Transportation
Land Development
Environmental
Services

Vanasse Hangen Brustlin, Inc.

Kilton Road
Six Bedford Farms, Suite 607
Bedford, New Hampshire 03110-6532
603 644-0888
FAX 603 644-2385

Memorandum

To: Chichester Conservation Commission

Date: June 9, 2008

Project No.: 51690.00

From: Peter J. Walker, CWS
Peter Steckler, CWS
Dale Abbott

Re: Wetlands Study
Phase I & II Results

This technical memorandum summarizes the work completed by VHB during Phase I and Phase II of the wetlands study for the Town of Chichester. Phase I was completed in November of 2005. The objective of Phase II was to perform functional evaluations of wetlands in the northern portion of Chichester, similar to the Phase I work that was completed for the southern portion of the Town. What follows is a description of the methods used to complete the wetland study, as well as the study results.

1.0 Methodology

1.1 Existing Information Retrieval and Base Map Development

A base map for overlaying the boundaries of wetlands was created during Phase I of this study. For Phase II, VHB obtained digital, true-color orthophotos dated 2005 from the New Hampshire Department of Transportation. Information that was incorporated into the GIS in Phase I included:

- Zoning and Tax Parcel Boundaries (supplied by Chichester)
- USGS Topographic Quadrangles covering Chichester (two total – Loudon and Suncook)
- NRCS Hydric Soils Mapping (GRANIT)
- FEMA Floodplain Maps
- National Wetlands Inventory (NWI) Maps (GRANIT)
- NHDES Well Inventory Data (NHDES)
- USGS Stratified Drift Aquifer Mapping (GRANIT)
- Land Use Mapping (GRANIT)
- New Hampshire Natural Heritage Bureau Database
- Conservation Lands (GRANIT)
- National Register of Historic Places (GRANIT)

Phase I wetland watershed boundaries were delineated using USGS quad sheets. Phase II wetland watersheds were determined using ArcHydro tools. The USGS-based Digital Elevation Model (DEM) was instrumental to perform watershed delineations for each wetland in Phase II.

1.2 Screening of Wetlands

Using the base map developed in task 1.1, all wetlands included in the National Wetlands Inventory (NWI) greater than two acres within Chichester were identified. This mapping found a total of 55 wetland systems (25 wetlands in Phase I, 30 wetlands in Phase II). These wetlands were screened

further using the GIS by the following criteria to select a list of wetlands that would be evaluated in the field.

1. At least 50% of the wetland must be mapped by the Natural Resources Conservation Service (NRCS) as having very poorly drained soils ("VPD") and

2. The wetland must have at least one of the following attributes:
   a.) Is adjacent to Conserved Public Lands
   b.) Overlays a Stratified Drift Aquifer
   c.) Is within or adjacent to a riparian corridor (*i.e.*, stream or river corridor),
   d.) Is adjacent to a lacustrine habitat (lakes or ponds greater than 6.6 feet deep) That is, the wetland provides an important buffer to the lake or pond.
   e.) Contains threatened or endangered species or is an "exemplary natural community" as identified by the NH Natural Heritage Bureau.

Additionally, all other wetlands smaller than two acres were screened to determine if they were located within an area identified by the NH Natural Heritage Bureau as an exemplary natural community or containing occurrences of threatened or endangered species. The intent of this screening was to include these areas for field evaluation. However, no such wetlands were identified in either the Phase I or Phase II portion of Chichester.

The Phase I and Phase II screening process resulted in a total of 32 wetland systems that were selected for field evaluation (the 32 wetland systems ended up as 34 evaluation units, which will be described in more detail in 1.3). Phase I wetland locations are shown on **Figure 1**. Phase II wetland locations are shown on **Figure 2**.

1.3 Wetland Investigations and Revised Mapping

All field work was performed by NH Certified Wetland Scientists who have previous experience with wetlands mapping in other New Hampshire communities.

VHB identified landowners in Chichester who own parcels that include or abut any portion of the wetlands identified during the screening process. For Phase I of the study, postcards were sent to abutting landowners to notify them of the study, notify them of a public meeting to discuss the study, and to request comments and concerns about the study. For Phase II of the study, the Conservation Commission sent letters to each property owner that VHB identified. The letters included a form for landowners to fill out to either permit or deny access to VHB wetland scientist to perform wetland evaluations on their property. Landowners who provided no response to the mailing were assumed to deny access to their property. VHB wetland scientists were able to access 9 of the 16 wetlands in part or in total for Phase II. At the request of the Conservation Commission, the remaining 7 wetlands were evaluated using the GIS remotely.

