

CENTER HARBOR
PRIME WETLANDS COMPLETION PROJECT

PHASE III



Fogg Hill Bog

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CENTER HARBOR PRIME WETLANDS

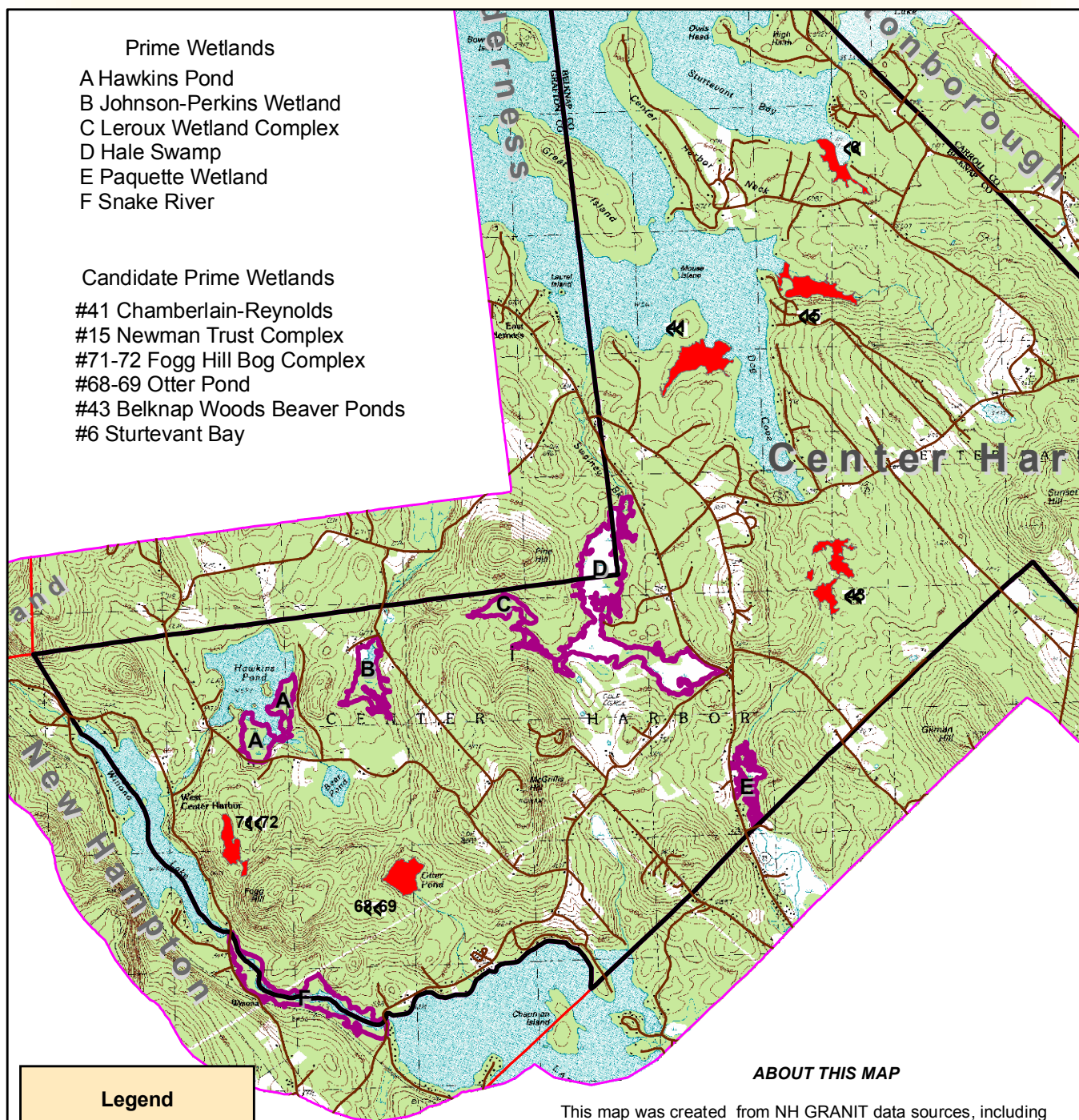
AND CANDIDATE PRIME WETLANDS

Prime Wetlands

- A Hawkins Pond
- B Johnson-Perkins Wetland
- C Leroux Wetland Complex
- D Hale Swamp
- E Paquette Wetland
- F Snake River

Candidate Prime Wetlands

- #41 Chamberlain-Reynolds
- #15 Newman Trust Complex
- #71-72 Fogg Hill Bog Complex
- #68-69 Otter Pond
- #43 Belknap Woods Beaver Ponds
- #6 Sturtevant Bay

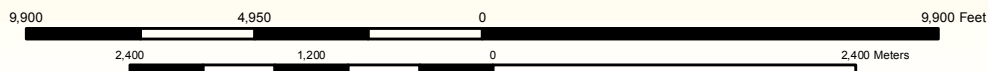


Legend

- Roads
- Phase III Candidates
- Town Boundary
- Half-mile Buffer Area
- Political Boundaries
- Prime Wetlands

ABOUT THIS MAP

This map was created from NH GRANIT data sources, including the 2010 color infrared aerial photos and the 1987 USGS topographic quads. Soil types were derived from 2005 NRCS maps and field inspection of wetland cover types, which entailed a field delineation of the perimeter using a Garmin 12XL GPS unit with an average precision of 3.2 - 6.2 m. Candidate prime wetlands were selected on the basis of their unspoiled and fragile nature, which was in part determined in the field. Most candidates were also found to include significant ecological resources such as rare and endangered species and exemplary natural communities.



SUMMARY

Between July and December 2012 the third phase of the Prime Wetlands Mapping Project was completed in Center Harbor, New Hampshire. The focus of this effort was the mapping and assessment of six additional candidate prime wetlands as recommended in the December 2011 Center Harbor Natural Resource Inventory (NRI) and the June 2012 Master Plan.¹ Section 6.10.12 of the latter document recommended adding a final suite of the largest and highest value wetland complexes in Center Harbor to the roster of six existing prime wetlands. These included Chamberlain-Reynolds / Heron Cove, Newman Trust Wetland, Fogg Hill Bog, Otter Pond, Belknap Woods Beaver Ponds, and Sturtevant Bay.

