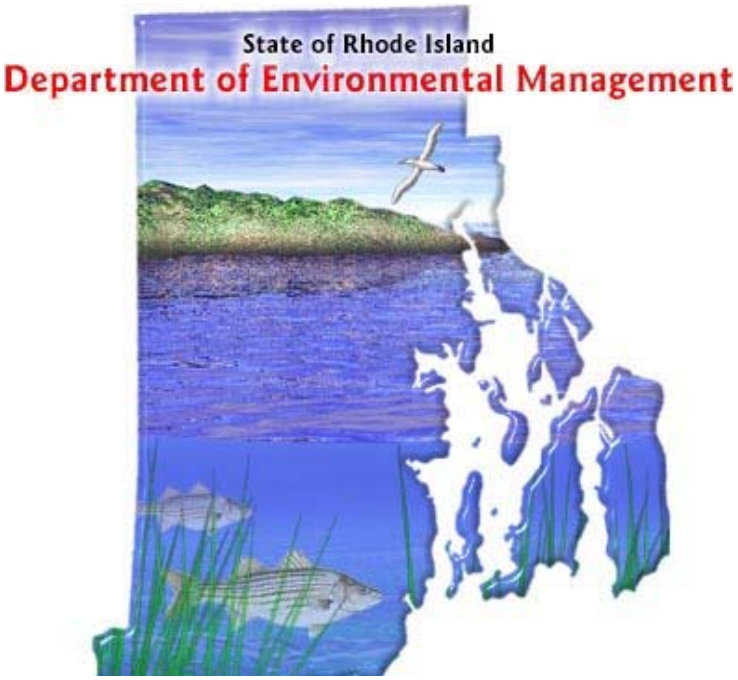
Plan for Managing Nutrient Loadings to Rhode Island Waters



Prepared by the
Rhode Island Department of Environmental Management

Pursuant to RI General Law § 46-12-3(25)

February 1, 2005

[*Edited February 10, 2005]*

Introduction

This report is written in response to amendments to Chapter 46-12 of the RI General Laws, enacted during the 2004 legislative session. These amendments require the Department of Environmental Management to:

> Implement measures to achieve an overall goal of reducing nitrogen loadings from waste water treatment facilities by fifty percent (50%) by December 31, 2008, which date, in its implementation, my be adjusted to be consistent with compliance with permit modifications, through waste water treatment facility upgrades scheduled to be undertaken by December 31, 2006, and through proposed permit modifications, which shall be issued by the department on or before July 1, 2004. (RIGL § 46-12-2(f))
>
> [And to] Prepare and to submit to the governor, the speaker of the house, the president of the senate, the chairperson of the house committee on environment and natural resources and the chairperson of the senate committee on environment and agriculture, not later than February 1, 2005, a plan, including an implementation program with cost estimates, recommended sources of funding, measurable goals, objectives, and targets and limitations for nutrient introduction into the waters of the state, for the purposes of: (i) managing nutrient loadings and the effects of nutrients in the waters of the state; and (ii) preventing and eliminating conditions of eutrophication and report on the implementation of the required WWTF upgrades. (RIGL § 46-12-3(25))

Nutrients and Impacts of Excessive Nutrients

Nutrients, such as nitrogen and phosphorus, are necessary for growth of plants and animals and support a healthy aquatic ecosystem. In excess, however, nutrients can contribute to fish disease, brown tide, algae blooms and low dissolved oxygen.

Excessive nutrients, generally phosphorus in freshwater and nitrogen seawater, stimulate the growth of algae, which starts a chain of events detrimental to a health aquatic ecosystem. The algae prevent sunlight from penetrating through the water column. Once deprived of sunlight, underwater seagrasses cannot survive and are lost. Animals that depend on seagrasses for food or shelter leave the area or die. As the algae decay, they rob the water of oxygen. Fish and shellfish are in turn deprived of oxygen. Excessive algae may also cause foul smells and decreased aesthetic value.

Nutrient and Nutrient Related Criteria

Allowable levels of pollutants may be expressed in terms of the pollutant (i.e. typically phosphorus in freshwaters and nitrogen in saltwater), numeric limit for the impact of the pollutant (i.e. acceptable dissolved oxygen or chlorophyll levels) or a narrative description of acceptable conditions (i.e. nutrients shall not exceed the site-specific limits necessary to prevent or minimize accelerated or cultural eutrophication). The allowable level of nutrients can depend on several site-specific factors such as how long pollutants

are retained in a particular water body. See Appendix A for more concerning numeric and narrative criteria contained in the RI Water Quality Regulations.