Wetland boundaries were revised for all wetlands within the Phase I and Phase II study sets. Wetland boundaries that were accessible for field evaluation were updated when discrepancies between the NWI mapped wetland boundary and the actual wetland boundary were encountered. Wetland scientists used their professional judgment to locate the boundary of the wetland areas, but it is important to note that no formal "delineation and survey" of the boundary or collection of data for determination of a jurisdictional boundary was performed. Thus, the boundaries developed through this study are not necessarily appropriate for use during site-specific design and permitting analyses.

For wetlands where access was denied by the property owner, wetland boundaries were revised using the best available digital orthophotos. In this case, 1-foot resolution true color orthophotos captured in 2005 were used. Contours extracted from the USGS DEM also aided in refining wetland boundaries in some unclear situations. It is important to note that forested wetlands are most often underestimated when identifying or revising wetland boundaries in this manner.

The *Method for Comparative Evaluation of Nontidal Wetlands in New Hampshire (*the "NH Method"; Ammann and Stone 1991) was used to evaluate functions and values of each wetland system evaluated. The NH Method provides guidelines for determining the extent of wetland evaluation units within a larger wetland system. That is, a single wetland system may comprise one or more evaluation units if certain conditions exist. A separate functional evaluation must be conducted for each wetland evaluation unit. Therefore, 9 of the 16 wetland systems that were accessible in Phase II resulted in 11 evaluation units. In total, 16 and 18 evaluations units were included in the Phase I and Phase II study sets, respectively.

1.4 Functions and Value Assessment

The 34 wetland evaluation units were assessed following the procedures outlined in the *NH Method* guidance, which requires that each wetland be scored on a minimum of 14 functional values described as follows:

Ecological Integrity – Evaluates the overall health and function of the wetland ecosystem.

Wetland Wildlife Habitat – Evaluates the suitability of the wetland as habitat for those animals typically associated with wetlands and wetland edges. No single species is emphasized.

Finfish Habitat – Evaluates the suitability of watercourses, ponds, or lakes associated with the wetland for either warm water or cold water fish. No single species or group of species is emphasized.

Educational Potential – Evaluates the suitability of the wetland as a site for an "outdoor classroom."

Visual Aesthetic Quality – Evaluates the visual and aesthetic quality of the wetland.

Water-based Recreation – Evaluates the suitability of the wetland and associated watercourses for non-powered boating, fishing, and other similar recreational activities.

Flood Control Potential – Evaluates the effectiveness of the wetland in storing floodwaters and reducing downstream flood peaks.

Ground Water Use Potential – Evaluates the potential use of the underlying aquifer as a drinking water supply.

Sediment Trapping – Evaluates the potential of the wetland to trap sediment in runoff water from the surrounding upland.

Nutrient Attenuation – Evaluates the potential of the wetland to reduce the impacts of excess nutrients in runoff water on downstream lakes and streams.

Shoreline Anchoring and Dissipation of Erosive Forces - Evaluates the effectiveness of the wetland in preventing shoreline erosion.

Urban Quality of Life (as influenced by Wetland Wildlife Habitat, Educational Opportunity, Visual/ Aesthetic Quality, and Water-based Recreation values) – Evaluates the potential for the wetland to enhance the quality of urban life by providing wildlife habitat and other natural values in an urban setting. None of the wetlands in this study were considered as being in an urban setting.

Historical Site Potential – Evaluates for indications of use by early settlers.

Noteworthiness – Evaluates the wetland for certain special values such as critical habitat for endangered species, *etc.*

Using the base map and data collected in the field, we completed a series of standard data sheets to calculate an average Functional Value Index (FVI) for each of the 14 functional values for each wetland evaluation unit. These data were then entered into a customized electronic spreadsheet that automatically calculated an average for each Functional Value and then multiplied them by the "evaluation area" (in acres) for each unit, to provide a total number of Wetland Value Units (WVUs) for each wetland.

In order to provide a quick comparison among the candidate wetlands, we also calculated an average FVI and total WVU for each candidate wetland. Intuitively, these latter numbers provide an index to both the "quality" of the wetland and the "quantity" of value it provides. Caution must be used when taking this approach, as it lumps each functional value into a single wetland "score". The intent of the NH Method is to evaluate each function separately, so wetlands can be compared on a function by function basis. If the Town is primarily interested in protecting certain wetland functions but not all of them, a more detailed review of wetland rankings per function will need to be made.

2.0 Wetland Descriptions

The following descriptions are presented by phase for the wetland study. Wetlands are organized in relative order of wetland quality from high to low as judged in the field by the professional wetland scientist. The wetlands are also grouped based on their structural or vegetative similarity (*e.g.*, entirely forested wetlands, old beaver meadows, geographic location, etc). The numerical scoring or quantitative analysis of each wetland is presented below (Section 3.0 - Numerical Scoring). Photographs of the wetlands are provided in the **Photographs** section at the end of the memorandum.