Beginning in June 2012, property access permission was sought by members of the Center Harbor Conservation Commission (CHCC) and Town Clerk from all property owners that owned lots in or adjacent to the six candidate prime wetlands. Written permission was granted on 14 of the 20 lots involved, with two denials and four no responses. After initial map preparation, fieldwork began in July on permissioned properties and continued until November. GPS-based mapping was completed in the field, and assessments were completed soon thereafter.

Office-based assessments followed the *Method for the Inventory and Assessment of Freshwater Wetlands in New Hampshire*, or the 'NH Method' (Stone & Mitchell, ed.s, 2011). The following functional values of wetlands were assessed:

- 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

Field data was transferred to the NH Method data sheets in the office following the field surveys. GPS data was uploaded into ArcGIS 9.2 project files and individual maps prepared according to the specifications of the NH Method. In addition, a large-scale location map was prepared that exhibited some of the wetland attributes of each candidate prime wetland.

¹ The Master Plan chapter on Natural Resources can be accessed at :
<http://www.centerharbornh.org/mp62012.pdf>

All six wetland complexes met the minimum requirements for designation as prime wetlands, and exhibited the “unique, fragile, and unspoiled character” required by law. Chamberlain-Reynolds had the highest average scores for nine out of 12 functions and had an overall point rank of 95. Sturtevant Bay had the highest scores for Education Potential and Shoreline Anchoring and a point rank of 82. Newman Trust Wetland had the second highest point rank of 86 owing to its contribution to water quality and rare species. Belknap Woods had the second highest scores for wildlife and a point rank of 85. Otter Pond had the largest and most undeveloped open water habitat and a point rank of 81. Fogg Hill Bog, although the most unique, was the smallest wetland and the lowest point rank score of 75.

The following report summarizes the findings of the field and map work, and provides an analysis of the wetland functions for each wetland complex. This report is intended to provide local officials and the town citizenry with background information on each candidate prime wetland as well as satisfy the submittal requirements to the N.H. State Wetlands Bureau. This submission will take place after the expected affirmative town warrant vote in March of 2013.

Acknowledgments

The author would like to thank the following individuals and organizations for their support during this project:

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Harry Viens
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Lakes Region Planning Commission

Squam Lakes Conservation Society (for digital approximations of tax parcels)

Lakes Region Conservation Trust (for conservation parcel data)

NH Natural Heritage Program (for rare plant information)

NH Fish & Game Department (for rare animal information)



Belknap Woods Beaver Pond

I. Overview



Fig. 3 Fogg Hill Bog looking through trees at the south end

In late 2008, the Center Harbor Conservation Commission (CHCC) commissioned an update of the prime wetlands study that was begun in 1978 by Barry Keith. The purpose of the update was to verify the “unique, fragile, and unspoiled character” of the five wetlands that were voted in as prime in 2006. These included the Hawkins Pond Wetlands (#79-80), the Johnson-Perkins Wetlands (#88), the Leroux Wetland Complex (# 58), Hale Swamp (#54-55), and the ‘Mug’ or Paquette Wetland Complex (#52). The qualifications of each prime wetland, as prescribed by law under RSA 482-A:15, were assessed for their functional values using the *Comparative Evaluation of Non-Tidal Wetlands in New Hampshire* or the NH Method (NHDES 1991). By the spring of 2009 the final report was submitted to the CHCC for review and by September 2009 it was submitted to the NHDES Wetlands Bureau for approval. Receipt of this approval was dated March 8, 2010.

Phase II of the Prime Wetlands Protection Project began two months later in May of 2010 and was concluded in March of 2012. This phase focused on the Snake River (#77), a wetland complex in the western part of town that was recognized as having critical wildlife habitat and water quality value above the adjacent Lake Waukewan. Both the New Hampton Conservation Commission and the CHCC had commissioned studies to help protect this high quality water resource. On March 8, 2011, by a vote of 262 to 71, the voters of Center Harbor approved the designation of the Snake River as prime. A month after the submittal of the final report to the State in February 2012 approval was received. In the meanwhile, the Town of New Hampton had secured conservation protection for all three parcels on their side of the Snake River thus ensuring its long-term protection.

The current study arose from the Center Harbor Natural Resources Inventory (NRI) Project that was completed in December 2011. This report provide an in-depth mapping update of all wetlands and water resources in Center Harbor and identified an additional six wetland complexes as having high or very high value. These wetlands included the Chamberlain-Reynolds / Heron Cove Complex (#41), the

Newman Trust Wetland Complex (#15), Fogg Hill Bog (#71-72), Otter Pond (#43), Belknap Woods Beaver Pond Complex (#68-69), and Sturtevant Bay (#6). Phase III of the Prime Wetland Protection Project therefore focused on these wetland resources and applied the same methodology of delineating, classifying, mapping, and assessing these wetlands on the ground. The following section describes these methods both according to office and field-based work that ensued.

