Coastal Features

The Newsletter of the Rhode Island Coastal Resources Management Council

CRMC Funds Groundwater Research in the Salt Ponds Region Watershed

by

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The Coastal Resources Management Council (CRMC) is allocating funds to produce the first comprehensive study of the hydrogeology and groundwater flow patterns of the southern Rhode Island salt ponds region (figure 1). The study will develop a predictive watershed model as a tool to protect this critical estuarine ecosystem. It is expected that the watershed model will provide the CRMC with the best scientific information from which to strengthen its ability to protect the region s coastal resources through its Salt Ponds Region Special Area Management Plan (SAMP) and other regulatory programs.

The study itself consists of two separate research projects that will collectively characterize the hydrogeology and groundwater flow patterns of the salt ponds region watershed (figure 2). The research project, being funded by the CRMC - and led by Principal Investigator John Masterson of the United States Geological Service (USGS) - is titled *Hydr ologic Characterization and Flow Simulation of the Ground-Water System of the Rhode Island Salt Pond Region.* The companion project is titled *Hydr ologic Characterization and Groundwater Flow Patterns in Southern Rhode Island and Implications for Coastal Lagoons: Numerical Simulations and Field Simulations,* and is being led by Dr. S. Bradley Moran of the University of Rhode Island Graduate School of Oceanography (URI-GSO). The Principal Investigators are working very closely to coordinate their respective research projects.

The CRMC first demonstrated its interest in managing the salt ponds region as a unique coastal watershed ecosystem when it promulgated *Rhode Island s Salt Pond Region: A Special Area Management Plan* on November 27, 1984. From the beginning, the CRMC recognized the central role of groundwater in the ecological health of the watershed and its salt ponds. The SAMP also recognized that bacterial contamination and nutrient enrichment were the primary threats to water quality as a function of wastewater inputs to groundwater from residential development.

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CRMC
Coastal Resources Management Council

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New Publication Tells History of Greenwich Bay

The CRMC is pleased to announce the release of a new publication, *Greenwich Bay: An Ecological History,* which sheds light on the past and present uses of a critical coastal resource for which the CRMC is currently developing a Special Area Management Plan. Authored by Sue Kennedy and Virginia Lee of the University of Rhode Island Coastal Resources Center, *An Ecological History* delves into the bay s past to the time of King Phillips War. It also describes the bay s current environmental conditions including water quality, land and water habitats, and hydrogeology. Cultural and historic resources, land use, and the local economy that is intimatelt connected to the bay and its resources are also described. The publication is available free of charge, but a $3 shipping and handling charge applies. To order a copy, please call Jean Gallo at (401) 874-6842.

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The SAMP linked polluted groundwater underneath older, densely developed communities in the watershed with bacterial contamination from residential individual sewage disposal systems. In some cases the bacterial contamination of groundwater was so significant a human health threat that it was no longer safe to rely on private wells for human uses of water; the high incidence of contaminated wells in the Green Hill and Matunuck neighborhoods necessitated the construction of the South Shore Water Supply System by the Town of South Kingstown during the 1970s. When the original SAMP was revised in 1999, updated information showed that the impact of bacterial contamination had gone beyond fresh water supplies for human uses. In 1994, significant bacterial contamination in the salt ponds region led the Rhode Island Department of Environmental Management to declare a permanent shellfishing closure in Green Hill Pond. A portion of Ninigret Pond adjacent to Green Hill Pond was similarly closed in 1996, while the waters of Point Judith Pond were declared closed in the vicinity of marinas, at the commercial fishing Port of Galilee, and in the ponds s upper reaches.

Nutrient contamination was also identified by the original SAMP, in particular nitrogen and phosphorus, as the other major source of groundwater pollution in the watershed. Nitrogen loading in the more saline portions of some salt ponds was cited as the cause of eutrophication during the summer months. Anoxic conditions resulted in some poorly flushed shallow portions of the ponds, severely impacting these ecosystems. And just as bacterial contamination was identified as a major source of groundwater pollution under densely developed communities in the watershed, extensive goundwater sampling revealed the concentration of nitrogen beneath densely developed areas to be 100 times the background levels present in undeveloped areas.

