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Memorandum

To: Chris Ganotis, Chairman, North Hampton Conservation Commission

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From: Lenny Lord, Ph.D., Certified Wetland Scientist and Bill Arcieri, Senior Water Quality Specialist

Re: North Hampton Conservation Commission: Review of the Scientific Literature Regarding the Importance of Wetland Buffer Analysis

The following is a summary of recent research findings with regard to the value and role that wetland buffers—undeveloped uplands adjacent to wetlands—have in enhancing the effectiveness of adjoining wetland areas to perform ecosystem functions that serve the public interest. These findings highlight the importance of the 100 foot wetland buffer setback as established by North Hampton Zoning Regulations (Article 4, §409.9). The summary was developed with funding from the New Hampshire Estuaries Project thought its Community Technical Assistance Program.

It is generally well understood that wetland buffers are valuable with respect to wildlife habitat and other ecosystem functions that benefit society and the human environment. With the focus primarily on wetlands themselves, however, public education has often been lacking in the essential role that wetland buffers play in these processes. The discussion below focuses on describing the importance of wetland buffers with respect to protecting public interests and property values in developing communities.

BUFFERS AND WETLAND FUNCTIONS

Wetlands provide a number of functions and values important to society. These include enhancing surface and groundwater quality through sediment trapping and pollutant removal, providing for groundwater recharge, mitigating and attenuating peak flood flow during storm and snowmelt events, supporting fish and wildlife habitat, as well as enhancing community aesthetics and providing recreational opportunities (USACOE, 1999). However, the ability of wetlands to provide these functions depends in large part on their position in the landscape and their relationships to adjacent undeveloped uplands. These vegetated upland transition zones enhance the functions of wetlands and buffer the sensitive aquatic environment from the impacts of human activities. Furthermore, preventing development in these upland areas precludes them from being an additional source of wetland degradation. Indeed, most wetland scientists consider the presence of significant intact buffers as a key element in determining the ecological integrity and healthy functioning of wetland systems (e.g., USACOE 1999; Ammann & Stone 1991).

Buffers enhance wetland functions and help prevent them being overloaded with human-related inputs in a number of ways. They typically provide additional sediment trapping and pollutant removal for enhanced water quality protection. Buffers slow runoff velocity and provide for infiltration for enhanced floodflow protection and stream channel stabilization. They provide multiple habitat types, food sources, screening, and shading important for healthy and diverse fish and wildlife habitats. And they provide aesthetic screening between areas such as open marshes with sweeping vistas and developed areas, thereby increasing the value of wetlands as a component of community character.

Buffers enhance floodwater attenuation when excess runoff generated from developed impervious surfaces flows into wetlands. Dense vegetation in the buffer can slow sheetflow and increase infiltration within the upland. Depending on the size of the storm and degree of development within the watershed, the runoff volume may exceed the storage capacity of the wetland such that the excess water may overflow into the adjacent areas surrounding the wetland. Depending on the slope of the adjacent land and whether or not there are any obstructions to flow, this added flood storage may be significant. Where surrounding wetland buffers have been altered or contain structures that impede flow or eliminate natural flood storage, then the excess flow that would otherwise be stored is conveyed downstream, which increases the potential for flooding and property damage downstream. Given the predicted effects of global climate change on precipitation levels (e.g., McElfish et al. 2008), the steady increases in impervious surfaces (e.g., Complex Systems 2006) contributing to increased stormwater runoff, and the major flood events that have occurred in recent years (i.e.., 2006 and 2007), many communities have become more concerned about the need for controlling floodwaters, which can have a direct adverse impact on property values in flood prone areas.