II. Office & Field Methods

Most of the background GIS mapping for Phase III of the wetlands protection project had been completed as a result of the town-wide NRI. The initial aerial photograph interpretation (API) mapping of wetlands that had taken place in 2005 was updated in 2009 using 2006 color, 1-foot pixel orthophotography of the Lakes Region and then in 2011 using 2010 color infrared, 1-foot pixel orthophotography. Base maps were created of each of the six wetland complexes using both aerial photo and USGS topographic base information. Property owners were identified and letters of request were sent out seeking approval for private property access during the field portion of the inventory and assessment. The following illustrates this letter:

July, 2012

TO: Property owners of Center Harbor, NH
FROM: Center Harbor Conservation Commission
Re: Center Harbor Prime Wetlands Project

Dear Landowner;

The Center Harbor Conservation Commission (CHCC) is in the process of continuing its prime wetland protection project that began in 1978 and was approved for certain wetlands in 2006 and 2011. According to the recently completed Natural Resources Inventory (NRI) of the town, there are six remaining wetland complexes of extremely high value that may be considered for designation as prime wetlands. The wetlands have exceptional wildlife habitat, water quality, and flood storage value. Based on aerial photo interpretation, the following lots appear to contain the approximate amounts of wetland:

| <u>Name</u> | <u>Map/Lot #</u> | <u>Lot Size</u> | <u>Wetland size (approx.)</u> |
|------------------------------------|------------------|-----------------|-------------------------------|
| 1) Chamberlain-Reynolds/Heron Cove | Map 213 Lot 11 | 150 | 22.5 |
| 2) Newman Trust Wetland | Map 208 Lot 14 | 22.14 | 17.25 |
| | Map 208 Lot 13 | 45.71 | .3 |
| | Map 208 Lot 15 | 10.7 | .06 |
| | Map 208 Lot 1 | 17 | 1.39 |
| | Map 208 Lot 2 | 47 | 0.0 |
| 3) Fogg Hill Bog | Map 224 Lot 4 | 192 | 11.45 |
| | Map 224 Lot 12 | 5.7 | .05 |
| 4) Otter (Tuttle) Pond | Map 229 Lot 4 | 24 | .68 |
| | Map 104 Lot 19 | 104 | .43 |
| | Map 229 Lot 3 | 72 | .18 |
| | Map 225 Lot 10 | 84 | 2.46 |
| | Map 225 Lot 0 | 12 | 12 |

| | | | |
|-------------------------------|----------------|-------|-------|
| 5) Belknap Woods Beaver Ponds | Map 215 Lot 7 | 68 | 8.67 |
| | Map 215 Lot 14 | 40 | 11.52 |
| 6) Sturtevant Bay | Map 220 Lot 5 | 158.5 | 2.81 |
| | Map 208 Lot 31 | 32.65 | 2.01 |
| | Map 208 Lot 32 | 4.35 | 1.82 |
| | Map 208 Lot 33 | .19 | 0 |
| | Map 208 Lot 36 | 10.55 | .24 |
| | Map 208 Lot 43 | 3.61 | .17 |
| | Map 208 Lot 0 | 4.5 | 4.5 |

Since wetlands protection is a top priority in the Town, the Center Harbor Board of Selectmen and the Center Harbor Planning Board have sanctioned this study and are contributing to its completion. [Please see the Project Plan in the Town Offices.]

You have been identified as a landowner of one or more of the lots listed above that may contain a portion of a potential prime wetland. Because of this, the CHCC is seeking written permission to conduct a field delineation and evaluation of these wetland resources. The principal investigator for this project, Dr. Rick Van de Poll of Ecosystem Management Consultants in Sandwich, may need to access your property and make a brief visual inspection of these wetlands. He will leave no markers, signs, sampling equipment or any other evidence of his passing. Permission is for foot access. Typically, this will involve just one visit.

The attached letter of consent releases you from any liability for injury that may be caused to the principal investigator while crossing your property that is the result of negligence. It also acknowledges your receipt of this letter or request. Should you wish to deny access to your property, please sign the appropriate denial form. Should you allow it, please indicate when and where access may be allowed. If you request to be notified prior to the field site visit, the principal investigator will follow up with a phone call or email in advance. Your cooperation is greatly appreciated. It will go a long ways towards the protection of this invaluable part of our natural economy!

If you have any questions or concerns about this project, please contact Bruce Bond, Chairman, Center Harbor Conservation Commission at 279-6430.

Thank you very much for your cooperation.

Sincerely,

Center Harbor Conservation Commission

PS. Please keep in mind that this permission is to study the wetlands only. It does not authorize the CHCC to designate prime wetlands. That must be done according to a town-wide vote at a regular balloting session in March.

Beginning in July 2012, seven field days were used to complete the on-the-ground delineation and map refinement of each wetland complex. Field sessions took place according to the following schedule:

| CENTER HARBOR PRIME WETLAND PROJECT - Field Log 2012 | | | | |
|---|--------------------|-----------------------------------|--|------------|
| DATE | SURVEY TYPE | LOCATION | PURPOSE | GPS |
| 7/27/2012 | Off-road | Chamberlain-Reynolds / Heron Cove | Gen. reconn and discussion of primes, values, restrictions with NEFF Director & Forester | none |
| 10/18/2012 | Off-road | Newman Trust Wetland | Wetland delineation & assessment reconn | 1-67 |
| 10/25/2012 | Off-road | Belknap Woods | Trails reconn. and wetland delineation | 1-224 |
| 10/31/2012 | Off-road | Belknap Woods | Finish wetland delineation and assessment | 225-421 |
| 11/8/2012 | Off-road | Sturtevant Bay & Otter Pond | Complete wetland delineation & assessment | 1 - 270 |
| 11/9/2012 | Off-road | Chamberlain-Reynolds / Heron Cove | Finish wetland delineation and assessment | 271 - 546 |
| 11/12/2012 | Off-road | Fogg Hill Bog Complex | Complete wetland delineation & assessment | 1 - 174 |
| | | | SUM | 1207 |

Table 1. Field Log for prime wetland assessments

Fieldwork utilized a Garmin 12XL GPS unit and a Canon SXIS 20x zoom digital camera. Each wetland was circumnavigated where written private property permission was obtained. For those landowners where prior contact was requested, a phone call or email was sent to advise them of the field date. For properties where permission was denied or where the landowner did not respond, information was gained by aerial photograph only (mostly) or by viewing the property from public land (e.g. from Squam Lake). Wetland boundaries were approximated on the basis of the three technical parameters of wetlands, namely, hydrology, hydric soils, and wetland plants. In spite of the adherence to these state and federal criteria for wetlands, no attempt was made to perform a thorough wetland delineation as prescribed by state law.¹