The SAMP identified several sources for bacterial contamination of groundwater in the watershed, including leachate from failed septic systems, leaking sewers, and sanitary landfills. Similarly, the sources of nitrogen contamination include septic systems and lawn and garden fertilizers. In the case of septic systems, phosphorus is readily adsorbed to subsurface sediments. But approximately half of the nitrogen produced, particularly in the highly soluble nitrate form, leaves the leaching field and enters the underlying groundwater. And the relatively porous glacial outwash sediments common to the salt ponds watershed are particularly susceptible to this process.

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Despite reliable information on the sources of groundwater pollution in the salt ponds watershed, and a fundamental understanding of the glacial geology of the region, the specific groundwater transport pathways by which non-point source pollutants threaten the ecological health of the salt ponds are not well understood. An overarching goal of the USGS/URI-GSO study is to delineate the hydrogeology and map the groundwater flow patterns of the salt ponds region. Utilizing this subsequently advanced body of knowledge, the CRMC will be significantly better equipped to fulfill its continuing mandate to protect the economically valuable and ecologically sensitive environmental resources of Rhode Island s salt ponds region.

Another benefit of this research is that it will significantly improve the existing body of scientific knowledge regarding the groundwater boundary of the salt ponds region. Since promulgating the original Salt Ponds Region SAMP in 1984, and identifying the central importance of groundwater protection, the CRMC has relied upon the best available information to establish reasonable boundaries for the salt

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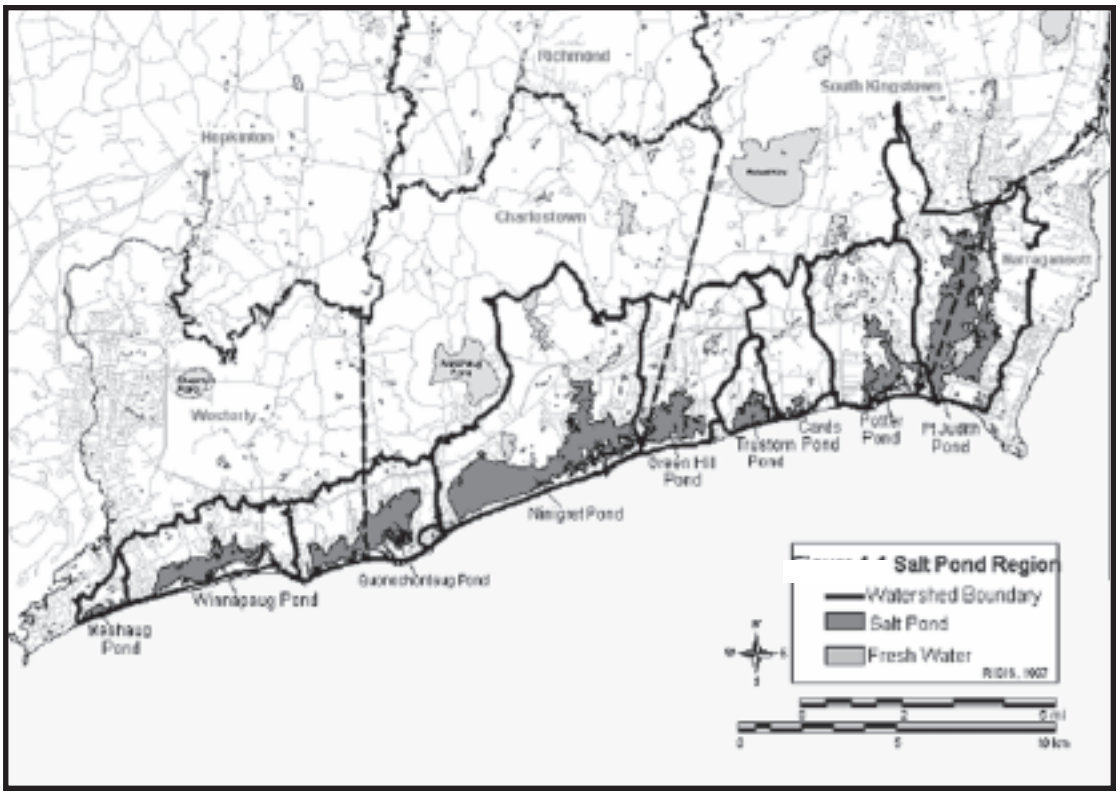