Identification of Impaired Waters

Section 305(b) of the federal Clean Water Act requires that each state assess the health of their surface waters and submit biennial reports describing the water quality conditions to the USEPA. This 305(b) process is the principal means by which states, EPA, and the public evaluate water quality, the progress made in maintaining and restoring water quality, and the extent to which problems remain. DEM utilizes water quality information available from a variety of sources to determine if the standards necessary to support aquatic life, drinking water supply, shellfishing, fish consumption and swimming use, are attained. It is important to keep in mind that the waters considered assessed may be evaluated for only a single pollutant while numeric water quality criteria are established for over one hundred different pollutants. Below is a summary of the most recent assessment of RI water bodies, with particular reference to nutrient impacts.

Rivers and Streams

Approximately 38% (570 miles) of the 1,498 river miles in Rhode Island have been assessed, 30% for nutrient impacts. Of the waters assessed for nutrients, 8% are impaired. The majority of unassessed river miles in general include the many small headwater streams and rivers of the state.

Lakes

Eighty percent (16,742 acres) of the 20,917 acres of lakes in Rhode Island have been assessed, 50% (10,536) for nutrient impacts. Of the lake acres assessed for nutrients, approximately 22% (2300 acres) are impaired.

Estuarine Waters

Of the 156.29 square miles of estuarine waters over 99% (156.23 square miles) are considered assessed. It is important to note that a large percentage of estuarine waters considered assessed are, for the most part, only monitored for bacteria by the RIDEM Shellfish Monitoring Program. Fifty-three percent of the estuary areas (82 square miles) have been assessed for nutrient impacts, and, of those 50% are impaired.

Development of Water Quality Restoration Plans

Pursuant to Section 303(d) of the federal Clean Water Act, each state is required to develop a list of impaired waters and a schedule for completing water quality restoration plans (know as TMDLs, or Total Maximum Daily Loads) for those impaired waters. Restoring waters with bacteria levels that impact shellfish harvesting and swimming have been assigned the highest priority. Since the most significant nutrient (nitrogen) related impairments are found in the Providence River, Seekonk River and Upper Bay, these waters have been assigned the highest priority among waters impacted by nutrients. Appendix B contains the schedule for developing restoration plans for the waters

impacted by nutrients. Whenever feasible, multiple impairments are addressed within one water quality restoration plan.

Reduction of Nitrogen From Wastewater Treatment Facilities Impacting the Providence, Seekonk River and Areas in Upper Narragansett Bay

There are many sources of nitrogen to the Upper Bay, including municipal wastewater treatment facilities (WWTFs), storm water (particularly with respect to agricultural and residential fertilizers), ISDS systems, and atmospheric deposition. Since the late 1980s it has been recognized that WWTFs are a significant source of nutrients to the Seekonk River, Providence River and Upper Bay (including the Palmer River and Greenwich Bay). As noted in the Initial Report by the Nutrient and Bacteria Panel of the Governor's Narragansett Bay and Watersheds Planning Commission (March 3, 2004; www.ci.uri.edu/govcomm/Documents/Phase1Rpt/Docs/Nutrient-Bacteria.pdf), all analyses of the Bay conditions indicate that WWTFs are the largest source of nitrogen to the Bay. In addition, many WWTFs discharge to shallow, poorly flushed areas such as the head of the Upper Bay, either directly to the Providence or Seekonk River or to freshwaters rivers that flow into these waters (e.g. Blackstone, Ten Mile and Pawtuxet Rivers), which exacerbates the impact of nutrients. For these reasons, past and present efforts to reduce nitrogen discharges to the Bay have been principally focused on WWTFs.

Water quality sampling and modeling studies, for the most part commissioned by the Narragansett Bay Project between 1985-1990, indicated that additional data collection and a more detailed computer model was necessary to predict the reduction in nutrients necessary to meet water quality standards. Since1995, DEM has conducted additional fieldwork, hired a consultant and worked with a technical advisory committee (TAC), consisting primarily of scientists and engineers representing, academic, municipal, state and federal organizations, to calibrate a model and develop a water quality restoration plan, or TMDL, for the Providence and Seekonk Rivers. It was recently determined that the hydrodynamic model formulation could not adequately simulate conditions due to the relatively severe changes in the bathymetry in the Providence River. DEM has evaluated impacts and set nitrogen load reduction targets using studies conducted at the University of Rhode Island's Marine Ecosystems Research Laboratory (MERL). This analysis indicated that even if the WWTF discharges are reduced to the limit of technology (total nitrogen of 3 mg/l), the Seekonk River and portions of the Providence River would not fully comply with existing water quality standards (minimum of 5.0 mg/l "except as naturally occurs") and may not meet the latest Environmental Protection Agency (EPA) guidelines that DEM has proposed to adopt (see Appendix A).