Data analysis followed the protocols prescribed by the *Method for the Inventory and Evaluation of Freshwater Wetlands in New Hampshire*, or the 'NH Method' (Stone & Mitchell, ed.s 2011).² Having served as the principal wetland scientist author of this publication, I was familiar with the requirements for reviewing and completing the data sheets associated with the method. The following wetland functions were assessed using the NH Method:

- 1) Ecological Integrity
- 2) Wetland-dependent Wildlife Habitat
- 3) Fish & Aquatic Life Habitat
- 4) Scenic Quality

¹ As was the case in Phase I & II of the Prime Wetlands Protection Project, the boundary of each wetland as shown on the attached maps are approximate only, and therefore are as accurate as the limit of a hand-held GPS unit. On-the-ground accuracy for the exact location of each wetland in question must be verified by a Certified Wetland Scientist registered with the state of New Hampshire.

² The 'NH Method' can be accessed at <http://www.nhmethod.org>

- 5) Educational Potential
- 6) Wetland-based Recreation
- 7) Flood Storage
- 8) Groundwater Recharge
- 9) Sediment Trapping
- 10) Nutrient Transformation
- 11) Shoreline Anchoring
- 12) Noteworthiness

Each function included a data form that had between four and 11 questions. Each question had a range of answer scores from “0” to “10.” In certain instances, an intermediate score was assigned, i.e. a “2.5” for a value that fell between “0” and “5.” Notes explaining the rationale behind each intermediate score were provided in the appropriate column. Each set of function scores were then averaged and entered into the data analysis spreadsheet that comes with the method. A copy of the data sheets can be found in Appendix C.

This data was then transformed into a **point rank** according to the five attributes used in both Phase I & II of the Prime Wetlands Protection Project:

- 1) **Size** – wetlands were arranged by size and a rank given for each – i.e. 1st, 2nd, 3rd, etc.
- 2) **Mean scores** – a point was assigned for each wetland function where the average score exceeded the mean score for all six wetlands; these were then summed and a rank provided (e.g. 1st, 2nd, 3rd etc.)
- 3) **Wildlife** – a cumulative sum was derived from the average scores for Ecological Integrity, Wetland-dependent Wildlife Habitat, and Fish & Aquatic Life Habitat; a subsequent rank was then provided for each of the six wetlands
- 4) **Water Quality** - a cumulative sum was derived from the average scores for Sediment Trapping, Nutrient Transformation, and Shoreline Anchoring; a subsequent rank was then provided for each of the six wetlands
- 5) **Rare & Endangered Species and Exemplary Natural Communities**³ - for each wetland a point was assigned for each occurrence of a rare plant, animal, or potentially exemplary natural community; the point totals were then summed and rank was provided as noted above

Point ranks were summed for the five attributes above and listed in order of lowest to highest (i.e. most number of firsts highest and so on). These placement ranks were then deducted from 100 points to provide an arbitrary measure of value more familiar to the general public, wherein the top-scoring wetlands achieved the highest number (with a maximum of 95) and the lowest scoring wetlands the lowest number (with a minimum of 64). Graphical representations of the average scores for each wetland, all wetlands, and the point rank total for all wetlands are provided in Appendix B.

³ “Exemplary” is a term used by the NH Natural Heritage Bureau that defines high quality examples of natural communities; the use of the term here is intended to offer the opinion of the author only, and does not assure that the state Natural Heritage Staff may come to the same finding and designate such a natural community as “exemplary.” See for a more complete explanation of the term at <http://www.nhdfi.org/about-forests-and-lands/bureaus/natural-heritage-bureau/about-us/naturalcommunities.aspx>

III. Results / Discussion of Findings

A. General Findings

Between July and November 2012 all six candidate prime wetlands were visited on the ground in whole or in part. Property access permissions were provided by 70% of the landowners (N = 14), denials were given by two landowners (10%), and no responses were returned for four landowners (20%).⁴ Denials and no responses inhibited most fieldwork at the Newman Trust Wetland, although visibility from Squam Lake and from the adjacent Audubon Proctor Sanctuary provided some degree of reconnaissance. All other wetlands were accessible in their entirety on the ground.

The following size and location data for each of the six candidate prime wetlands was gathered by fieldwork, aerial photograph, or both:

| CODE | NAME | SIZE | SIZE | TAX MAP | NEAREST ROAD(S) | ZONING |
|--------|-----------------------------------|-------|--------|-------------|--------------------------------|--------|
| | | NWI | Actual | Sheet #'s | | |
| #41 | Chamberlain Reynolds / Heron Cove | 20.17 | 24.60 | 213 | College Road | RR |
| #15 | Newman Trust Wetland | 18.79 | 18.35 | 208 | Newman Road, Mouse Road | RR |
| #71-72 | Fogg Hill Bog Complex | 11.32 | 11.66 | 224 | Winona Road, Fogg Hill Road | RR |
| #68-69 | Otter Pond | 15.94 | 15.52 | 104,225,229 | Piper Hill Road, Waukewan Road | RR |
| #43 | Belknap Woods Beaver Ponds | 10.53 | 19.30 | 215,220 | Dane Road, Keyser Road | RR |
| #6 | Sturtevant Bay | 4.53 | 11.23 | 208 | Center Harbor Neck Road | RR |
| | SUM | 81.28 | 100.66 | | | |

Table 2. Size and location data of six candidate prime wetlands

In the chart above the “Size NWI” column refers to the estimated size according to the National Wetlands Inventory (NWI) mapping program of the late 1980’s. Because of the lack of sophisticated aerial photographs and the scope of the project at that time (i.e. Nationwide), the accuracy of the size estimates was very low. In addition, certain wetlands required distal delineations at the deepwater end in order to provide necessary coherence to the functional values being assessed. For example, the Chamberlain-Reynolds / Heron Cove wetland bordered on Squam Lake and contained an open water edge that included an aquatic landscape that was integrally a part of the wetland complex. A similar situation was encountered at Sturtevant Bay and at the Newman Trust Wetland. In each case, a decision was made to include the shallow water portion of Squam Lake with the adjacent wetland since both parts were hydrologically connected and contained the entire hydro-sequence that affects the hydric soils and hydrophytic vegetation of the wetland.