2.1 Phase I Wetland Descriptions

Wetlands 10 and 15
Wetlands 10 and 15 are named on the USGS quad maps as Marsh Pond and Lynxfield Pond, respectively. As is the case with most named wetlands, these wetlands are indeed special. Marsh Pond can be accessed from the parking area behind the Town Offices on Main Street making this an excellent educational wetland as it provides a wide diversity of wetland types surrounded by undisturbed forested uplands. Lynxfield Pond is much more remote, but worth the walk. It can be accessed from snowmobile trails from either Canterbury Road, Center Road or Bear Hill Road. A good parking area is not apparent.

Lynxfield Pond is the larger of the two wetlands and is a more complex wetlands system that appears to include black spruce and larch stands. Both Marsh Pond and Lynxfield Pond have areas dominated by plants commonly found in low nutrient boggy environment, *i.e.,* the sedge *Carex lasiocarpa* and the shrubs myrica gale and leather leaf. Water-willow, *Decodon verticllatus,* is common in the emergent zone of Lynxfield Pond. Other dominant rooted aquatic bed plants include white water lily, water shield, and pond weeds. The emergent edge and wet-meadow zone include, in

addition to the species just mentioned, pickerelweed, arrowhead, blue-joint grass, wool grass, tussock and lake sedge, and cattail. The surrounding shrub-forested wetlands and uplands are dominated by meadow-sweet, steeple-bush, willow, alder and red maple.

These wetlands provide all of the following functions: water quality improvement, an attractive landscape for visual quality, flood storage, wildlife habitat, fisheries spawning and nursery habitat, export of primary production to downstream reaches, and recreational opportunities. The quality or magnitude of these functional values is much higher in these wetlands than any of the other wetlands because of the diversity and large size of both. An old stone foundation and other stone works were observed adjacent to Lynxfield Pond suggesting a potential historical significance. In addition, both Marsh Pond and Lynxfield Pond provide an educational opportunity for student field trips. There also may be an opportunity for non-powered boating (with a walk in) and potentially fishing. No hunting signs were observed during the field inspection.

It is worth noting that aggressive and invasive plants, including purple loosestrife and reed canary grass, were observed only on road sides and not in these wetlands. This is remarkable, based on experience in other areas of New England.

Wetlands 1, 3, 4, 7, and12
The central portions of these wetlands are active beaver impoundments creating diverse and extensive wetland complexes in wide level basins along perennial streams. Their locations are as follows:

- Wetland 1 is located off Horse Corner Road in the southwestern corner of Chichester;
- Wetland 3 is a remote location north of Horse Corner Road and is best accessed from a residence at the end of a long gravel driveway;
- Wetland 4 is accessible from either Short Falls or Leavitt Roads;
- Wetland 7 is partially in Epsom and is accessible from Highland Road; and
- Wetland 12 is located just north of Route 4 and is best accessible from King Road.

Beaver are presently the dominant influence in the morphology of these diverse wetlands producing the permanent shallow ponds vegetated with rooted floating leaf and submerged plants that grade land ward to emergent marsh-shrub-forested wetlands. However, the deep muck and peat deposits mapped by the NRCS Soil Survey of Merrimack County attest to the ancient origin of these wetlands. In addition to providing excellent water fowl habitat, these wetlands have stands of dead trees in various stages of decay that provide nest locations for the great blue heron and great horned owl, and also for many cavity-nesting bird species like the wood duck, and downy and hairy woodpecker. Heron nests were observed at Wetland 4, but probably also occur in some of these other wetlands.

Common plants of the rooted and floating-leaf aquatic bed zones include white water lily, water shield and several species of pond weeds and bladderworts. The emergent edge, depending on the present height of the beaver dams, can be an extensive area composed of pickerelweed, arrowhead, blue-joint grass, wool grass, tussock and lake sedge, and cattail. This emergent zone grades to a shrub-forested wetland dominated by meadow-sweet, steeple-bush, willow, alder and red maple. The surrounding uplands are mixed hardwood-white pine-hemlock forest isolated from road and residences.

These wetlands provide many valuable functions due to the diversity, size, and presence of permanent vegetated aquatic beds and their association with perennial streams. These functions include: water quality improvement, flood storage, wildlife habitat, some fishery spawning and nursery habitat and food production for transport downstream. These wetlands provide an attractive diversity to the landscape, but are not seen from roads or residences. They are, however, attractive locations for hiking, wildlife observation and probably some hunting. “No Hunting,

Fishing, or Trapping" signs were observed around Wetland 4, although trespassing was not included.

Wetlands 2, 8 and 14
Wetland 2 located behind the used car dealership on Route 4, Wetland 8 at the end of Granny Howe Road, and Wetland 14 along Giddis Brook north of King Road are beaver meadows in wide level valley floors along small perennial streams. Beavers have abandoned these wetlands about 3 to 5 years ago or, according to the neighbors at Wetlands 8 and 14, have been removed because of flooding. The continued absence of beavers indicates that these former ponds have silted in and the surroundings are no longer suitable for this species that require deep, unfrozen water during the winter.

