Chapter 13

Additional Non-Wastewater Nitrogen Nitrogen Mitigation Alternatives

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ADDITIONAL NON-WASTEWATER NITROGEN MITIGATION ALTERNATIVES

13.1 INTRODUCTION

This chapter discusses additional options available to reduce nitrogen inputs to the groundwater beyond those associated with construction of wastewater collection, treatment and recharge facilities. The non-wastewater sources of nitrogen that are typically evaluated when modeling nitrogen loading to watersheds include road and roof runoff, lawn fertilizers, precipitation on natural areas (including surface water bodies), atmospheric deposits and benthic flux. This chapter will discuss the non-wastewater nitrogen management and mitigation methodologies that could be implemented to reduce nitrogen from some of these sources considered controllable. These methodologies will include management/regulation of fertilizer use, stormwater management, flushing improvements to embayments, modifications to the watersheds to improve natural attenuation, and modification of zoning laws.

13.2 REDUCTION OF NITROGEN FROM FERTILIZERS AND PET WASTES

A. **Fertilizer Reduction.** The possible reduction of nitrogen leaching from fertilized areas is difficult to predict due to the popular desire of growing green lawns with minimal effort. Education on proper fertilizer types, application techniques, and frequency of use can help reduce overfertilization, which is the most common cause of fertilizer leaching into the groundwater system.

Other Cape Cod towns have initiated public education and participation programs to reduce nitrogen originating from lawn fertilization. Two notable public participation programs that have been initiated in Falmouth are the Preserve Falmouth's Bays and Ponds and the Falmouth Friendly Lawn programs. The Preserve Falmouth's Bays and Ponds is a public outreach program designed to educate people on the uses of fertilizers and was developed as part of the

Nitrogen Offset Program for Bournes, Green, and Great Ponds. The Falmouth Friendly Lawn program, approved in July 2003, has created a means of rewarding those organizations and individuals who volunteer to limit their use of fertilizer nitrogen; it also identifies the products that are considered Falmouth Friendly.

A similar program was established in Dennis by the Comprehensive Wastewater Management Task Force's Public Outreach Subcommittee, working with the Cape Cod Collaborative Extension. The *Clean-Green Lawn Program*, which is patterned after Falmouth's Friendly Lawn program, is intended to make the public aware of the potential damage improper use of lawn fertilizers can do to estuaries and groundwater. It also provides a simple program from soil preparation to proper fertilizer application, maintenance, watering, and weeding to help homeowners have a healthier lawn, avoid over fertilization, and reduce nitrogen leaching into the local groundwater.

B. **Landscape Design Practices.** Although the majority of the population does not realize it, landscaping practices have a significant impact on water quality. Education to inform homeowners of ways to minimize negative impacts can reduce the effect that landscaping has on water quality. Certain landscape design practices can reduce fertilizer needs, reduce impervious area, and increase runoff control. One program initiated to promote the use of landscape practices that maintain and/or improve water quality is the 2006 Greenscapes program (http://www.nsrwa.org/greenscapes/default.asp). This program is an effort by several non-profit groups and southeastern Massachusetts towns. The program provides workshops and guidebooks to educate consumers on environmentally-conscious landscape designs. Landscape practices recommended include pesticide and fertilizer alternatives, composting, and low maintenance plants. Programs such as this are voluntary and therefore will rely on thorough public education. However, the Town's cost could be as low as a few cents per resident reached. Therefore, public education is important to obtain support for these practices from homeowners and lawn care providers.

C. **Animal Waste Management.** In addition to being a source of bacterial contamination, nutrients from animal waste can result in eutrophication of lakes and ponds or algal blooms. Several options should be considered to encourage pet owners to control animal waste.

- Ordinances and associated fines can be implemented requiring removal of pet waste from public areas (roads, beaches, parks, etc.) and other peoples' property.

Reminders of the ordinance in public parks along with supplies for waste removal may improve compliance.