⁴ Note: permission to access the two “public” lots, the New England Forestry Foundation Chamberlain-Reynolds Forest and the Squam Lakes Association’s Belknap Woods was given in person. Also, two of the lots in the list on pages 2 and 3, Map 208 Lot 0 and Map 225 Lot 0, are public open water lots.

The inclusion of shallow water embayments into the wetland evaluation unit for Chamberlain-Reynolds, Sturtevant Bay and Newman Trust resulted in the addition of *lacustrine* cover classes to the mix of NWI types. As noted in the explanatory publication on wetland cover types, *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979), lacustrine types refer to open water lakes and their shallow water shores. By definition, shallow water includes all inundated areas that have a mean depth of less than 6.6 feet (2 meters). Based on bathymetric maps, this shallow/deepwater limit was delimited on the base maps as shown in Appendix A and assigned as the farthest edge of each wetland evaluation unit. In the case of these three wetland complexes, these areas have substantial value to the functions of Wetland-dependent Wildlife Habitat (e.g. waterfowl), Fish and Aquatic Life Habitat (e.g. fish), and Shoreline Anchoring. In at least two of these wetlands, as described below, these areas also harbor rare and endangered species.



Fig. 4. Shallow water embayments as shown above at Chamberlain-Reynolds provide critical habitat that is dependent on upstream wetland integrity

In all, a total of 56 NWI cover classes (130 units) were identified across the 100+ acres and six wetlands. The most abundant wetland cover type was scrub-shrub marsh (PSS) with 21 units across 24.1 acres. These are generally colored orange on the attached maps. The second most frequent type was emergent marsh (PEM) with 19 units representing 8.95 acres. These are generally colored yellow on the attached maps. Larger yet less frequent numbers of mixed forest and shrub swamp (PFO/SS) was present in most of the wetland complexes, with 18 units representing 10.8 acres. These units are generally shaded green on the attached maps. Less common types included the sphagnum-based shrub fens and peatlands that can be found at Fogg Hill Bog and Sturtevant Bay. Surprisingly, the least common type was the upper perennial stream (R3UB), which was only present at the Newman Trust Wetland (.24 acres across 100 feet of length).

All six of the candidate Phase III prime wetlands occurred in low lying positions in the midst of very small watersheds. Given the location of Center Harbor between three large lakes and with an elevation difference of just 617 feet across the entire town, this was not surprising. In all but the Newman Trust Wetland the size of the wetland was greater than 10% of its watershed size. The mean size of the six wetland watersheds was 165 acres, whereas the mean size of the six wetlands was 16.78 acres. The smallest watershed above a candidate prime wetland was 42.7 acres above Fogg Hill Bog and the largest was 558 acres above Newman Trust Wetland. Because watershed size has a distinct relationship to the ability of the wetland to serve as floodwater storage areas, it was not surprising that each of the six wetlands scored moderate to high for Flood Storage.

Landscape position and watershed also dictated to a large degree the soils types that were found in each wetland. In general, hydric soils were very poorly drained organic soils with greater than 16 inches of peat and muck at the surface. The hydric soil series known as Meadowsedge and Ossipee were the most common types found. Wetland edges primarily contained poorly drained (hydric B) mineral soils of the Pillsbury series. These were also prevalent in all drainageways feeding into the main wetland

complexes. Slightly perched, stony basins such as at Sturtevant Bay contained Lyme and Moosilauke soils as well. In all, a total of 50.83% of the hydric soils were very poorly drained, 8.18% were poorly drained, and 30.68% was water. In two wetlands, Otter Pond and Belknap Beaver Ponds, water made up more than 80% of the overall wetland acreage. A total of 10 upland islands were identified within the context of five of the six wetlands, or 2.92% of the total acreage. Upland soils of the islands were reflective of the surrounding landscape, and were mostly comprised of stony glacial tills of the Tunbridge-Lyman-Becket series.

In 10 of the 12 functions that were evaluated nearly all six of the candidate wetlands scored well above the mid-point value of 5.0. [Please see score totals graphically depicted in Appendix B]. Mean scores for Ecological Integrity and Wetland-dependent Wildlife Habitat exceeded 8.0; scores for Scenic Quality, Education Potential, Wetland-based Recreation, and Shoreline Anchoring exceeded 7.0; and scores for Fish & Aquatic Life Habitat, Sediment Trapping, and Nutrient Transformation exceeded 6.0. Moderate scores were returned for Flood Storage and Noteworthiness. The only function that all six candidate wetlands scored very low in was Groundwater Recharge. They were not located above stratified drift (i.e. glacial outwash) aquifers and therefore had little direct contribution to potential drinking water supplies. Only the Chamberlain-Reynolds / Heron Cove wetland had a position close to a nearby sand and gravel aquifer.

The following section describes each of the six candidate prime wetlands in more detail. It provides a discussion of each of their attributes and potential contribution to the integrity of high quality water resources in Center Harbor. It also includes a review of the conservation status of the lands within and adjacent to the wetland complex. Note that maps of the cover types and hydric soils of each wetland are contained in Appendix A.

Figure 5. Below: Belknap Woods Beaver Ponds. These ponds actually span a divide that drains into two sub-watersheds above Squam Lake. The uppermost pond, when dammed to its current level or higher, forces water to flow both northeasterly and southwesterly.