The old beaver dams are mostly earthen structures that probably still function during the spring to flood these wetlands. The dominant vegetation is cattail, blue-joint grass, wool grass, and many species of sedges and rushes. Tussock and lake sedge and soft and Canada rush are the most abundant species. Pickerel and pond weeds are the most common aquatic plants in the stream channels and small pools. Along the periphery, the wet-meadows grade to shrub and red maple forested wetlands. Meadow-sweet, steeple-bush, alder, and willows are the most abundant shrubs. Wetland 2 extends north of Route 4 as a shrub-forested wetland grading into an emergent marsh to the west near the east bound on-ramp to I-393.

There is a large diversity of herbaceous flowering plants in the wetlands, with boneset being particularly abundant in Wetland 8. The shallow pools and stream channels produce abundant amphibians, as evidenced by the observed tadpoles and adult frogs. Great blue herons were observed along with many species of birds that need open habitat. Except for Wetland 2, which extends on both sides of Route 4, these wetlands are located in forested areas with little human disturbance. Although these are all old beaver impoundments, the wetlands are of ancient origins, *i.e.,* dating from the glacial retreat as attested by the deep muck and peat deposits mapped by the NRCS as reported in the Soil Survey of Merrimack County (revised edition in preparation).

These wetlands serve several functions due to their location along perennial streams and the diversity of the vegetation, wildlife habitats, and landscape settings they provide. The primary functions are water quality improvement, flood storage, and wildlife habitat. These wetlands provide a visually diverse and attractive landscape, but only Wetland 2 can be partially seen from roads or residences. Recreational uses include hiking, wildlife viewing, and probably some hunting, although "No Trespassing" signs are evident along the eastern boundary of Wetland 14. The perennial streams are small but provide some spawning and nursery habitat, as well as provide food for fish further downstream.

Wetlands 5, 6 and 16
Wetland 5 off Towle Road, Wetland 6 off Highland Road and Wetland 16 off Ricker Road are red maple forested wetlands of moderate size (approx. 5 to 10 acres) developed on deep organic soils in depressions in the landscape that form headwater streams. Wetland 6 is the largest of these because it extends into Epsom but from examination of the aerial photo and USGS quad map appears to be only a forested wetland throughout its extent. Although these wetlands are close to rural residences and roads, there is little human disturbance evident since the abandonment of agriculture in the mid-20th century. The surrounding uplands are mature mixed hardwood-white pine and hemlock forest. The USGS Quad map shows the streams in Wetlands 5 and 6 as perennial. However, observable flow was absent during the late summer field investigation (after a prolonged dry period). These three forested wetlands are very wet, with a hummocky micro-topography including wind thrown trees. A well developed shrub layer consists of many common species: winterberry holly, highbush blueberry, arrowwood, meadow-sweet, steeple-bush and alder. In openings, sphagnum moss, wetland grasses and sedges dominate the herbaceous layer (*e.g.*, blue-joint grass,

rattlesnake grass, tussock sedge, and lake sedge) and in the shaded areas, cinnamon and sensitive ferns.

The primary functions of Wetlands 5, 6, and 16 are flood storage, water quality improvement, and wildlife habitat.

Wetlands 9, 11, and 13
Wetlands 9 and 11, located on Main Street, and Wetland 13, on Route 4 adjacent to the Value Mart store, are small red maple forested wetlands developed in drainage depressions on deep organic soil deposits. Highbush blueberry , winterberry holy, meadow sweet and alder are common shrubs. Herbaceous species include sensitive and cinnamon ferns and in the more open areas blue joint and *Glyceria* grasses. These wetlands have been affected by considerable human disturbance: roads, residences, and agricultural and pasture land use. The wetlands form the headwaters of intermittent streams, which are associated further downstream with more diverse wetlands. The primary functions are water quality improvement and some flood storage of runoff.

2.2 Phase II Wetland Descriptions

Wetland 18
Wetland 18 is located at the southwestern end of Old Clifford Road along the northwestern municipal boundary. This is a large (62-acre) remote wetland that appears to be beaver influenced based on the broad water level fluctuations that are apparent. The outlet of the wetland was not accessible because property access was not available, so a beaver dam was not directly observed but was inferred. However, a large beaver lodge was observed. The wetland is dominated by unconsolidated bottom habitat, with areas of emergent, scrub-shrub, and forested wetland surrounding the shallow open water. Common vegetation includes red maple and eastern hemlock in the overstory, highbush blueberry, maleberry, meadow sweet, and steeplebush in the shrub layer, and tussock sedge, peat moss, bristly blackberry, cinnamon fern, and sensitive fern in the herbaceous layer. The mature upland forest surrounding the wetland is dominated by red oak, white pine, eastern hemlock, red maple, and American beech, with witch hazel below the canopy. Logging appears to have occurred surrounding the wetland in some areas within the last 10-15 years.