Figure 1. Salt Pond Region (From Salt Ponds Region Special Area Management Plan As Revised April 12, 1999)

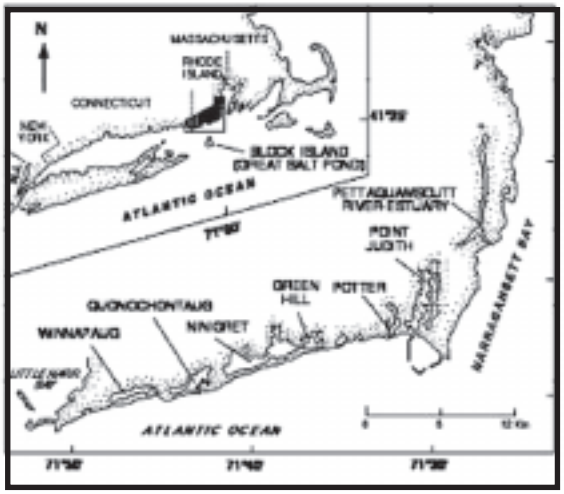

Figure 2. Proposed study area (From Dr. S. Bradley Moran, URI-GSO, proposal to RI Sea Grant)

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ponds region in order to establish a meaningful geographic area for regulatory purposes. The original SAMP identified the salt ponds region as a 32 square mile area that included portions of the Towns of Narragansett, South Kingstown, and Charlestown. The original region was bounded by roadways on three sides which approximated the groundwatershed boundary. The eastern and western boundaries were described as to the east by Route 108 in Narragansett, to the west by East Beach Road and Cookestown Road in Charlestown. The northern reads like a surveyor s report: from Route 1 in Narragansett, along Tuckertown Road and Narragansett Trail in South Kingstown to the Town Hall in Charlestown; thence following a straight line across the northernmost shore of Schoolhouse Pond to Kings Factory Road; thence following the Burlingame State Park boundary to Watchaug Pond; thence Watchaug Pond, following Watchaug Pond, following Healy Brook to Cookestown Road in Charlestown. The southern boundary was based on the shoreline of the barrier beaches that stretched from Route 108 in Narragansett to Cookestown Road in Charlestown. Under the original SAMP, this was the only one that represented an actual watershed boundary.

The boundary underwent some significant changes when the SAMP was revised in 1999. The SAMP region expanded under the 1999 revisions to encompass an area of 45 square miles that was based on the surface watershed boundaries of the nine coastal salt ponds between the Towns of Narragansett and Westerly (figure 1). While this represented a more meaningful region for regulatory purposes, it still did not achieve an ideal relationship between the fundamental basis for management - groundwater protection - and the protected area itself. The URI-GSO and USGS studies represent an opportunity for the CRMC to define the salt ponds SAMP region by its actual groundwatershed boundary.

The USGS Study: *Hydrologic Characterization and Flow Simulation of the Ground-Water System of the Rhode Island Salt Pond Region*

The USGS study proposal outlines the familiar impacts of increasing development in the salt ponds region: bacterial and nutrient enrichment of groundwater, groundwater withdrawals and waste discharges, all exacerbated by the strong seasonal influence of tourism, particularly during the hot, sunny, summer months when conditions for eutrophication are optimal. The ecological health of the salt ponds is also linked to the watershed s hydrogeology, and the ponds physical properties (i.e. shallow water habitats) and processes (i.e. low flushing rates).