Similarly, with regard to water quality enhancement functions, wetland buffers help to provide initial pretreatment as sheet flow travels across the land surface towards low-lying wetlands. They also help to reduce runoff volumes by allowing runoff to infiltrate into the groundwater, which ultimately reduces the potential pollutant load to the receiving water body. Well-established vegetation along riparian and wetland corridors provides for nutrient uptake and maintains lower water temperatures essential to fish habitat in streams due to the shading. Based on recent findings of a USGS study conducted in the NH Seacoast Region, there was a strong negative correlation between the percentage of urban land within the 25 meter (83 foot) buffer adjacent to a stream and the water quality and biological habitat conditions within the stream. In other words, there was a general decline in the water quality and biological conditions within the stream as the percentage of urban land increased within the 25 meter buffer. The most dramatic differences were observed in stream buffers that had less than 10 percent urban land as compared to those with more than 20 percent urban land coverage in the 25 meter buffer (Deacon, J.R., S. Soule, and T. Smith, 2005). The impact of the decline in water quality depended on the original quality, size and designated uses of the water body.

The effectiveness of buffers in enhancing wetland functions depends on a number of factors including the buffer width, the intensity of development in the uplands, the sensitivity of the wetlands, the size and character of the watershed above the buffer, buffer slope, soil type, and the specific wetland function in question. In general, wider buffers provide more protection for all functions and are more critical around sensitive wetlands and sensitive wildlife habitat. Densely vegetated and more gently sloping buffers have increased abilities to slow runoff velocity, provide increased water quality renovation, and provide increased runoff infiltration. Dense vegetation also provides better screening for wildlife and aesthetics. Mixed vegetation types in the buffer can enhance wildlife diversity and provide for more effective uptake of nutrients and pollutants in runoff (McElfish et al. 2008). Although some towns provide for variable buffer widths, a review of recommended buffers conducted by Chase et al. (1997) found a 100-foot buffer width to be an effective minimum in most cases to ensure water quality and provide a minimum level of wildlife screening. Particularly sensitive wetlands and wildlife habitats, as well as water supply areas may require wider buffers.

WETLAND BUFFERS AND THE PUBLIC INTEREST

While wetland buffers may enhance wetland functions at the scale of the individual property, the greatest benefits and need for buffer regulations are at the community and watershed level. Typically surface runoff and wetlands encompass multiple parcels in a watershed so that actions along one portion of the wetland may affect the entire community further downstream. These functions affect the health, safety, and well being of the entire community.

If buffers are lost and resulting negative effects of development on wetlands increase, it is likely that the community will need to increase revenues spent on engineering solutions to replace lost functions. Such solutions may include construction of stormwater detention ponds, sedimentation ponds, vegetated treatment swales, placement of riprap along streambanks and roads, dredging of stream channels, and increased culvert maintenance (Schwartz 2006). For example, the cumulative effect of incremental losses in flood storage areas with increasing imperviousness associated with land development within a watershed can result in a measurable increase the frequency and magnitude of flooding downstream. The significance of flood-prone areas on property damage and property values has been clearly demonstrated in the recent flood events that occurred in May 2006 and April 2007. The financial impact associated with increased flooding frequency and intensity are not only borne by affected property owners, but by local governments as well in terms of repairing bridges, roads and other infrastructure.

Wetlands associated with public water supplies are extremely important to the public interest, and protecting the buffer areas around water supplies is essential. A recent USGS study projects water usage to increase by 50% in Seacoast New Hampshire by 2025 (Horn et al. 2008). Many communities are looking to augment their ground water supplies through artificial recharge using water pumped from nearby rivers. This is a much costlier and less reliable approach than allowing natural infiltration of precipitation on permeable soils before it reaches the river.

Surface water quality issues also affect public recreation and tourism. Maintenance of healthy streams and rivers is essential to support high quality fisheries, recreational boating, and swimming, all of which are important in preserving public interest.