This wetland is very remote, which explains its high functional value for ecological integrity and wetland wildlife habitat. There is very little evidence of human disturbance around the majority of the wetland. Evidence of wildlife included deer scat, browse, and tracks, the beaver lodge and beaver cuttings, and wood-duck boxes. The grounds manager at Millican Nurseries noted that moose, deer, and turkey are abundant around the wetland, and that hunting is common as well. He also noted that the wetland is used for fishing and boating, providing values for finfish habitat and water-based recreation. Wetland 18 is somewhat accessible as an education site from the Millican property, but it is still fairly remote, which is why it scores so well in many other categories. Its value for water quality functions, including flood control potential, groundwater use potential, sediment trapping, nutrient attenuation, and shoreline anchoring are all among the highest for wetlands in the Phase II portion of Chichester. As the second largest wetland within the combined Phase I and II study area, this is one of the most valuable wetlands in Chichester.

Wetlands 25 & 26
Wetlands 25 and 26 are located in the southern portion of the Phase II study area, between Pound Road, Center Road, and Bear Hill Road. Sanders Brook runs through these wetlands from west to east. Wetland 25 is the smaller of the two wetlands at 18.2 acres, while Wetland 26 is 38.1 acres. Access to both of these wetlands was partial due to lack of landowner permission.

Both Wetland 25 and 26 are very similar in character. They are wide, valley bottom emergent wetlands that appear to have significant water level fluctuations based on flow debris observed and discussions with landowners. Both wetlands appear to be influenced by beaver intermittently,

although no clear indication of current beaver activity was noted. Sanders Brook in both wetlands is between 4 to 8 feet wide, with depths ranging from 1 to 3 feet. The low-gradient brook is surrounded primarily by dense emergent vegetation. Some evidence of historic ditching is apparent in Wetland 25. One of the landowners of Wetland 26 noted an access easement to his property explicitly for haying marsh grass. It is likely that both of these wetlands were used for this purpose within the last 100-years.

Emergent vegetation throughout these wetlands includes a variety of sedges, peat moss, woolgrass, broad leaf cattail, and boneset. The perimeter of emergent habitats in both wetlands grade into narrower bands of scrub-shrub and forested wetlands, which include red maple, eastern white pine, eastern hemlock, American elm, speckled alder, high bush blueberry, common winterberry, silky dogwood, maleberry, arrow wood, interrupted fern, and goldthread. The upland adjacent to these wetlands is characterized by a mature mixed forest of eastern white pine, red maple, and eastern hemlock.

Wetland 25, the more western of the two wetlands, is in closer proximity to development and Center Road. The construction of Center Road probably resulted in direct impacts to Wetland 25. Wetland 26 is among the most isolated wetlands from human development within the Phase II study area. Evidence of use of Wetland 26 is apparent by trails to and around its perimeter, but this wetland is remarkably remote and unspoiled. This is reflected in the high score for ecological integrity and wetland wildlife habitat that it receives. Wildlife signs observed in the field included deer and moose tracks, deer scat and browse, wildlife trails, songbirds, a large snapping turtle, and an old beaver lodge. Large eastern white pines surrounding the wetlands that are sometimes used as "nursery" trees by black bear were also observed, suggesting that these wetlands could very well be utilized by black bear. A nursery tree is typically a large tree with a branching pattern that is easy for bear cubs to climb into while their mother feeds on green wetland vegetation in the early spring.

Wetland 26 should also be noted for its educational use potential. It is the only wetland within a safe walking distance from a school, and the variety of wetland, stream, and upland habitats available for study in the vicinity of the wetland is great. The wetland is already being utilized for educational purposes by the Chichester Central School, which is evident from an educational sign that is posted near the wetland's outlet. The sign describes what a marsh is, the functions that it provides, and the types of wildlife that utilize marsh habitat.

The broad, flat, open character of these wetlands provide each of the water quality functions, from controlling flood flows that is evident by the large water level fluctuations, to trapping sediment and attenuating nutrients in the dense emergent vegetation. The proximity of these wetlands to Lynxfield Pond, among the most valuable wetland in the entire town, is worth noting since wildlife travel between these two important wetland complexes is probable.

Wetland 17

Wetland 17 is located along Sanborn Brook at the Chichester/ Pittsfield town line. Similar to Wetland 18 and 25, this wetland is very remote. It has a strong riparian influence similar to Wetlands 25 and 26. Wetland 17 drains from north to south, and ends where it intersects a power line corridor. The properties on the western and southern sides of the wetland were not accessible in the field because of landowner permission, so the boundary for that portion of the wetland was refined using aerial photography.