Typical Treatment Methods to Reduce Nitrogen

Secondary treatment facilities can be modified to promote the growth of bacteria that convert nitrogen in wastewater to nitrogen gas. First, bacteria reduce ammonia by converting it to nitrite (nitrification) then other bacteria convert nitrite into inert nitrogen gas (denitrification) that is released to the atmosphere. Cranston, West Warwick and Warwick are proposing biological nitrogen treatment to meet their requirements to reduce

ammonia, which impacts the Pawtuxet River, and reduce total nitrogen levels, which impact the Providence River. Some facilities, such as Burrillville and Smithfield, are required to reduce their ammonia levels, but will also reduce total nitrogen since studies have demonstrated that denitrification stabilizes the treatment process and reduces energy and chemical addition costs. Facilities with a sufficient number of tanks available can be retrofitted to reduce nitrogen at substantially less cost than those required to construct additional tanks.

Status of Efforts to Achieve 50% Reduction in WWTF Inputs by December 2008

This goal, first recommended by DEM, was subsequently adopted in the spring of 2004 by the Governor's Narragansett Bay and Watershed Planning Commission, and then signed into law as a statutory mandate during the 2004 legislative session. A total of 11 RI WWTFs within the Upper Narragansett Bay watershed have been identified for nutrient control. DEM has evaluated implementation costs, analyses of the performance of available technology, and estimates of water quality improvement to developed a phased plan for implementation of WWTF improvements that maximizes nutrient reductions relative to implementation cost. Implementation of nitrogen removal would initially reduce the summer season nitrogen load discharged from these eleven Rhode Island WWTFs to the Upper Bay by 65%, dropping to 48% as WWTF flows increase to their approved design flows.

Based on this evaluation of the sources of excessive nitrogen levels in the rivers and the capabilities of existing treatment processes, the DEM has determined that it would be appropriate to establish seasonal (May – October) WWTF total nitrogen limits that range from 5.0 mg/l to 8.0 mg/l and require operation of all available treatment equipment throughout the rest of the year in order to maximize the benefits of the WWTF improvements. Limits vary based on the relative environmental impact of each discharge, which depends in part on proximity to the areas that are most significantly degraded. This will result in substantial progress towards the mitigation of hypoxic/anoxic events and meeting water quality standards. There was general consensus among the TAC that nitrogen impacts in Upper Bay are primarily the result of summer inputs and that inputs during other parts of the year are not a significant factor during the critical summer period.

Monitoring and Assessment

An integral component of the above-described phased implementation approach is monitoring and assessment of water quality changes to determine if additional reductions are necessary to meet applicable standards. DEM, in partnership with the Prudence Island National Estuarine Research Reserve, the Narragansett Bay Commission, University of Rhode Island, and Roger Williams University, increased the number of Narragansett Bay continuous water quality monitoring stations from 7 to 9 in the summer of 2004. DEM has obtained funding from the federal Bay Window grant to increase the number of stations to at least 13 by the summer of 2005. This monitoring network will provide the data necessary to evaluate compliance with water quality standards, particularly temporal detail needed to evaluate compliance with EPA's dissolved oxygen guidelines

In January 2005, DEM completed the development of a draft statewide Water Monitoring Strategy and forwarded it to the newly established RI Environmental Monitoring Collaborative for review (the document can be found at www.ci.uri.edu/Projects/RI-Monitoring/Docs/DEM_WQ_Mon_Jan5_05.pdf). The strategy outlines monitoring approaches, both existing efforts and program enhancements, that are needed to meet the State's priority data needs concerning surface waters. Also in January, the Monitoring Collaborative forwarded its first annual report to the RI Bays, Rivers, and Watersheds Coordination Team.

In support of the State's monitoring needs, Governor Carcieri, in his FY06 budget request, has proposed $1 million in new funding for enhanced water quality monitoring. The enhanced monitoring will provide data that is important to tracking the health status of the Bay and its watershed over time and eliminate many of the critical data gaps highlighted in Phase 1 Report. For example, work will resume to collect data that allows nutrient pollutant loadings from the larger rivers that drain into the Bay to be tracked over time. This information, along with other data, is important to evaluating the State's success in restoring the water quality of the Upper Bay as planned wastewater treatment improvements are implemented this year and in the future. The investment will build important capacity, through staffing and equipment within DEM, not only for systematically monitoring the ambient condition of the state's waters, but also for responding to emergencies such as fish kills or oil spills that may occur in the future.