NORTH HAMPTON BUFFERS

On April 24, 2008, representatives from VHB, Inc., NH Estuaries Project, and the North Hampton Conservation Commission reviewed important watersheds and buffers in town at road crossings of the Winnicut and Little Rivers and their related watersheds. Field reviews in the Little River watershed were conducted at Rt. 111, Woodland Road, Rt. 1, and North Road. Field Reviews in the Winnicut River watershed were conducted at Winnicut Road, Lovering Road, and Walnut Road. The relative extent and development of upland buffers in town was also evaluated by using the GRANIT Data Mapper (http://mapper.granit.unh.edu) to generate an overlay of hydric soils with 2003 aerial photography (Attachment 1). Development impacts along second order or higher streams in these areas were also reviewed utilizing the NH GRANIT Buffer Characterization Study for North Hampton (Complex Systems Research Center 2006). In addition to buffer impacts, the GRANIT Buffer Characterization study revealed that impervious surfaces in town increased from 7.3% of the town in 1990 to 12.4% in 2005. This is considerable considering only approximately half the town lies on upland soils. Such increases in impervious surfaces are likely to continue until all lands precluded from development by regulation have been built out, increasing the effects of stormwater related flooding and pollution on local riparian systems.

The two main watershed areas in town are those of the Winnicut River and the Little River. The Winnicut flows to the north and the Little River to the southeast, with the watershed divide between these systems roughly following along Rt. 1 from the south then along Birch Road and Highlander

Road to the north. Development to the west of this divide affects the Winnicut and to the east it affects the Little River.

The headwaters of the Winnicut River occur in Line Swamp, in the southwest corner of town, from which the river flows north. In fact, much of the land in town to the west of I-95 is a large wetland complex associated with the river. This watershed appears to have significant capacity to detain flood waters, provide water quality renovation, and has significant wildlife value. Only the upper portion of the Winnicut River watershed lies within North Hampton, meaning that the community of Greenland, in the lower portion of the watershed to the north, will be significantly impacted by the way North Hampton regulates the development of buffers in town.

Buffers along the Winnicut River and its tributaries west of I-95 have undergone relatively little residential development, with more intensive development occurring between Rt. 1 and I-95 in the center of town. Highway crossings particularly those of I-95 and Rt. 111 have also had a significant impact on the watershed and buffers. Another area of past impact to stream buffers is in the northwestern portion of town, where Cornelius Brook, a tributary to the Winnicut, passes through the Sagamore-Hampton Golf Club and then through a culvert beneath I-95 and into a ditch for approximately 1,100 feet along the western edge of the highway. Runoff from roadways and golf courses often contain high levels of nutrients, which are likely to affect water quality in the brook.

One area of recent buffer impact that was noted in this watershed was the construction of a new house directly adjacent to an expansive marsh near the point where the Winnicut River crosses Lovering Road. Another home at that location across Lovering Road also appeared to be located very near the wetland boundary, but seemed to be sited many years ago. This impact of both of these properties is relatively small, with the primary effect being to the character and aesthetics of the area. Additional impacts to water quality and wildlife habitat are likely, though diluted given the size of the wetland. Such impacts would be rapidly compounded, however, if additional homes were built in similar proximity to the marsh. These homeowners and others sited near the river should be encouraged to routinely inspect and maintain their septic systems, since failure of these systems would have significant impact on the river. Furthermore, lawn care practices in these areas should minimize fertilizer and pesticide use.

One important component of the Winnicut River watershed is the inclusion of the town water supply wells off Winnicut Road. Implementation of wetland buffers is particularly important to protect groundwater quality and infiltration in this area. It appears that the recent subdivision to the north of Winnicut Road, across the street from the town wells, has included wetland buffers and conservation lands, which will help protect groundwater resources (Photos 1 and 2).

Given the relatively large wetlands in the Winnicut River watershed and limited development of wetland buffers, this is a relatively healthy wetland system. The system appears to have a significant capacity for flood storage/attenuation, water quality renovation, and wildlife habitat, while also providing scenic vistas and recreational opportunities for the community. It is likely to retain these functions for the public good provided the North Hampton wetland buffer ordinance is retained and enforced. Cumulative impacts to these functions could result in erosion of aesthetics and rural character associated with this area of town, directly affecting property values of local residents. Furthermore, cumulative impacts could result in increases in flooding damage, reduced water quality, and reduced ecological integrity of the wetland system, with resultant increased costs to mitigate these effects. Such effects tend to accumulate downstream and would not only influence North Hampton residents, but would impact the community of Greenland as well.