The core of Wetland 17 surrounding Sanborn Brook is classified as emergent wetland. Sanborn Brook throughout the wetland is a relatively wide, low gradient, meandering reach. Areas of forested wetland occur to the up-slope side of the emergent areas, as the wetland gradually transitions from open water to upland. Emergent vegetation includes sedges, peat moss, broadleaf cattail, sensitive fern, and cinnamon fern, among others. Over story and shrub vegetation includes

red maple, eastern white pine, eastern hemlock, arrow wood, highbush blueberry, and American elm.

This wetland scores very well for ecological integrity and wetland wildlife habitat because of its remote nature. It also stands out above the other wetlands for its river and stream finfish habitat. It provides important functions for water-based recreation, shoreline anchoring, groundwater use potential, and sediment trapping.

Because the outlet of Wetland 17 was not accessible during the site visit, the wetland control length was not identified clearly in the field. Therefore, the conservative wetland control length value used to evaluate this function in all likelihood underestimates this wetlands ability to control flood flows. The broad, flat nature of Wetland 17, its association with a second order stream with a watershed greater than 6,000 acres, and evidence of water level fluctuations within the wetland, suggest that this wetland is important in controlling flood flows.

Wetlands 23& 24
The commonality of the highest scoring wetlands in Phase II seems to be their remote and intact nature. Wetlands 23 and 24 are no exception, as it is truly an effort to get to these areas. These wetlands are located in the northeastern corner of Chichester. They are associated with an unnamed tributary to the Suncook River. Although remote, both of these wetlands were fully accessible to evaluate in the field.

Wetland 23 is the eastern-most, downstream wetland. The most notable feature of Wetland 23 is the large stone dam that is responsible for holding back water to create the wetland. It is a small 0.75-acre unconsolidated bottom wetland with emergent and scrub-shrub areas along its perimeter. Wetland 24 is 13 acres in size, and is located upstream of Wetland 23. It is a diverse mix of stream channel, open water, emergent, scrub shrub, and forested wetlands. There is a high degree of cover type interspersion within the wetland, which contributes to value for wildlife habitat. Within both wetlands, typical vegetation includes sensitive fern, horsetail, peat moss, broad leaf cattail, jewelweed, wool grass, swamp dewberry, sedges, soft rush, and royal fern among emergent areas, speckled alder, steeplebush, maleberry, highbush blueberry, and wild raisin among the shrub species, and red maple, eastern hemlock, and eastern white pine among the forested portion of the wetlands.

Evidence of wildlife in and around these wetlands include deer trails and tracks, raccoon tracks, unidentified tadpoles, green frogs, a red squirrel, and an unidentified upland game bird. Beavers appear to have influenced Wetland 24 historically, although no current beaver activity was observed.

As is the case with the wetlands described previously, the remote nature of these wetlands contributes to their high functional values for ecological integrity and wetland wildlife habitat. Because these wetlands are smaller than some of the other wetlands, they score moderately well in terms of their wetland value unit. However, their functional value index, which assesses the quality of the wetland alone without concern for wetland size, is high. Other important functions that these wetlands provide include river and stream finfish habitat and historical site potential.

Wetland 34
Wetland 34 is a large floodplain wetland sandwiched between NH Route 28 and the Suncook River. No access was granted to evaluate this wetland in the field, so this entire functional evaluation was done remotely using GIS and practical experience. Wetland 34 is approximately 59 acres in size based on an aerial delineation. It includes areas of forested, scrub-shrub, unconsolidated bottom, and emergent wetlands. It is interspersed among portions of upland agricultural fields, drained agricultural fields, and upland forests.

Wetland 34 is a much different wetland than most others within the study set in that is associated with the Suncook River, a fifth order stream at this particular location. The watershed above this wetland is approximately 98,000 acres. The Suncook River in this area sees dramatic fluctuations in water flows and depths, and the ability of this wetland to serve as an accessible floodplain during times of high flows is very important. Also, Wetland 34 acts as a buffer between the Suncook River and the adjacent agricultural fields, enhancing its importance for nutrient and sediment retention.

Due to the size of Wetland 34, it scores very well for most of the functions. It stands out for its finfish habitat in rivers and streams because of its association with the Suncook River, and for its shoreline anchoring functions. It also serves the important functions of flood control potential, water based recreation, educational potential, groundwater use potential, sediment trapping, and nutrient attenuation.

Wetlands 28-33
Wetlands 28 through 33 are located downstream, or to the southeast of Wetland 18 along Perry Brook. Similar to Wetland 34, no property access was granted to evaluate these wetlands in the field, so their functional evaluations were conducted remotely using GIS and practical experience. Wetland 28 is the largest and western-most of these Wetlands at 17.4 acres. Wetland 29 is the next downstream at 17.3 acres, followed by Wetlands 30 (9.6 acres), 32 (6.3 acres), 31 (4.6 acres), and 33 (3.3 acres).