Issuance of Proposed Permit Modifications by July 1, 2004

RIGL § 46-12-2(f) required that RIDEM issue proposed permit modifications by July 1, 2004, to achieve an overall goal of reducing nitrogen loadings from WWTFs by fifty percent (50%) by December 31, 2008. Attainment of the goal was judged against May-October 1995-1996 discharge data. Of the 11 facilities identified for nutrient reductions to achieve the required goal:

- Six permits already contained appropriate conditions -- Burrillville, Smithfield, Cranston, Warwick, West Warwick and East Greenwich.
- Four preliminary draft permit modifications were sent to the permittees on July 2, 2004 -- East Providence, Woonsocket, the NBC Fields Point facility, and the NBC Bucklin Point facility. Along with the preliminary draft permits, each permittee received a copy of the analysis supporting the drafts entitled *Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*.
- One (1) facility permit modification has not yet been drafted – Warren WWTF. The Department has not yet completed an analysis of the impact of nitrogen from the Warren WWTF on the Palmer River. It is anticipated that the preliminary draft permit modification will be issued in May 2005.

Status of Permit Modifications Proposed in July 2004

NBC and Woonsocket submitted comments on the preliminary draft permit modifications by August 11th. RIDEM developed a written response to the comments received and

consistent therewith, revised the supporting analyses. In addition, detailed guidance was developed to aid in the review of spreadsheets used to complete the analysis.

On December 28, 2004 RIDEM issued a public notice indicating that oral comments could be presented at a hearing on the draft permit modifications (February 8th at 5:00 p.m.) and written comments would be accepted through February 11th, 2005 After the close of the public comment period, RIDEM will develop a written response to all significant comments and either finalize the modifications (as drafted, or with minor modifications) or make significant amendments and provide additional opportunity for public comment.

Actions Following Issuance of Final Permit Modifications

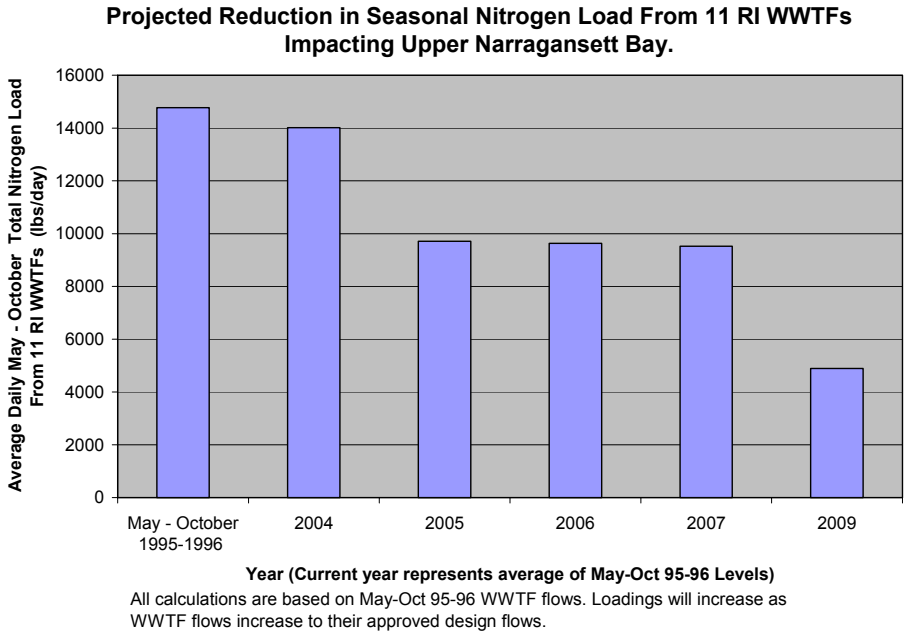
Upon issuance of the final modifications, it is anticipated that the permittees will appeal the permits and enter a consent agreement with RIDEM. Through this process, interim limitations and an enforceable schedule for completing planning, design and construction will be established. These consent agreements will include the December 2008 target date for completion of construction. Based upon the results of planning and design work at each facility, a specific construction schedule will be developed for each facility. Facility plans and final designs must be approved by DEM prior to initiation of construction.

Status of WWTF Modifications

As of January 2004, four WWTFs have completed nutrient upgrades (Burrillville, Warwick, West Warwick, and Woonsocket). By the summer of 2005, the NBC Bucklin Point Facility will be operational (over 1 year ahead of schedule) and the Cranston WWTF is scheduled to complete construction (the City has indicated an extension request is forthcoming). This will bring the total to five facilities capable of reducing nitrogen. These modifications will result in a 34% reduction of the 95-96 loadings from the 11 WWTFs. To meet the proposed discharge limits, Woonsocket WWTF will require further modifications, Burrillville will be installing enhanced controls, and the NBC Bucklin Point WWTF may require additional modification.