The second major watershed in town is that of the Little River. Unlike the Winnicut River, the Little River originates and runs its entire length through North Hampton. The headwaters of the river lie in the northern end of town, north of North Road and east of Highlander road. From here the river flows southeastward to its mouth along North Hampton State Park. Existing buffer impacts to this watershed are primarily associated with commercial development along Rt. 1, and due to residential development in the lower watershed.

No recent impacts to buffers were noted during our site review of the Little River, however two adjoining parcels were noted to be at particularly at risk in a sensitive area. This land is located at the southwest corner of US Route 1 and North Road, and at least one of the parcels is currently for sale (Photo 3). This area is important because it has buffers that are relatively undeveloped, it is in a commercial area, and it is located in the headwaters of the watershed. Buffers between areas of high potential impact and upper portions of a watershed are important for ensuring water quality and other critical functions further downstream in the watershed. These critical headwater functions include processing of organic matter, stabilization of stream flows, nutrient processing and attenuation, as well as providing breeding and dispersal sources for countless species of microbes, invertebrates, amphibians, and minnows that help sustain the entire riparian system (Cappiella and Fraley-McNeal 2007).

Due to their position in the watershed, the residential areas in the lower portion of the watershed and the Little River Tidal Marsh will be subject to the greatest impacts associated with increased impervious surfaces and buffer impacts associated with development over time (Photo 4). A significant amount of algae was observed in the Little River in this area along Rt. 111 during our review (Photo 5). Excess algae typically indicates high nutrient inputs to a waterbody (e.g., Caduto 1990). Development is often associated with high nutrient inputs that can be due to factors such as fertilizers, pet wastes, and silt. Degradation of water quality could affect property values along the river as well as the health and integrity of the Little River Marsh, directly downstream. North Hampton and other public agencies have made a significant financial investment in restoring the Little River Marsh as it is important to the health of the ecosystem and character of the town. Nutrient inputs from upstream may also encourage growth of invasive species such as common reed (*Phragmites australis*) and contribute to degradation of the marsh, which would clearly not be in the public interest. Such impacts could result in increased expenditures to restore the marsh and to treat stomwater inputs upstream, as well as having a negative effect on property values along the marsh if it were to become significantly degraded.

CONCLUSIONS

Failure to protect wetland functions and buffers can result in significant costs to the community, including reduced property values, expensive property and road damage due to flooding, pollution of surface waters, pollution of groundwater and wells, loss of valued native plant and animal species often followed by the invasion of nuisance species, and loss of community aesthetics and character. Headwaters of these systems are particularly important as they affect processes downstream throughout the watershed. Once buffers have been lost to development, their benefits are essentially lost for good, often requiring costly engineered solutions to replace these lost functions and mitigate impacts. Such engineered solutions typically do not fully replace lost functions and ecological integrity of riparian areas. Several areas of irreversible buffer impact have occurred in North Hampton, particularly along Rt. 1 and I-95, but existing regulations should provide for the protection of remaining undeveloped buffers and their associated wetlands into the future.

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PHOTOGRAPHS

Photo 1. Subdivision along Winnicut Road near town wells (4/28/2008).

Photo 2. Conservation land along Winnicut Road near town wells (4/28/2008)

Photo 3. Parcel for sale along Rt. 1 in upper portion of Little River watershed (4/24/2008).

Photo 4. Residential development in buffer of Little River viewed from Woodland Rd (4/24/2008).

Photo 5. Algae in the Little River along Rt. 111 (4/24/2008).

ATTACHMENT 1: NORTH HAMPTON UPLAND BUFFERS