These wetlands, in addition to Wetland 18, consist of a core, unfragmented landscape in the upper Perry Brook Watershed. A diversity of wetland cover types occur within this wetland complex including forested, scrub-shrub, emergent, and unconsolidated bottom. The national wetland inventory mapping indicates beaver influence within each of these wetlands, which is evident in the aerial photography upon close inspection.

Functional values of these wetlands are provided for ecological integrity, wetland wildlife habitat, finfish habitat, water-based recreation, flood control potential, groundwater use potential, sediment trapping, nutrient attenuation, and shoreline anchoring. Treated as one wetland complex, which these wetlands most likely act as because of their close proximity and influence on one another, this area (in addition to Wetland 18) is tremendously important for all of the functions noted above. Treated as single evaluation units, these wetlands appear far less important.

Wetlands 19-22
Wetlands 19 through 22 are located in the lower Perry Brook watershed in the vicinity of Hilliard Road, Swiggey Brook Road, and NH Route 28. At least partial access to each of these wetlands was available for field evaluation. Wetland 19 is the western most wetland upstream of Hilliard Road. It is 8.6 acres in size. Wetland 20, measuring 3.5 acres in size, is located between Hilliard Road and Swiggey Brook Road. Wetland 21 is located between Swiggey Brook Road and NH Route 28, measuring 5.3 acres. Wetland 22 is the furthest downstream, located between NH Route 28 and the Suncook River. It is 8.4 acres in size.

These wetlands have a mix of emergent, scrub-shrub, forested, and unconsolidated bottom cover types. Wetland 19 is primarily dominated by emergent and scrub-shrub habitats. Perry Brook is between 4 to 8 feet wide within Wetland 19, with depths between six inches to one foot. A small farm pond occurs near the wetlands outlet providing open water habitat. Agricultural fields are the dominant cover type surrounding this wetland. Wetlands 20, 21, and 22 are a mix of emergent, scrub-shrub, and forested wetland types. Perry Brook throughout these wetlands is wider and deeper, measuring 10 to 30 feet wide and 2 to 3 feet in depth. The stream has a low gradient and meanders through these wetlands. Residential and transportation is the dominant land use surrounding Wetlands 20 and 21, while Wetland 22 is surrounded by transportation, commercial, and forested uses. For these reasons, it was no surprise to see excessive sedimentation within Perry Brook's stream channel.

Vegetation within these wetlands include red maple, swamp white oak, and eastern white pine in the overstory, speckled alder, American elm, black willow, arrow wood, common winterberry, buttonbush, elderberry, nannyberry, and silky dogwood in the shrub layer, and sedges, joe-pye-weed, broadleaf cattail, sensitive fern, interrupted fern, cinnamon fern, New York fern, reed canary grass, jewelweed, early meadow rue, and boneset in the herbaceous layer.

In terms of anthropogenic disturbance, these wetlands are the most impacted and altered wetlands within the study set. There are three road crossings that fragment these wetlands, and many of the wetlands are in close proximity to residential and commercial development, and agricultural land use. Wetland 22, the least disturbed of these wetlands, would be considered the exception as it is adjacent to a large tract of unfragmented land to its south, east, and north. The remainder of the wetlands score among the poorest for ecological integrity and wetland wildlife habitat. However, they serve important functions for flood control potential and sediment trapping, in addition to finfish habitat.

Wetland 27
Wetland 27 is located between NH Route 28 and the Suncook River, just south of Depot Street. It appears to be a historic channel of the Suncook River, but now serves as a floodplain wetland during periods of high flows. Wetland 27 is 4.3 acres in size and is dominated by unconsolidated bottom, emergent, and forested cover classes. Vegetation includes red maple, American elm, high bush blueberry, common winterberry, gray birch, royal fern, and sensitive fern in forested areas, and meadowsweet, silky dogwood, tussock sedge, and speckled alder in emergent areas.

Residential and transportation land use surrounds this wetland to the west and north. The primary functions that this wetland provides is flood control potential, groundwater use potential, and sediment trapping.

3.0 Numerical Scoring

The numerical scoring for each of the wetlands is summarized on the attached spreadsheets (**Table 1**) and is graphically presented in the attached figures (**Figures 3 & 4**).

3.1 Comparisons of Functional Scores

Inspection of the top portion of **Table 1** indicates the relative importance of a wetland for each of the fourteen functional values based on the number of Wetland Value Units (WVUs) provided by the wetland for that function. In some communities, a particular function, say flood control, may be of special importance or interest to the public. Similarly, a community may decide that the educational potential of the wetlands within their town is of particular importance for providing "outdoor classrooms" for their middle-school's science curriculum for example. These types of determinations are all appropriate since the relative importance of one function over another is largely dictated by a variety of local circumstances, societal attitudes, and management objectives.