Chamberlain-Reynolds / Heron Cove (#41)

Chamberlain-Reynolds is a very well known property that has been owned by the New England Forestry Foundation since the 1950's when it was donated to the organization by donors of the same name. It lies in the northern part of Center Harbor along the shoreline of Heron Cove on Squam Lake. At 24.6 acres it is the largest of the six candidate prime wetlands. It lies in a low position with a southwest-northeast axis at the end of several intermittent streams. The watershed is fairly small (107.4 acres) and therefore very little water flows through the wetland. As a result, the plurality of the wetland complex contains deep beds of peat and muck. Heron Cove is well recognized as one of the most critical aquatic beds of Squam Lake and regularly supports a successful common loon nest on the lake.

The unique configuration of a large wetland expanse between two rocky promontories on Squam Lake has likely contributed to Chamberlain-Reynolds' long-term success as a fully functioning ecosystem. Spared from severe logging, agriculture and development by its conservation-minded owners, this conservation property has been a destination location for over half a century by the general public. An exquisite sandy beach and several camp sites border the northern edge of the property with minimal impact on the wetland system itself. Even the 600-foot boardwalk that traverses the lower scrub-shrub portion of the wetland has not impacted the functioning of this wetland system. Rather, it has enhanced the accessibility of the wetland to the average visitor and has increased its value as a regional resource.

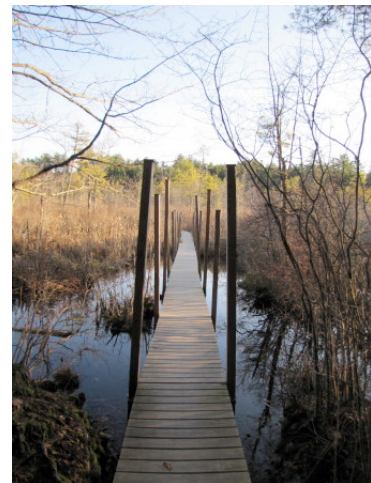


Fig. 6. Boardwalk at Chamberlain-Reynolds

In eight of the 12 functions assessed Chamberlain-Reynolds scored higher than any other candidate wetland. This included Ecological Integrity, Wetland-dependent Wildlife Habitat, Fish & Aquatic Life Habitat, Scenic Quality, Flood Storage, Groundwater Recharge, Sediment Trapping, and Nutrient Transformation. It also shared the highest score of 40 points for Noteworthiness owing to the presence of critical habitat, rare species, and old growth forest. The latter component was first recognized in 2001



Figure 7. Old growth forest at Chamberlain-Reynolds

during the Squam Lakes Watershed Assessment (Van de Poll 2002), and has become a *cause célèbre* for nature walks ever since. Eastern hemlock trees regularly exceed 350 years in age and the oldest white pine known on Squam Lake lives just off of the Swamp Trail. With careful, high visibility timber management for the uplands surrounding the wetland,⁵ this property will likely maintain the integrity of this remarkable wetland system on Squam Lake.

⁵ Conversations with NEFF personnel and observations of the type of timber management practiced at the Chamberlain-Reynolds Forest suggest that this will likely be true for the foreseeable future.

Newman Trust Wetland (#15)

This wetland system has the largest watershed of any of the six candidate prime wetlands and as a result had the only perennial stream associated with a candidate wetland. At 558 acres, the watershed begins at the roadside beaver pond next to Dane Road and includes much of Newman Road over to Center Harbor Neck Road. The adjacent Audubon Proctor Sanctuary includes a stretch of the perennial stream system and has trails that get close to but does not quite reach the wetland proper. The only current public access point is via Squam Lake by boat or across the ice. This was the method of approach during an earlier assessment of Center Harbor's natural resources during the 2011 NRI project, and provided some field-based visual estimation of wetland types and condition prior to the Phase III project.

The wetland complex lies on an east-west axis along the shores of Squam Lake just south and west of Center Harbor Neck. It primarily includes a beaver-mediated marsh and swamp system dominated by emergent grasses and sedges and alder scrub. The lower portion includes a short outflow into a shallow water basin on Squam Lake as well as a small forested swamp that lies along Newman Road. The outflow area includes a portion of Squam Lake proper, which is comprised of an extremely rich aquatic bed and deep muck embayment. A shallow water dive in this area in 2002 during the Squam Lakes Bio-Inventory Project yielded one of the highest counts of submerged and floating-leaved macrophytes as well as the only known station of water-marigold (*Bidens beckii*) in the region. This plant is rated endangered (S1) by the NH Natural Heritage Bureau and currently is known to occur at only seven locations in the state.

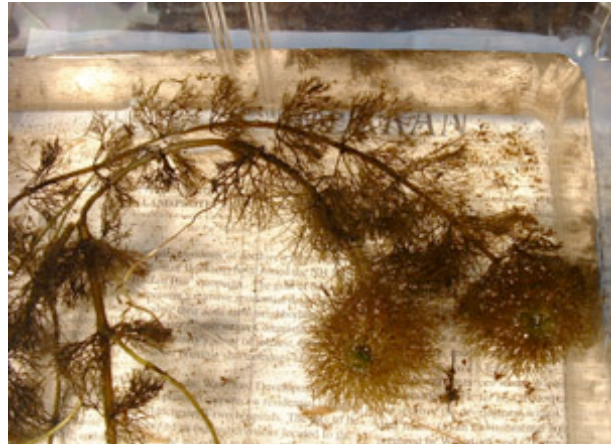


Figure 8. *Bidens beckii* water-marigold at Newman Trust Wetland

The Newman Trust Wetland had the second highest score for Sediment Trapping and Nutrient Transformation and therefore plays a critical role in water quality maintenance in this part of Squam Lake. Given the size of the watershed and the fact that there are several opportunities for road salt and



Figure 9. *Siphloplecton* mayfly in perennial stream above Newman Trust wetland.

other nutrients to enter the system, the protection of the beaver impoundments, vegetation density, and inshore aquatic beds are essential maintaining a positive water quality index in this part of the lake. This wetland also had the second highest score for Fish and Aquatic Life support, largely because it had the only perennial stream, which at present appears to be in **reference** condition, that is, of such a high quality as to be able to be compared with impaired systems as an indicator of excellent quality.