By March 2006, East Greenwich will complete construction of facility modifications currently underway. While this will result in a significant reduction of nitrogen for the facility, it will only slightly decrease the total from the 11 WWTFs (changing the total reduction from 34% to 35%).

The graph presented on the next page illustrates the timing of the seasonal nitrogen reductions anticipated from the 11 WWTFs. This needs to be moved ahead of the figure



Interim WWTF Modifications

Beginning in 1998, wastewater treatment facility operators that were required to upgrade their facilities to reduce ammonia or to meet other requirements agreed to reduce nitrogen as well. As a result significant progress toward attainment of this goal has already been made.

Also, as part of Rhode Island's nutrient removal initiative, RIDEM and the New England Interstate Water Pollution Control Commission invited plants to participate in training on nutrient removal in April 2000. Two recognized experts in the field conducted an initial screening analysis at five facilities to determine the feasibility of either making some minor modifications to the plants and/or making operational changes to reduce the amount of ammonia and nitrogen in the discharge. The West Warwick, Warwick, Cranston, East Greenwich and NBC Fields Point WWTFs participated in this program.

As a result of this initial effort, and with assistance from RIDEM (a $35,000 Aqua Fund Grant, and additional operator training) and $7,000 in matching funds from the City, the Warwick WWTF was able to construct modifications that resulted in the removal approximately 80-90% of the ammonia and 50% of the nitrogen in its discharge. Warwick noted that operational costs were increased due to the associated increased electrical consumption and chemical addition. (The city has since completed construction of its permanent upgrade.)

In 2004, a second round of DEM-assisted training again focused on the East Greenwich, Cranston, and NBC Fields Point WWTFs, while also adding the Warren WWTF. The training again focused on potential opportunities to construct interim modifications to achieve significant reductions in nutrients discharged to the receiving waters, in some

cases years before final improvements were to be completed. Below is the status as of January 2005:

Warren: The Town of Warren has recently purchased and installed timing equipment to cycle the aeration of their secondary treatment process. This technique, used by the Burrillville wastewater facility (which has a similar design), can be very effective in forcing the removal of nitrogen from wastewater. The facility will institute the cycling programming towards the end of January and into February of 2005, with results being monitored and adjustments being made in an attempt to reduce total nitrogen levels.

East Providence: Experimental process and equipment modifications appear to have resulted in total nitrogen levels decreasing about 2-3 mg/L, from about 12 mg/l to around 10 mg/L. High winter flows have necessitated the cessation of this experimental process; however as flows drop with the approach of summer, the facility is expecting to re-institute this process in its entire secondary facility, with the goal of reducing its nitrogen loadings into the Providence River by some 15-20%.

East Greenwich: The Town of East Greenwich, which is building a permanent nutrient removal facility, is examining the feasibility of temporary process changes (pumping, etc.) to help remove nitrogen. Final checks are being made, with a decision sometime in February of 2005. If doable, these interim process changes could reduce nitrogen discharges throughout the summer of 2005, while workers complete the permanent facility, scheduled for opening in 2006.

NBC – Fields Point: While theoretically possible to test a portion of its aeration system for a traditional "BNR" nutrient-removal system, preliminary analyses indicate that temporary modifications are not reasonable. A significant expenditure of resources would be required and would not result in meaningful reductions prior to construction of permanent modifications. NBC completed pilot testing of a nitrogen reduction technology during the summer and fall of 2004.

Cranston: In anticipation of construction related to permanent nutrient-removal upgrades, Cranston will be modifying available equipment to install new nutrient-removal systems currently required by April 2005 (the City has indicated they intend to request an extension). Therefore interim modifications will not be pursued. Recent DEM-assisted experimentation has, however, provided plant staff with a better understanding of nitrogen removal at their facility.

Massachusetts WWTFs

The Upper Blackstone Wastewater Pollution Abatement District (UBWPAD), North Attleboro, and Attleboro WWTFs play a significant role in the ability to improve water quality in the Providence and Seekonk River system, and efforts to reduce their nitrogen inputs should be initiated as soon as possible. The first phase of the nitrogen reduction plan developed by DEM includes a targeted Blackstone River nitrogen load of 463 kg/day (dissolved inorganic nitrogen) based on combined input from Woonsocket and

MA sources. Of this allowable load, 85 kg/day has been allocated to Woonsocket and 378 kg/day to MA sources. The UBWPAD WWTF (located in Worcester), is large relative to the other WWTFs impacting the Seekonk River: 1.8 times larger than Bucklin Point and 3.5 times larger than Woonsocket. The UBWPAD is currently planning an upgrade and it would be prudent to consider nitrogen removal options while the planning process is underway. RIDEM will be working with Massachusetts and the US EPA to pursue nitrogen reductions at these facilities.

