WATER INTEGRATION FOR SQUAMSCOTT EXETER (WISE)

Preliminary Integrated Plan
Draft Technical Report

March 29, 2015

Prepared By:

Geosyntec consultants

National Estuarine Research Reserve System

University of New Hampshire

cbi Consensus Building Institute

Rockingham Planning Commission

Prepared For:

Towns of Exeter, Stratham, and Newfields, New Hampshire

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PRELIMINARY DRAFT

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The Science Collaborative of the National Estuarine Research Reserve (NERR)

March 29, 2015

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ACRONYMS

AOC	Administrative Order on Consent
CSO	Combined Sewer Overflows
CIP	Capital Improvement Plans
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
I/I	Inflow and Infiltration
IP	Integrated Planning
GBNNPSS	Great Bay Nutrient Nonpoint Source Study
GI	Green Infrastructure
LID	Low Impact Development
MEP	Maximum Extent Practicable
NHDES	New Hampshire Department of Environmental Services
NLM	Nitrogen Load Model
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint source pollution
NRCS	Natural Resources Conservation Service
MS4	Municipal Separate Storm Sewer System
O&M	Operations and Maintenance
ORIWMP	Oyster River Integrated Wateshed Management Plan
PREP	Piscataqua Region Estuaries Partnership
PTAPP	Pollution Tracking and Accounting Pilot Program
PV	Present Value 50 year
SSO	Sanitary Sewer Overflows
SWMM	EPA Stormwater Management Model
UNH	University of New Hampshire
WISE	Water Integration for the Squamscott-Exeter
WWTF	Wastewater Treatment Facility

ACKNOWLEDGEMENTS

The WISE project was made possible from funding through the University of New Hampshire National Estuarine Research Reserve System Science Collaborative, made possible through the National Oceanic and Atmospheric Administration. We are deeply grateful to the Science Collaborative whom shared their vision on the power of meaningful collaboration amongst stakeholders to jointly work towards common goals. We would like to express our appreciation to all those who participated in and provided feedback during the course of this Project.

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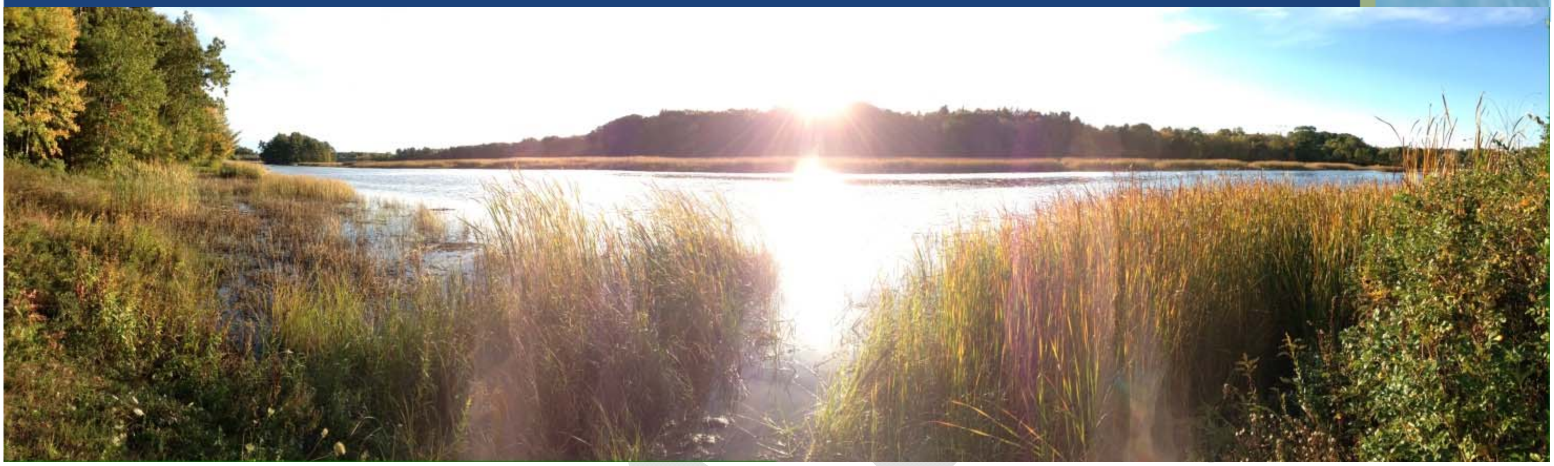
WATER INTEGRATION FOR THE SQUAMSCOTT-EXETER (WISE)