- Dog parks can be created where pets are allowed off the leash. Parks can include reminder signs and waste removal supplies.
- Public education programs can be used to educate pet owners on the link between animal waste and water quality, thereby making it more likely that owners will clean up after their animals.

13.3 WATERSHED MODIFICATIONS AND CONSTRUCTED WETLANDS FOR NITROGEN ATTENUATION

A. **Introduction.** Wetland areas have demonstrated the ability to attenuate nitrogen in the groundwater as it moves through the watershed. Research by the School of Marine Science and Technology in the Mashapaquit Creek area of West Falmouth Harbor has indicated an approximate 40 percent nitrogen attenuation. Other evaluations by the School of Marine Science and Technology in the Great, Green, and Bournes Ponds watersheds, as well as in Chatham's coastal watersheds, have indicated an approximate 60 percent nitrogen attenuation as the groundwater flows through freshwater ponds. These findings have resulted in the promotion of the concept of modifying the watershed to create freshwater ponds and wetlands where increased nitrogen attenuation can occur.

Several Cape Cod towns including Barnstable, Falmouth, Chatham and Harwich have considered the use of constructed wetlands or modifications to wetland/bog systems and practical opportunities will be considered in Eastham as they become available.

13.4 STORMWATER MANAGEMENT AND TREATMENT

Estimates of nitrogen loading associated with road and roof runoff was developed as part of the Cape Cod Commission Technical Bulletin (TB 91-001) and has been updated as part of the work done for the MEP. Concentrations of nitrogen in precipitation and runoff were examined, and average concentrations of 1.5 mg/L from paved surfaces and 0.75 mg/L from roofs were considered to be appropriate. An estimated 90 percent of the stormwater is recharged to the aquifer from impervious surfaces. Precipitation on Cape Cod has been identified as 44.44 in/yr; and 90 percent of that value equals 40 in/yr of recharge from road and roof runoff.

In addition to the use of constructed wetland systems as modifications to watersheds, they are also used for stormwater treatment for nitrogen. The wetland system is constructed to biologically denitrify the oxidized nitrogen in the stormwater. However, this type of treatment requires a large land area to construct and the nitrogen removal performance for the stormwater is highly variable and dependent on several factors, including climate, season, vegetation types, and surrounding land use. Most road layouts do not have sufficient space for constructed wetland facilities.

The best management practice (BMP) for stormwater has typically been to catch the stormwater in catch basins, retain the "settleables" and "floatables" in the catch basin, and then infiltrate the water in subsurface leaching pits. This BMP is successful at reducing flooding on the roads and reducing bacterial contamination of surface waters. It may not be the best way to remove nitrogen from the stormwater because it introduces the stormwater into the subsoil where there is little biology that could remove the nitrogen.

Whenever possible, stormwater should be directed to vegetated swales or basins where suspended solids and fecal coliform are removed and nitrogen (and phosphorus) is used by the biological material in the swale or basin. The pretreated stormwater should also be directed to constructed (where space allows) or natural wetlands where the nitrogen can be further removed. The practice of directing stormwater to natural wetlands is typically not allowed by conservation commissions, as empowered by the Wetlands Protection Act. The Town's Conservation Commission should be further educated to understand the potential benefits of diverting pretreated stormwater to natural wetlands. Greater understanding of the benefits may result in allowance of this BMP where possible while minimizing impacts to the wetlands.

13.5 IMPROVED FLUSHING

Another method of reducing nitrogen impacts to embayments is to increase the flushing experienced by the embayment. This increased flushing means that a larger volume of water is entering and exiting the embayment, providing greater dilution of the groundwater that reaches the embayment.

The MEP Technical Report for Rock Harbor discusses possible options for achieving greater flushing in Rock Harbor. Further investigation will be necessary to determine if any of the alternatives presented by MEP are feasible.