Estimate of RI WWTF Upgrade Costs

Below is a summary of the estimated funding needed to provide treatment to reduce ammonia and nitrogen at municipal WWTFs in Rhode Island. As noted, most costs are estimates based upon data from studies completed in the Chesapeake Bay watershed. Facilities with extra capacity require fewer or no new tanks and larger facilities typically incur greater costs. Approximately $80 million is needed to complete the remaining WWTF upgrades necessary to achieve the 50% reduction. Cost estimates will be further refined as planning and design work is completed.

WWTF	**Cost * ($M)**
Cranston	4
East Greenwich **	7.5
East Providence	11.7
NBC Fields Pt. ***	43.4
Warren	4.6
Woonsocket	9.5
Total	**80.7**

* Unless otherwise noted, costs are capital costs and include allowance for planning, design, construction and administration to modify the existing treatment facility to achieve the target levels on a seasonal basis. All costs are "order-of-magnitude" estimates, since specific facility characteristics have not yet been evaluated. All estimated costs are based on "Nutrient Reduction Cost Estimations for Point Sources in the Chesapeake Bay Watershed," November 2002. Effluent concentrations are based on maximum monthly average, unless otherwise noted. Costs are based on use of a 1.25 factor for maximum monthly average, vs. annual average limits.

** Facility under construction; figure is based on actual bid costs.

*** This cost is from NBC's FY2006-2010 Capital Improvement Program and represents the mid-range of alternatives to remove nitrogen to less than 5mg/l on a seasonal basis. This cost is associated with higher removal than

required by the draft permit modification (which was not available when the NBC document was prepared).

Mechanisms to Fund WWTF Costs

Below-market rate interest loans provided through the State Revolving Fund (SRF) program have replaced federal grants as the major source of water pollution abatement funding. The SRF Program, administered by the Rhode Island Clean Water Finance Agency, has awarded over $500 M in low-interest loans funds for approximately 235 projects since 1991. The SRF Program is capitalized using federal dollars allocated through the Clean Water Act and state bond funds. These funds are used to provide low-interest loans to eligible communities and sewer commissions. Presently, the subsidized interest rate from the RI SRF program is one-third off the community's stated borrowing rate.

In November 2004, Rhode Island voters approved a bond measure that included $10.5 million for improvements to WWTFs. The monies will be used to further capitalize the State's SRF Program. The bond measure was proposed by Governor Carcieri and approved by the Rhode Island General Assembly. In announcing his proposal, the Governor offered his commitment to propose an additional $20.2 million in funding for WWTF upgrades as part of a follow-up bond referendum on the 2006 ballot. After being leveraged through the SRF program, the State bond funds are expected to provide sufficient loan capacity to support the WWTF modifications necessary to achieve the 50% nutrient reduction goal.

Other WWTF Upgrades

Westerly completed construction of nutrient upgrades in October 2003, which reduced loadings of nitrogen to Little Narragansett Bay.

Other Nitrogen Reduction Efforts

As noted above, there are many sources of nitrogen to the Upper Bay, including WWTFs, storm water (particularly with respect to agricultural and residential fertilizers), ISDS systems, and atmospheric deposition. While priority has been given to temporary and permanent modifications at WWTFs to reduce the discharge of nitrogen to the Bay, many other pollution prevention and treatment-based approaches are being implemented by DEM, CRMC and other agencies and organizations to reduce nutrients from these other sources.

Water quality restoration plans addressing nutrient impairments (TMDLs, Special Area Management Plans (SAMP) or other action plans) are underway for a number of coastal embayments and rivers discharging to the Bay, including Greenwich Bay, Kickemuit River and Reservoir, Ninigret and Green Hill Ponds, and the Palmer River. These plans identify sources of nutrients and necessary actions to restore water quality – including control of both point source (e.g. wastewater treatment plant discharges) and non-point sources of pollution (e.g. cesspools, stormwater, agricultural sources, etc.).