The WVU is calculated by multiplying the Functional Value Index (FVI) by the evaluation area for each particular function. For many of the functions, the evaluation area is the entire wetland area. For functions such as education potential, visual aesthetic quality, water-based recreation, and historical potential, the evaluator must determine the evaluation area for that particular function. The evaluation may be the same as the overall wetland area, but it is often smaller than the overall wetland area. For example, for a function such as visual aesthetic quality, the evaluation area is determined for the portion of the wetland that can be viewed from the primary viewing location(s). If the evaluator deems that a particular function is not at all present, then an evaluation area of zero can be applied.

3.2 Comparisons among Wetlands

Wetlands were compared using both an "average" FVI score and a "total" WVU score. See **Figures 3** and **4** for combined Phase I and Phase II results. The average FVI for a wetland is calculated as the mean of its 14 FVI scores. In most cases, this average provides a sense of how effectively the wetland performed all 14 functions (*i.e.*, represents an "average grade," so to speak, for the wetland). A low average may reflect that the wetland does not perform any of the functions at an exceptional level. In comparing average FVI scores, the presence of a very high or very low individual FVI score may go unnoticed unless accompanied by careful inspection or by providing some sort of statistical measure of the spread of scores around the mean, like a standard deviation. In contrast, total WVU is simply the sum of a wetland's individual WVU scores for all 14 functions. This latter metric gives a sense of the magnitude of a wetland's contribution to the total ecological and societal needs of a community.

In general, the wetlands in the Phase II portion of Chichester score consistently higher than the Phase I wetlands in terms of average FVI. This is largely due to the remote nature of many of the Phase II wetlands and thus, higher ecological integrity and wetland wildlife habitat scores. These two functional scores are used in calculating many of the other functions, which is reflected in the overall higher FVI averages in Phase II.

The WVU scores, however, are more evenly distributed between the two study areas. Wetlands 23, 11, 20, 13, 9, 21, and 27 had the lowest total WVU scores, in order (4.8, 9.1, 18.0, 20.7, 25.2, 25.7, 25.8, respectively), which agrees with the professional judgment made in the field. The exception in this case is Wetland 23, which has a relatively high average FVI (0.61) but, because of its small size, has a very low WVU. Wetland 23 also is one of the few wetlands in the entire town with a high historical site potential. With exception of Wetland 23, these wetlands also had the lowest average FVIs of the 34 wetlands included in the study with scores ranging from 0.28 to 0.52.

Wetlands 17, 2, 26, 10, 34, 18, and 15 had the seven highest total WVUs with 208, 237, 284, 307, 422, 474, and 868, respectively. These scores line up very well with the professional judgment made about these wetlands functional values in the field. The large sizes of these wetlands and their high average FVI contributed to their high rankings. These wetlands were also at the top of the study set in terms of average FVI scores, ranging from 0.54 to 0.79. Each of these seven wetlands should be considered very important resources for protecting many of the functional values evaluated in this study.

4.0 Conclusion & Recommendations

In summary, all of the wetlands evaluated in this study, with the exception of Wetlands 9, 11, 13, 20, 21, and 27 are considered high value wetlands and should be protected to the greatest extent possible. This conclusion is based on our professional interpretation of the results and the town could reach different conclusions if it chose to prioritize functional values important to the town differently, as discussed below. Each of these wetlands has one or more characteristics that make them appropriate for additional levels of protection beyond NHDES Wetlands Bureau rules. In dramatic contrast to other communities in central and southern NH, Chichester is fortunate in that its high value wetlands are relatively remote, with the upland landscape immediately surrounding them still mostly undeveloped. Additionally, wetlands in Chichester are seemingly much less common than in other communities, which makes their protection even more important. Preservation of the high value wetlands and unfragmented upland buffers should be given the highest priority for protection as the community continues to develop.

Each town has the authority to regulate development in the vicinity of wetlands beyond state regulations. The high value wetlands identified in this study would benefit from limiting development in close proximity to them. Clearly, a wetland will be protected ecologically with larger protection buffers. However, a balance must be struck between landowner rights and the establishment of wetland buffers. This balance is likely to be different in every community.

In over 80 towns in New Hampshire, wetland buffers have been established between 25 and 300 feet in width. Different wetland buffers are effective at protecting certain wetland functions. A 100-foot wetland buffer is more than adequate to protect water quality functions, but is not optimal for protecting wildlife habitat and travel corridors. NHDES recently adopted 100-foot buffers to protect prime wetlands, yet the US Fish and Wildlife Service recommends 300-foot buffers to protect wildlife habitat. If the Chichester Conservation Commission is planning to pursue wetland buffers to protect high value wetlands identified in this study, the Commission should identify its management goals before proposing wetland buffer widths.