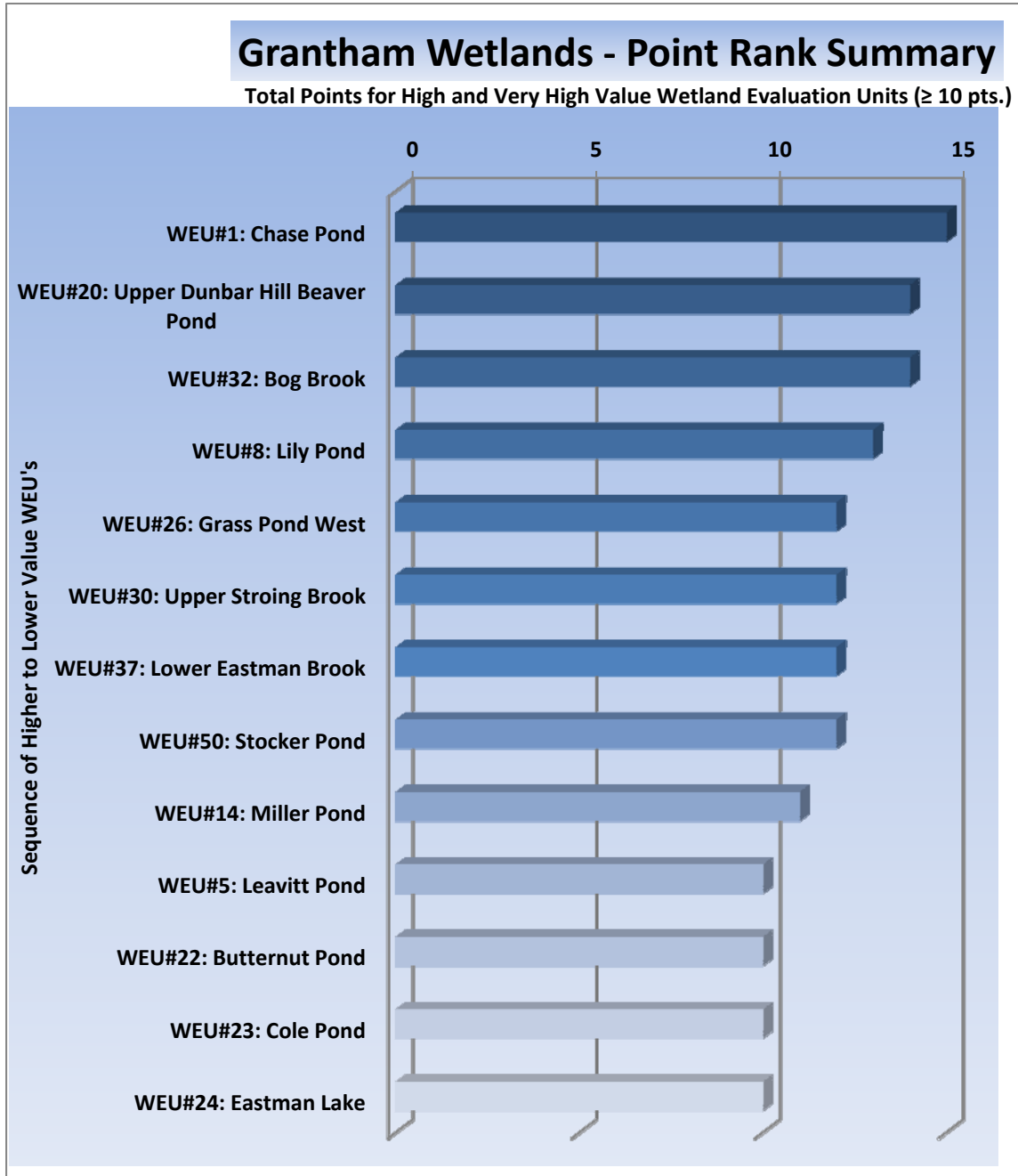


Fig. 8 Top-ranked WEU's according to the final point tally, in descending order

The total acreage of these 13 WEU's is 1292.2 acres, or roughly 70% of the acreage of all 54 WEU's combined. The smallest is Lily Pond (8.96 acres) and the largest is Bog Brook (509.7 acres), with a mean of 105.9 acres. Eight of the high and very high value WEU's include acreage outside of Grantham. As required by the NH Method, these units were evaluated as a whole since their functional attributes clearly crossed municipal boundaries. Within the town itself, the 13 top-ranking WEU's include a total acreage of 866.77 acres, with the smallest unit being lower Cole Pond at .62 acres and the largest, Eastman Lake at 322.45 acres, with a mean of 66.68 acres. The total acreage of the high and very high value WEU's in Grantham equaled 61.6% of the total wetland acreage in Grantham, and 4.83% of the town as a whole.