Many efforts are underway to both prevent water quality impacts associated with stormwater runoff in undeveloped areas, and to enhance the treatment and management of stormwater from urban and agricultural areas – thus incrementally reducing the discharge of nitrogen and other pollutants from these areas. Among the efforts to prevent water quality impacts are 1) initiatives such as Grow Smart RI and the Governor's Growth Planning Council, and Growth Center Implementation project; 2) watershed-based projects to identify and protect and/or restore riparian buffers, and 3) public education and municipal assistance efforts to encourage low impact development. A significant level of effort is underway by 36 RI communities and RIDOT to better manage urban stormwater through the development and implementation of storm water management plans consistent with RIPDES Phase II permit requirements. Local efforts will include such minimum measures as the mapping of outfalls, routine maintenance of drainage systems, pollution prevention/good housekeeping measures at municipal facilities, adoption of ordinances to control construction site and post development stormwater, and the identification and mitigation of illicit connections to drainage systems.

To ensure that new site development, re-development and stormwater retrofit projects utilize current information on the design and installation of best management practices (BMPs) for structural and non-structural measures to reduce runoff volumes and improve stormwater quality, DEM and others have focused efforts in developing new guidance materials. Efforts to create and/or update guidance documents for use by municipal and state permitting programs include the Conservation Development Guidance Manual and Training program, updates to the Rhode Island Storm Water Manual with improved standards for best management practices, and the Urban Design Manual to guide re-development in urban areas.

The proposed cesspool phase-out legislation and proposed revisions to the ISDS regulations requiring denitrification systems in the watersheds of nutrient sensitive coastal waters both aim to reduce nitrogen loadings to the state's waters. More specifically, DEM is considering an addendum to the proposed cesspool phase-out legislation that would phase-out all cesspools having access to sewers -- estimated at 7,500 homes, of which nearly two-thirds are located in Warwick and East Greenwich – and thereby eliminate this source of nitrogen to the state's groundwaters and ultimately, surface waters. Also underway are proposed revisions to the ISDS regulations contemplating the requirement of denitrification systems for septic systems installed in nutrient sensitive watersheds including the Narrow River and South County Coastal Ponds, and possibly other coastal waters impaired and/or threatened by nutrients. DEM also continues to work with municipalities on establishment of wastewater management districts to ensure ISDS systems are properly maintained and inspected.

Agricultural activities can also be a source of nitrogen to the state's waters. DEM continues to work closely with the USDA Natural Resources Conservation Service (NRCS) to provide technical assistance and funding to farmers identified as potential pollution sources (through the TMDL assessment program) in developing and implementing nutrient management plans.

With respect to atmospheric sources of nitrogen, the most important source of nitrogen oxides (NOx) in Rhode Island's atmosphere is the transport of NOx from upwind states. Significant reductions in the transport of NOx into Rhode Island is being achieved by implementation of the "NOx SIP Call" (see 62 FR 60318) in 19 states, which was expected to reduce summertime NOx emissions from electric generating units by 64% by May 2004.

Appendix A

Nutrient and Nutrient-Related Criteria

The RI Water Quality Regulations state that nutrients shall not exceed the limitations specified below and/or more stringent site-specific limits necessary to prevent or minimize accelerated or cultural eutrophication (human induced acceleration of algae growth that results in nuisance conditions).

Freshwaters:

Average Total Phosphorus shall not exceed 0.025 mg/l in any lake, pond, kettlehole or reservoir, and average Total P in tributaries at the point where they enter such bodies of water shall not cause exceedance of this phosphorus criteria, except as naturally occurs, unless the Director determines, on a site-specific basis, that a different value for phosphorus is necessary to prevent cultural eutrophication.

Nutrients

None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication, nor cause exceedance of the criterion above in a downstream lake, pond, or reservoir. New discharges of wastes containing phosphates will not be permitted into or immediately upstream of lakes or ponds. Phosphates shall be removed from existing discharges to the extent that such removal is or may become technically and reasonably feasible.

Dissolved Oxygen

Cold Water Fish Habitat - Dissolved oxygen content of not less than 75% saturation, based on a daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5 mg/l. For the period from October 1st to May 14th, where in areas identified by the RI Division of Fish and Wildlife as cold water fish spawning areas the following criteria apply: For species whose early life stages are not directly exposed to the water column (ie, early lifestages are intergravel), the 7 day mean water column dissolved oxygen concentration shall not be less than 9.5 mg/l and the instantaneous minimum dissolved oxygen concentration shall not be less than 8 mg/l. For species that have early life stages exposed directly to the water column, the 7 day mean water column dissolved oxygen concentration shall not be less than 6.5 mg/l and the instantaneous minimum dissolved oxygen concentration shall not be less than 5.0 mg/l.

Warm Water Fish Habitat - Dissolved oxygen content of not less than 60% saturation, based on a daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5.0 mg/l. The 7 day mean water column dissolved oxygen concentration shall not be less than 6 mg/l.

