

# Great Bay MATTERS

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*Promoting research, education  
and stewardship throughout  
the Great Bay Estuary*

## Water Quality Matters



**G**reat Bay has certainly been in the news a lot over the past eighteen months and for all the wrong reasons. Increased levels of nitrogen pollution, coupled with additional sedimentation from unusual storm events, have led to eelgrass declines and a rise in nuisance algae.

In 2009, PREP noted in their State of the Estuaries report that the total nitrogen load to Great Bay had jumped 42 percent in only five years. Some have argued if this rate of increase continues, Great Bay will be at a “tipping point.” This can lead to a decline of the entire ecosystem, similar to what happened in the Chesapeake Bay.

As a result, there has been a great deal of focus on both point and non-point sources of pollution. Cities and towns with sewage treatment plants have been under the gun by EPA to improve their treatment of wastewater. However, only about 30 percent of the nitrogen comes from these point sources.

At the Reserve, we have been more focused on reducing nonpoint sources, the largest contributor of nitrogen. The problem is identifying the thousands of potential sources of nitrogen pollution with the main culprits being septic systems and lawn fertilizers. In the past our rivers and streams have been able to treat much of the nitrogen from stormwater runoff before it reaches the Bay. Unfortunately, as the amount of nitrogen flowing into these tributaries has increased this is no longer the case.

The Reserve is currently working with the UNH's Water Resource

Research Center, under Bill McDowell and Michelle Daley, and other partners to better understand how nitrogen non-point sources reach Great Bay. With funding from the NERRS Science Collaborative, the goal is to locate nonpoint nitrogen hotspots throughout the watershed and identify the source. Once we know where the nitrogen is coming from, resource managers will be better able to fix the problem.

This effort builds upon the Reserve's water quality System-Wide Monitoring Program (SWMP) and the Lamprey River Watershed mapping project that was completed by Erica Washburn. The long-term goal is to provide local managers with a better understanding of all the land use conditions and sources of nitrogen that pose the greatest threat to Great Bay's water quality.

The UNH work also complements our Coastal Training Program (CTP). Any NERRS Science Collaborative funded project must be linked to the users and Steve Miller, CTP Coordinator, is responsible for stakeholder integration. This provides us with a unique opportunity to work with towns in identifying the sources of nitrogen and developing strategies to minimize nonpoint pollution impacts.

It will take many years and a lot of public dollars to solve the nitrogen problem in Great Bay. It will also take a commitment from people who live in the watershed to be more responsible citizens when it comes to cleaning out their septic tanks and using less lawn fertilizer. Together we can make the Bay a better place.

*Peter Wellenberger*  
Reserve Manager, GBNERR



GREAT BAY  
NATIONAL  
ESTUARINE  
RESEARCH  
RESERVE

Great Bay National Estuarine Research Reserve (GBNERR) is an estuary comprised of 7,300 acres of tidal waters and 2,935 acres of coastal land. Acquired through land purchases and conservation easements, GBNERR was designated on October 3, 1989 to be preserved for the purposes of education, research, and resource protection.

## Great Bay MATTERS

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# Berms in the Great Bay Estuary:

Linking past human activities to current tidal marsh dynamics

In the fall of 2008, I began my graduate studies at the University of New Hampshire pursuing a Master of Science in Water Resources from the Department of Natural Resources. For my thesis research, I chose to embark on a three-year project studying the impact of berms, defined as historic earthen barriers, on tidal marsh structure and function. This topic was of particular interest to me as it combined my love of wetland habitats with my inquisitive nature regarding how humans have impacted the ecological function of the surrounding environment.

Tidal marshes are extremely important estuarine ecosystems; powered by the steady tidal pulse, these marshes regulate the flow of energy and nutrients between the terrestrial and marine habitats along the coast. Their high rate of productivity supports numerous trophic levels, including rare plant, fish and waterfowl species. However, humans have a long history of degrading tidal marsh habitat by restricting the natural hydrology of the system. Berms represent one type of tidal restriction impacting the marshes of the Great Bay Estuary (GBE).

## History of Berm Development in the Great Bay Estuary:

Thirty-four berm sites were identified in the GBE as a result of my thesis research (size varied considerably, but the average length was 5.9 meters). Each berm is a remnant of historical human activities no longer permitted in the tidal marshes of the GBE. Primarily, berms were constructed to convert tidal marsh area into productive crop or pastureland, by impeding the incoming tide (the large linear structure in the tidal marsh along Crommet Creek in Durham provides a good example of an agricultural berm, see photos).

Berms also resulted as byproducts

from industrial endeavors developed in the mid-19th century, including (but not limited to) river dredging and brick making. River dredging is still used today to maintain or increase the number and size of the vessels entering riverine marinas. Before federal legislation was passed to protect wetland habitats, the spoils were dumped in adjacent tidal marshes. The berms on the Cochecho River in Dover may be composed of deposited spoils from a river dredging event which occurred in 1871.

Brickmaking involved removing the fibrous peat from the surface of the marsh in order to extract the underlying marine clay. Many of the tributaries of the GBE, including the Oyster, Bellamy, and Salmon Falls Rivers, supported brickyards and still contain berms consistent in size and shape with historical clay extraction methods. Additionally, Sandy Point, near the Squamscott River, was home to the Fiske System Inc., a large brick making industry established in 1902. The 11 berms surrounding the mouth of the Squamscott River are likely a result of the industry's extensive manufacturing and transportation operations.

Lastly, some environmental management tactics, such as waterfowl impoundments and mosquito ditching, left berms in the tidal marshes of the GBE. Waterfowl impoundments (e.g., the Herods Cove impoundment in Great Bay), were used between 1930 and 1970 to transform marsh area into open water encouraging avian species to stopover during migration. Mosquito ditching, authorized in the 1930s as part of the New Deal legislation, was performed in an effort to increase drainage of the marsh and reduce the mosquito larvae habitat (i.e., tidal marsh pools). The ditching spoils were left piled in the marsh creating many small berms. Because the removal of pools also limited the habitat

In the Field



**Above:** Berm along Crommet Creek, tributary of the Great Bay in Durham, NH. **Right:** Jordan Mora standing beside berm at Crommet Creek for size comparison.

for juvenile fish, mosquito ditching was largely abandoned in 1960-1970.

## Ecological Impacts:

Given the prevalence of berms in the GBE, understanding the effect of berms on tidal marsh processes and biodiversity is extremely important. Based on my findings, berms seem to have the greatest impact on marsh soil and plant community dynamics when oriented parallel to the creek edge. Parallel-oriented berms restrict tidal flooding from the marsh located landward of the berm, disrupting natural physical gradients, such as salinity and soil oxidation. Additionally, depending on the drainage of the site, pools of standing water can develop in the landward area, which causes dramatic changes in the physical factors and biological interactions governing plant diversity and abundance.

More information is needed regarding the potential for berms to reduce tidal marsh integrity. In particular, berms may negatively affect the health and sustainability of the GBE tidal marshes as invasive plant species continue to spread (e.g., the non-native variety of *Phragmites australis*) and the rate of sea level rise begins to accelerate.

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