All 13 of the highest scoring WEU's exceeded the mean of the average scores for at least seven of the 12 functions recognized by the NH Method. Six of the top-scoring WEU's exceeded the 95% percentile for flood storage value, with Stocker Pond achieving the highest score overall for that function. Eight of the 13 high-scoring WEU's exceeded the mean for combined sediment trapping and nutrient transformation scores with Bog Brook, Chase Pond, Stocker Pond, and Upper Stroing Brook having the highest scores. Nine of the 13 WEU's exceeded the mean for the combined average scores for wildlife, with Butternut Pond, Upper Dunbar Hill Road Beaver Pond, Upper Stroing Brook, and



Fig. 9 Lower Bog Brook as seen from Springfield Road

Chase Pond having the highest values.

Appendix B contains the spreadsheets and charts that compare each of these wetlands' scores against one another, as well as the scores for those wetlands that received less than 10 cumulative points.

Pages B-19 to B-21 also show the point ranks by WEU in descending order.

IV. CONCLUSIONS & RECOMMENDATIONS

The first step in protecting the wetland functions and values that provide invaluable services to society is to identify those wetlands of the highest value. The Grantham Wetlands Inventory and Assessment Project has succeeded in this task. Through a methodical, iterative, and fair process, each wetland in Grantham has been mapped, identified according to salient cover and soils types, and broken up into reasonable wetland complexes for evaluation purposes. These Wetland Evaluation Units or WEU's have undergone a rigorous, 88-question evaluation to address 12 important functions that wetlands serve. Through a remarkable effort of 22 town volunteers, this evaluation protocol has been completed in under a year's time and provided the town with excellent guidance on where the most valuable wetlands occur in Grantham.

The results of the wetland assessment has not only been a deductive prioritization of high-scoring wetland complexes, it has also identified those wetlands that provide the greatest value in preserving the most important societal functions described in Grantham's Master Plan, namely, the ability of wetlands to prevent downstream destruction by retaining flood waters, the ability of wetlands to ensure that water quality is at its highest level, the ability of wetlands to provide fresh clean water for ground water drinking supplies, and the ability of wetlands to continue to provide habitat opportunities for wildlife species as well as those people that enjoy them. Given the fact that Grantham's wetlands have provided millions of dollars in flood damage relief, water quality remediation, and invaluable opportunities for public enjoyment of outdoor environments, the need to protect these natural resources should be self-evident to all citizens of the town.

This report provides the basis for identifying the highest value wetlands to protect and offers the reader a rational means for doing so. With the exception of Cole Pond, whose high-ranking wetland mostly lies outside of the town's boundaries, all of the remaining 12 wetland complexes noted above are recommended for further protection as *prime wetlands* in the state of New Hampshire. It is understood that the Grantham Conservation Commission must deliberate on this recommendation, and that they may seek to protect these wetlands over a period of time. Since there is no requirement as to when high value wetlands get designated as prime wetlands, it is incumbent upon the Commission to balance the needs of water resource protection and social acceptability when putting forth their list of final recommendations.

In terms of the actual mechanism to provide ongoing protection to the designated prime wetlands after they have been approved by the town and the state, a wetlands conservation overlay district ordinance would be in order. Such an ordinance has been

approved in over 106 towns in the state, and they have successfully helped guide the local process of approving land use activities that may impact critical water resources. Appendix C provides a model of such an ordinance that if approved, will offer the residents of Grantham a legal tool for preventing the destruction of these wetland resources by ensuring more careful review under the state's regular wetland permitting process, and by applying reasonable buffer protections to be applied through the Special Exception process. Since the state has no jurisdiction over wetland buffers – the 100-foot prime wetland buffer having been repealed in 2011 – it is incumbent upon the town to consider adding local control of those high value wetlands that depend upon appropriate land uses in the buffer in order to continue to provide essential services to its residents. It is hoped that the general wishes of the town, as reflected in the latest Master Plan and the Critical Conservation Lands Index, will be upheld in a town wide vote that approves the enhanced protection for these cherished water resources in Grantham.



Fig. 10 Even non-prime wetlands continue to provide exceptional benefits to local residents, such as Upper Stocker Pond as depicted here from Sanborn Hill Road

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Appendices

A. Maps

1) 8.5 x 11" included with report

Grantham Base Map with GPS points	A-1
Waypoint List for Base Map	A-1.1 to A-1.15
Grantham Wetlands Map	A-2
Sample WEU Maps	A-3 to A-4
Wetland Ranking Map	A-5

2) 24 x 36" maps included separately

Grantham Wetlands Base Map – Aerial Photo Base	
Grantham WEU Base Map – USGS Topo Base	
Grantham Wetlands Assessment Map – WEU Ranking	

B. Spread Sheets & Charts

WEU Summary Table	B-1 to B-2
WEU Assessment Scores by Function	B-3 to B-6
WEU Charts by Function	B-7 to B-18
WEU Point Sum Charts	B-19 to B-21

C. Model Wetlands Ordinance C-1 to C-11

D. Sample Wetland Assessment Data Sheets D-1 to D-16

{In Digital CD File:

WEU Assessment Sheets with comments;

GIS shapefiles of all WEU's

All WEU maps in pdf format}