13.6 MODIFIED ZONING

There is often fear that increased growth could conceivably occur as a direct result of the removal of the current growth limitation that on-site systems may have provided following sewer installations in previously un-sewered locations,. Currently, Title 5 regulations control the number of bedrooms allowed per acre. Local amendments to Title 5 include increased definitions of what constitutes a "bedroom" based on square footage and ceiling height and other characteristics such as number of windows, electrical service and ventilation. If sewers are provided, the Title 5 regulations may no longer apply. To counteract this potential increased growth, zoning modifications should be instituted to regulate development outside of the growth/activity centers and Growth Incentive Zones. A critical criterion for a Town to receive funding from the Clean Water State Revolving Fund (SRF) Program is that the Town has growth neutral sewer connection policies in place. The applicant must have adopted land use controls, subject to the review and approval of the MassDEP in consultation with the department of housing and economic development and, and where applicable any regional land use regulatory entity, intended to limit wastewater flows to the amount authorized under zoning and wastewater regulations as of the date of the approval of a CWMP.

13.7 NITRATE BARRIER WALL CONSIDERATIONS

The groundwater system in Eastham carries nitrogen from the various watershed sources (septic systems, fertilizers, stormwater, atmospheric deposition, etc.) to the estuaries where the nitrogen causes water quality problems. Barrier wall technology has been identified as a possible method to treat the nitrogen in the groundwater before it recharges to the marine waters.

This concept would involve the construction of a "permeable wall" of reactive material that would allow the groundwater to flow through but would react with the nitrate in the groundwater and convert it to nitrogen gas. The reactive material currently identified to be used is the NITREX™ patented media (as discussed in Chapter 8) that would reduce the dissolved oxygen in the groundwater and supply organic carbon to a level where biological denitrification would occur. The barrier wall would need to be constructed the full length of the estuary's shoreline where groundwater recharges to the marine water, or where the plume of nitrate nitrogen has been identified or concentrated. It would need to be deep enough to prevent any nitrogen-laden groundwater from going under the wall.

Various studies have been completed with regards to groundwater discharge to estuarine environments along the Atlantic Coast. Recent surveys, hydraulic studies and aerial thermal infrared imagery for the Nauset Estuary have shown, "that most fresh groundwater discharge to the estuary occurs in high-velocity seeps, areas of concentrated groundwater discharge, immediately seaward of the upland-fringing salt-marsh deposits. Moreover, groundwater discharge is highly variable along the shoreline, as shown by salinity and nitrate concentrations measured along the shore of Town Cove." (Barlow, P.M., 2003) In addition, the patchy nature of groundwater discharge along the shores of the estuary also was apparent in an aerial thermal image of Town Cove that identified areas of cold groundwater discharge (Portnoy, J.W., et al., 1998). According to this study, cold water plumes discharge groundwater to the top of the estuary water column because of groundwater's lower salinity in comparison to the estuarine water. (Barlow, P.M., 2003) Hydrology in Eastham does not appear to be conducive to a nitrate barrier wall installation due to highly variable groundwater discharge and saltwater infiltration in estuarine environments.

The technology is also being studied by a group of scientists led by Dr. Joseph Vallino and Dr. Kenneth Foreman of Marine Biological Laboratory. Funding has been provided to conduct two pilot studies of the technology at the Waquoit Bay watershed.

The technology does not appear to be ready for full-scale application due to the following questions/issues:

- Affects of salt water flooding of the NITREX™ media.
- Feasibility of installing the wall deep enough to prevent the nitrogen-laden groundwater flowing under the wall.
- Full understanding of the nitrogen removal mechanism (denitrification versus nitrogen immobilization) occurring at the NITREX™ material.

The ability to permit this concept with the associated soil borings (for system design and long-term monitoring) and excavation (for wall installation) is still an unresolved issue. This work would need to occur in close proximity to the marine waters (in areas subject to the Wetlands Protection Act) and on private property. Due to these unresolved issues, this concept requires additional scientific research before it can be further considered as an option for nitrogen mitigation.