Fogg Hill Bog (#71-72)

This 11.23-acre wetland includes the only kettle hole bog in Center Harbor. Created by a melting chunk of ice during the post-glacial era 13,500 years ago, the nearly perfect circle of deep water forms the heart of a fen-swamp complex that lies on the northwest side of Fogg Hill. Located in the western edge of town, the wetland basin sits above Winona Lake at an elevation of about 700 feet. It is fed by just two small intermittent streams and therefore relies heavily on groundwater to sustain its aquatic natural communities. The action of beavers over the several years has raised the level of the swamp sufficiently to inundate the kettle hole and surrounding shrub swamp, to the detriment of several acres of gray birch and alder that once stood in the north end. Currently there is an extensive area of dead-standing gray birch stumps that attest to the higher water levels.

Fogg Hill Bog is the smallest of the six candidate prime wetlands and has had a roadway bull-dozed along its eastern edge. For this reason it generally scored lower than all of the other prime candidates. The only function where it ranked the highest was for Education Potential, and that was largely a result of this road creation activity that now makes it quite accessible from the nearby Fogg Hill Road. The cul-de-sac at the end of the latter town road is less than a five minute walk from the wetland and provides easy access for various studies and wildlife observations. The wetland itself is on private property, however, and until it becomes available for such endeavors should be kept 'off limits' to the general public.



Figure 10. At right: roadway along east side of Fogg Hill Bog

In spite of the presence of a kettle hole bog, the soils around the wetland are largely fine-textured, stony glacial till. Only a small bank of sand and gravel was evident along the roadway and therefore groundwater recharge is ranked very low. In fact, the presence of the amount of water at the outflow stream suggests that this wetland system operates more efficiently as a groundwater *discharge* rather than recharge site. The outflow stream, while intermittent, contains steep banks and a deep ravine



suggestive of the past flooding action from run-off off of Fogg Hill. Since it flows directly into the Hawkins Pond Outflow brook just above Winona Lake, this tributary has considerable value to the water quality concerns of Winona Lake residents.

Figure 11. At left is the southeast part of Fogg Hill Bog, where beavers have also been active and have blocked the outflow to the north. At present the flow heads northwesterly across a narrow channel into Fogg Hill Bog proper and thereby continues north towards Winona Lake.

Otter Pond (#68-69)

Otter Pond is centered around a 15-acre pond in the highlands of western Center Harbor. Lying east of Fogg Hill and west of McGrillis Hill at an elevation of 665 feet, it is just south of the watershed divide between Winona Lake and Lake Waukewan. Because the 104-acre watershed includes lands between the two hills, the outflow stream quickly becomes perennial as it heads southerly downstream towards Lake Waukewan. The pond is in a very pristine setting with just one rugged 4WD road leading up to a single cabin on its south side. The four-season structure is the only one within a half-mile of the pond and is currently used only in summer. As a consequence, the wildlife habitat value is very high and the area is regularly visited by moose, deer, bear, otter, fisher, snowshoe hare, coyote, fox, and several species of waterfowl.



Figure 12. Female buffleheads at Otter Pond

Besides having the second highest score for Wetland-dependent Wildlife Habitat, Otter Pond scored very high for Scenic Quality, Wetland-based Recreation, and Noteworthiness. A prior visit during late March during the Center Harbor NRI Project yielded evidence of a high density deer and snowshoe hare population. These two prey species provide excellent opportunities for wide-ranging predators to flourish, especially considering that the pond lies in the heart of the largest unfragmented woodland in Center Harbor. Although on private property, the pond is well-suited for warmwater fishing, canoeing and kayaking, and hence scored 8.25 for Wetland-based Recreation. Besides Fogg Hill Bog, it is the only relatively high elevation pond in Center Harbor and likely supports a variety of invertebrate fauna adapted to life in these conditions. The adjacent bog mat and boreal plants favor the occurrence of certain rare dragonflies; however these have not been researched to date.



It should be noted that at least three small, intermittent stream wetlands were not included in the prime wetland evaluation area. These areas lie in closed canopy forest areas that do not provide any significant addition to the wetland functional values associated with the pond. Upon prime wetland designation these areas will also likely be subject to continued timber harvesting activities that may change their character over time. For this reason, the edge of the



evaluation unit was held strictly to those wetland units that are both sensitive and integral to the pond ecosystem.

Figure 13. Above left: Otter Pond boggy edge; lower left: otter family swimming across pond

Belknap Woods Beaver Ponds (#43)

This remote wetland complex lies in part on land owned by the Squam Lakes Association (SLA) above and south of Dog Cove on Squam Lake. At an elevation of 660-680 feet, two beaver ponds and one semi-isolated basin form the complex at a watershed divide between two unnamed streams that feed into Squam Lake. Each pond is remarkably pristine. The nearest development is the NH Music Festival about a third of a mile away. The SLA has created and maintained several trails in the vicinity and one of these skirts the lower beaver pond. Besides this, the remoteness of this wetland complex is attested by the fact that it lies in the center of a 500+-acre patch of unfragmented forest.

Because of the above condition, Belknap Woods scored the second highest for Ecological Integrity. In spite of being an active site for beavers, the water quality of the streams leaving the northern beaver pond is very high as shown by the 28-year old water quality monitoring site near the trailhead on Dane Road. There are no road crossings, fill, invasive species, or nearby development. The only human activity besides the trail network is adjacent logging activities that have thus far spared the immediate edge of the beaver ponds themselves. As a consequence, the undisturbed buffer has helped Belknap Woods achieve the third highest score for Wetland-dependent Wildlife Habitat.