The proposal also describes the salt ponds as an integral part of the coastal boundary between the ocean and the salt ponds region s highly permeable freshwater aquifer. The salt pond s estuarine ecosystems are the inevitable outcome of this circumstance. And these ecosystems, while highly productive, are also extremely sensitive to the impacts of water borne pollutants from both the saline and freshwater inputs that maintain their unique character. The study s characterization of the salt ponds region freshwater hydrologic framework will greatly advance the current understanding of groundwater flow patterns that deliver nutrient enriched groundwater to the salt ponds. In order to achieve this, a hydrologic framework of the region s glacially deposited sediments will first need to be defined. This will in turn provide the basis for a preliminary groundwater flow model for the salt ponds region.

According to John Masterson, the USGS study Principal Investigator, the groundwater model will: 1) synthesize the available hydrogeologic data, including a conceptual depositional model of the surficial glacial sediments of the region; 2) evaluate the appropriateness of the depositional model in light of the existing hydrologic information, and 3) provide estimates of groundwater fluxes to the salt ponds. Masterson further notes that the model will be used for scenario-testing simulations to identify data collection needs for future development of local-scale models. (Any such models will be developed and used in a second phase of the project, not outlined here, for more detailed analysis of subsurface nutrient delivery to selected salt ponds under past, present, and potential future land-use conditions).

A USGS Water Resources Investigations Report that

includes the data collected, the groundwater flow system model, and the results of the model simulations is scheduled for publication by December 2005. The immediate expected benefit of this study to the CRMC is an improved understanding of the hydrogeologic framework and groundwater flow system. In addition, the regional groundwater flow model as determined by this study can serve as the basis for future studies in which more detailed, local scale models can be developed to simulate reactive-solute transport of nutrients to the salt ponds. For regulatory purposes, the study will provide the best available information to assist the CRMC and other agencies in developing technically sound coastal resource protection policies.

The RI Sea Grant Study: *Hydrologic Characterization and Groundwater Flow Patterns in Southern Rhode Island and Implications for Coastal Lagoons: Numerical Simulations and Field Simulations*

The URI-GSO study, led by Dr. S. Bradley Moran, addresses the ground truthing element needed to properly apply the USGS predictive model to the salt ponds watershed. As shown in his research grant proposal, Dr. Moran outlines *...a collaborative effort between GSO and the USGS to address a critical and timely need for a detailed study of the hydrogeology and groundwater flow patterns and magnitudes for the Rhode Island salt pond region (Figure 2). A key advantage of this proposal is the combination of state-of-the art numerical models of groundwater flow (Masterson et al., 1997b; Masterson and Walter, 2000), leveraged through the USGS and CRMC, that would be constrained by proposed mapping of the regional hydrogeology and ground-truthed against radium isotopic groundwater flux measurements for these coastal systems (Scott and Moran, 2001; Kelly and Moran, 2002; Hougham and Moran, 2003). These data and numerical simulations are required to validate and constrain models of groundwater nutrient transport and contaminant dispersal to this coastal zone that typically utilize a risk-based approach (i.e., Total Maximum Daily Loading; TMDL).*

In order to properly synthesize both the USGS and URI-GSO studies, Dr. Moran has developed the following research objectives for his own study:

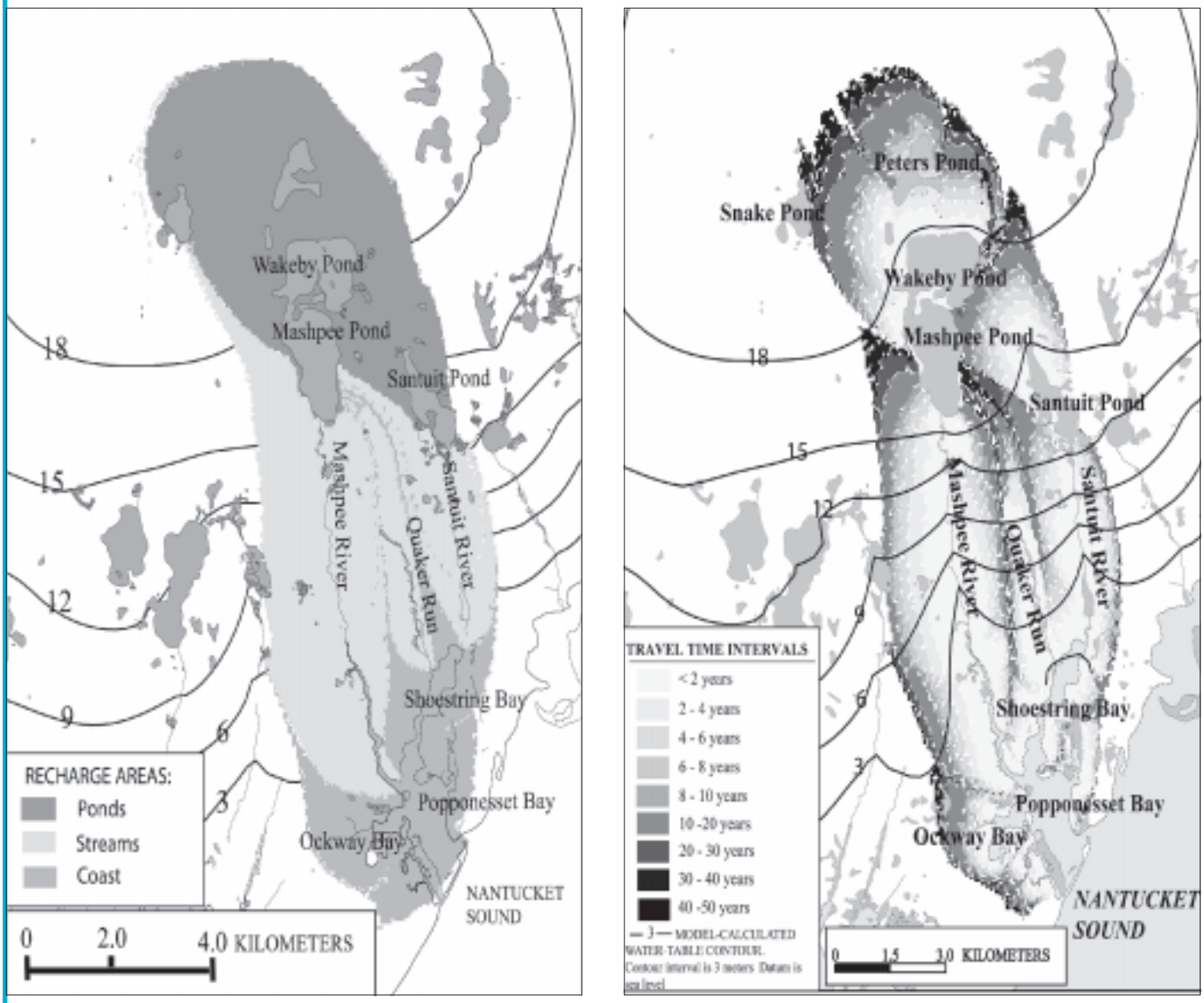
1) Conduct a comprehensive synthesis of existing hydrogeologic data from previous investigations of the southern Rhode Island salt pond region; specifically, surface and subsurface mapping and hydrogeologic interpretation of the regional glacial geology, including the distribution of fine and coarse grain sediments and bedrock topography.

2) Calculate the seasonal and interannual variability in the input of groundwater and groundwater borne nutrients to the salt ponds based on seasonal measurements of radium isotopic tracers.

3) Utilize the hydrogeologic and radium isotopic tracer data to develop and calibrate a preliminary numerical groundwater flow model for the Rhode Island salt pond region.

Taking the leap from scientific research objectives to coastal resource management information needs, Dr. Moran outlines several benefits of his study: a comprehensive map of the regional hydrogeology; the distribution and interpretation of glacial stratified deposits and bedrock topography of the salt ponds region; and preliminary numerical simulations of groundwater pathways and fluxes.