Saltwater:

Nutrients

None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication. Shall not exceed site-specific limits if deemed necessary by the Director to prevent or minimize accelerated or cultural eutrophication. Total phosphorus, nitrates and ammonia may be assigned site-specific permit limits based on reasonable Best Available Technologies. Where waters have low tidal flushing rates, applicable treatment to prevent or minimize accelerated or cultural eutrophication may be required for regulated nonpoint source activities.

Dissolved Oxygen

CLASS SA - Not less than 6.0 mg/l at any place or time, except as naturally occurs. Normal seasonal and diurnal variations which result in insitu concentrations above 6.0 mg/l not associated with cultural eutrophication will be maintained in accordance with the Antidegradation Implementation Policy.

CLASS SB AND SB1 - Not less than 5 mg/l at any place or time, except as naturally occurs. Normal seasonal and diurnal variations which result in insitu concentrations above 5.0 mg/l not associated with cultural eutrophication will be maintained in accordance with the Antidegradation Implementation Policy.

Recent EPA Dissolved Oxygen Criteria

DEM has drafted modifications to the RI Water Quality Regulations that include the most recent EPA guidelines for dissolved oxygen in salt water bodies. DEM accepted comments on the proposed regulation amendments until January 14, 2005 and is currently reviewing comments received. Below is a summary of the proposed dissolved oxygen criteria.

Aquatic life uses are considered to be protected if conditions do not fail to meet protective thresholds, as described below, more than once every three years. DO criteria presented here shall be protective of the most sensitive life stage – survival effects on larvae which affects larval recruitment – for both persistent and cyclic conditions. This criteria evaluates effects of exposure to low DO over time on larval recruitment. Because larval recruitment occurs over the whole season, the low DO exposure effects are cumulative. Exposures are evaluated on a daily basis to determine the total seasonal exposure. The criteria to protect larval survival is established to limit the number of exposure days over the range of low DO conditions such that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the season. Protection of larval survival will also afford adequate protection of juvenile and adult life stages.

Waters with a DO concentration above an instantaneous value of 4.8 mg/l shall be considered protective of Aquatic Life Uses. When instantaneous DO values fall below 4.8 mg/l, the waters shall not be:

1. Less than 2.9 mg/l for more than 24 consecutive hours during the recruitment season; nor
2. Less than 1.4 mg/l for more than 1 hour more than twice during the recruitment season; nor
3. Shall they exceed the cumulative DO exposure presented in Table 3.A of the proposed criteria document.

Appendix B

Schedule for Completing Water Quality Restoration Plans to Address Nutrient Impacts

WB Type	Waterbody Name	Target End Date
E	Apponaug Cove	2005
E	Brushneck Cove	2005
E	Buttonwoods Cove	2005
E	Greenwich Bay	2005
E	Greenwich Bay	2005
E	Greenwich Cove	2005
E	Greenwich Cove	2005
E	Palmer River	2005
E	Providence River	2005
E	Providence River	2005
E	Seekonk River	2005
E	Warwick Cove	2005
E	Warwick Cove	2005
L	Kickemuit Reservoir (Warren Reservoir)	2005
L	Mashapaug Pond	2005
L	Sands Pond	2005
L	Saugatucket Pond	2005
E	Greenhill Pond	2007
E	Mt. Hope Bay	2007
E	Mt. Hope Bay	2007
E	Mt. Hope Bay	2007
E	Mt. Hope Bay	2007
E	Potter Cove	2007
E	Tidal Pawcatuck River	2007
E	Upper Narragansett Bay	2007
E	Wickford Harbor	2007
L	Almy Pond	2007
L	Belleville Ponds	2007
L	Brickyard Pond	2007
L	Gorton Pond	2007
L	Hundred Acre Pond	2007
L	North Easton Pond (Green End Pond)	2007
L	Prince's Pond (Tiffany Pond)	2007
L	Roger Williams Park Ponds	2007
L	Sand Pond (N. of Airport)	2007
L	Scott Pond	2007
L	Spectacle Pond	2007

WB Type	Waterbody Name	Target End Date
L	Three Ponds	2007
L	Upper Dam Pond	2007
L	Valley Falls Pond	2007
L	Warwick Pond	2007
L	Barney Pond	2012
L	Chapman Pond	2012
L	Deep Pond (Exeter)	2012
L	Lower Sprague Reservoir	2012
L	Omega Pond	2012
L	Simmons Reservoir	2012
L	Slater Park Pond	2012
L	Turner Reservoir	2012
L	Turner Reservoir	2012
R	Cedar Swamp Brook	2012
R	Runnins River & Tribs	2012