Figure 14. Great blue heron nests at the upper Belknap Woods Beaver Ponds wetland

Perhaps one of the more noteworthy attributes of the upper pond is the heron rookery that is actively being used. A total of eight nests were observed in long-since-dead white pines in the northern part of the pond. Although herons were not present during the late October site visit, they were heard during an early summer site visit. Black ducks, wood ducks, and hooded mergansers were observed in October, and it is likely that several other species of waterfowl utilize both ponds as a stop-over point during migration. Besides beaver, sign of moose, deer, black bear, coyote, fisher, mink, otter, raccoon, and short-tailed shrew was observed during the site visit. At least five vernal pools were documented in the



immediate vicinity of the two ponds, which is one reason why the semi-isolated swamp was included in the wetland complex. The latter unit had probable sign of vernal pool activity and was joined by three other isolated pools in the vicinity. Connected by a high-water-only intermittent stream to the lower beaver pond, this swamp greatly contributes to the quality of water and wildlife habitat.

Figure 15. At left, the fishless, isolated pool area of the hydrologically connected swamp between the two beaver ponds at Belknap Woods Beaver Ponds Sturtevant Bay (#6)

Sturtevant Bay is the third candidate prime wetland that has shoreline on Squam Lake. Located in a narrow bay at the eastern base of Center Harbor Neck, this lake level wetland includes an intermittent inflow stream, a narrow marshy channel, and a broad, sphagnum-dominated black gum swamp. For reasons noted above (Page 6), the western part of the bay is included in the wetland complex owing to its essentially pristine character.

Although portions of this wetland has been subjected to significant land alteration activities in the mid-1960's due to the Asquam Homes Development Project, much of the prior filling and dredging has been repaired and/or reverted to near original condition. Evidence of prior stream channelization has returned to a braided series of rivulets, the former sandy beach fill has been removed back to the edge of the current Sturtevant Bay Association beach and storage shed, and scrub-shrub vegetation has reclaimed the area that was previously filled. The bay itself has reverted to aquatic bed plants and is now thick with a variety of native species. Only in the area near the current beach is there any obvious evidence of previous activity.

Besides being home to another successful, platform-nesting loon, Sturtevant Bay contains one of the lake's pre-eminent black gum swamps along its western side. Trees in excess of 210 years old exist in a broad basin behind a post-glacial, ice push ridge. The latter is defined by a linearly arranged pile of stones and boulders that was pushed up by the action of ice and wind several thousand years ago. The resultant berm has blocked immediate lake effects from entering this basin and created conditions suitable for the development of acid-loving shrubs and trees found in a Black Gum-Red Maple Basin Swamp. This uncommon natural community is one of six good examples in the Center Harbor portion of Squam Lake and was noted as a Significant Ecological Area (SEA) in the 2001 Center Harbor NRI.



Figure 16. Black gum trees at the west side of Sturtevant Bay



A further testament to the value of this wetland complex is the current recreational use it receives, largely as a result of the actions of the Sturtevant Bay Association. Recently-placed trail planks were noted in the trail along the wetland edge, and several canoes and kayaks were seen at the storage shed for use in the Bay. Sturtevant Bay received the highest score for Wetland-based Recreation and Scenic Quality, and the second highest score for Education Potential and Flood Storage.

Figure 17. View north across Sturtevant Bay

IV. Conclusions and Recommendations

Six candidate prime wetlands were identified and assessed as a part of the third and last phase of the Center Harbor Prime Wetlands Project during the fall of 2012. Each wetland was shown to have high to very high value relative to the 12 functions that they provide to society. Besides containing a high degree of ecological integrity, all six wetlands was characterized by exceptional wildlife habitat defined as “critical” by the state of New Hampshire Fish and Game Department.⁶ Four out of the six wetlands contained all or part of Tier 1 or 2 habitat, which is ranked as highest in the state (Tier 1) or highest in the biological region (Tier 2).

In terms of overall point ranks, the summary chart at Appendix B-4 illustrates that Chamberlain-Reynolds / Heron Cove had the highest overall score of 95 points. Newman Trust wetland had the second highest score of 86 points, and Belknap Woods Beaver Pond had the third highest score at 85 points. All others fell below the mean of 84 points as follows: Sturtevant Bay (82 points), Otter Pond (81 points), and Fogg Hill Bog (75 points). It should be noted that the mean point score for these six wetlands was fully 6 points above the mean of 76 for the first six wetlands in Center Harbor that were previously designated as prime.⁷ In fact, Chamberlain-Reynolds scored higher than any of the initial six wetlands, and Fogg Hill Bog exceeded the point score of all but three of the original six prime wetlands.

The above results provide a solid rationale for considering each of these recently assessed wetlands as candidate prime wetlands under the designation process of the state of NH Wetlands Bureau. Each is larger than the minimum requirement of two acres, each has much greater than the required 50% hydric A soils, and each has a “unique, fragile, and unspoiled character.” On the basis of the 1120 acres of non-lake wetlands in the town, the addition of 100.7 acres of prime wetlands – just 9% of the total number of wetlands and less than 1% of the entire town – is justifiable and necessary. The wildlife, recreation, and water quality functions that these wetlands serve far outweighs the potential value of their use as development sites, timber management sites, agricultural areas, or as sites for roadways, beaches, or fish ponds.

The addition of these six prime wetland units will complete the intended protection of the highest quality water resource sites in Center Harbor that have as yet not been fully conserved through land protection techniques or by state or local law. Just 29.78 acres of these six prime wetland candidates are currently under some form of permanent protection and most of this is located at Chamberlain-Reynolds / Heron Cove, where current use practices may include future recreational or timber management activities that could compromise some of the functionality of the wetland system. The addition of this layer of statewide protection will help ensure that the remainder of the highest ranked wetlands in Center Harbor will be afforded some of the regulatory oversight and protection they need.

⁶ See the explanation of critical wildlife habitat in the on-line version of the NH Fish & Game’s Wildlife Action Plan at http://www.wildnh.com/Wildlife/wildlife_plan.htm

⁷ Since the first six wetlands were assessed under the first edition of the NH Method, some variation in score results should be expected as a result of the difference between the two methods.

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