A three-dimensional groundwater flow model that simulates groundwater flow in the salt pond region would also be developed and calibrated based on available hydrologic data. The model would be developed for the primary purpose of synthesizing the available hydrologic data in the framework of a groundwater model to provide preliminary estimates groundwater fluxes and the sources of water to the salt ponds. Such models would be used in future studies for more detailed analyses of discharge to the salt ponds, estimates of aquifer residence times, and delineations of the sources of the sources of water to the region. Figure 3 on the following page shows an example of the type of model output proposed for the Rhode Island salt pond region.



(Figure 3) Example of proposed groundwater flow numerical model output for Rhode Island salt pond region: recharge areas to ponds, streams, and coastal areas, and the aquifer residence times in PopponessetBay watershed, Cape Cod, Massachusetts (Masterson and Walter, 2001).

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The Greenwich Bay Special Area Management Plan Citizen s Advisory Committee

By: Megan E. Higgins

The goal of the volunteer Citizen s Advisory Committee (CAC) is to provide community organizations and groups in Warwick and East Greenwich an opportunity to help shape the draft Special Area Management Plan (SAMP) for Greenwich Bay and its watershed. With ten meetings completed and one to go, the CAC has been instrumental in steering the course of the Greenwich Bay SAMP as well as promoting public awareness and understanding of the SAMP process.

Membership of the CAC consists of groups or organizations from Warwick and East Greenwich. In addition to the CAC meetings, many of the CAC members have been attending technical meetings and contributing to technical discussions. The recommendations are currently being incorporated into chapter drafts on such topics as water quality, recreational uses, and habitat protection which will soon be posted on the SAMP website (see http://seagrant.gso.uri.edu/G_Bay/Management/SAMP/). The goal is to encourage the CAC to establish a watershed coalition that acts as a steward for Greenwich Bay after the formal adoption of the Greenwich Bay SAMP by CRMC, State Planning, and, eventually, comprehensive town plans.

The Future of the Bay

By: Megan E. Higgins

On October 22, 2003, by Executive Order, the Governor s Narragansett Bay and Watershed Planning Commission was established for the following purpose: to advise and make recommendations to the Governor and the General Assembly for developing a strategic long-term plan for the Bay and its watershed that will address environmental protection, restoration, sustainability, economic development, and socially equitable use of resources. (Executive Order 03-16). Ten study panels were assembled by the Commission Chair J. Joseph Garrahy and the Steering Committee to focus on bay-wide issues ranging from nutrient and bacteria pollution to intergovernmental coordination. Each panel has a specific charge with regard to recommending both short-term and long-term actions to improve the health of Narragansett Bay and its watersheds.

One of the panels comprising the Commission is the Habitat and Resource Panel. The purpose of this panel, with thirteen members from various state, federal, and non-governmental agencies, is to address coastal and riverine habitat restoration and coastal resource protection. The Panel is finalizing a report that will be presented to the Governor with its recommendations. For more information, refer to http://www.ci.uri.edu/govcomm/.

In addition to providing recommendations to the Habitat and Resource Panel, CRMC Staff testified at a joint committee hearing of the Senate on Narragansett Bay and marine issues. Those recommendations, along with others, have been adopted by the Senate in a report entitled Habitat-Based Management for Rhode Island s Marine Environment. As a co-chair of the RI Habitat Restoration Team, I was asked to testify on the status of habitat loss and restoration state-wide. The State Estuary and Habitat Restoration Strategy, a document produced by the Team pursuant to legislation establishing a funding source for habitat restoration projects, was presented and referenced throughout the Senate s report. The Senate s report may be accessed on-line at http://www.rilin.state.ri.us/hbm.pdf.

Given the current initiatives by members of the Senate, the House Special Legislative Commission, as well as the Governor s Commission, the future of Bay planning, monitoring, and use is promising. The recommendations proposed and adopted are ambitious; however, with commitment and dedicated nonfederal funding to such programs as habitat restoration, the short-term and long-term goals are attainable.

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Upper Warwick Cove, Greenwich Bay, Rhode Island
(Photo Credit: City of Warwick Planning Department)

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