EXECUTIVE SUMMARY



What is WISE? In March 2015 the Water Integration for Squamscott-Exeter (WISE) project completed an Integrated Planning framework for three coastal communities including Exeter, Stratham, and Newfields to provide recommendations for affordably managing permits for wastewater and stormwater. The project has received tentative approval to fulfill the Nitrogen Control Plan requirements for Exeter and overlapping MS4 requirements for both Stratham and Exeter pending some critical next steps. This was accomplished by making use of a new flexibility in EPA permitting called Integrated Planning. The project bridged legal and technical gaps through a collaborative process working with regulators and municipal staff to develop a product that stakeholders and regulators trust and support. The project quantified the economic and performance advantages of municipal collaboration and integration of water resource planning. Success of this new approach depends upon leadership by municipalities, trust in the process an outcome, technical capacity and innovation, and regulatory flexibility. The process has included officials from the Towns of Stratham, Newfields, and Exeter working with a team from Geosyntec Consultants, the University of New Hampshire, Rockingham Planning Commission, Consensus Building Institute, and the Great Bay National Estuarine Research Reserve with funding was provided by the NERRS Science Collaborative.

What is Integrated Planning? Integrated Planning is a new EPA approach that allows a flexibility in permitting of wastewater and stormwater controls to plan for most cost effective measures first while still meeting regulatory standards that protect public health and water quality. Green infrastructure is a key integrated planning strategy for nutrient and stormwater management and enables management of stormwater as a resource and supports other economic benefits and quality of life. Integrated planning is being shown to have great cost-efficiencies through the comprehensive management of wastewater, stormwater and nonpoint sources throughout the nation.

Geosyntec consultants · University of New Hampshire · Rockingham Planning Commission · National Estuarine Research Reserve System Science Collaborative · cbi Consensus Building Institute

March 2015

Why this Project?

New Hampshire coastal communities have experienced rising populations resulting in an increase in development and stormwater and wastewater discharge to the Great Bay. As communities respond to new federal permit requirements for treating and discharging stormwater and wastewater, meeting regulatory requirements requires innovative ways to find effective and affordable means to meet water quality goals. The neighboring towns of Stratham, Newfields, and Exeter, New Hampshire share a history of collaboration. They share a regional school district, management of hazardous waste, and town recreation programs. More recently, representatives from the Towns of Stratham and Exeter have been working together to discuss sharing water and wastewater infrastructure and services. Integrated Planning for nutrient management could be a logical next step.

Major Findings

- Since 1960 Exeter, Newfields, and Stratham have experienced substantial population growth of 98%, 128%, and 602% and a 20 year increase in impervious cover of 108%, 177%, and 138% respectively.
- The Squamscott River has an average Total Nitrogen concentration (0.77 mg/L), more than double draft criteria, and has lost 100% of its eelgrass cover since 1948.
- A new pending MS4 (stormwater) permit combined with a new 2012 wastewater permit substantially increases municipal requirements for Nitrogen management.
- An Integrated Planning approach that satisfies elements of both the MS4 and wastewater permits reduces existing loads by 60% (56 tons N) and was estimated to provide around 50% cost avoidance from traditional permitting for the three communities.
- The incremental cost to increase reduction from 53 to 74% for nitrogen load by WW and NPS management is an increase in $159 million (62% increase).
- Annual nonpoint costs to Stratham are estimated to be $65,000 for town controlled properties and $60,000 for private sector for a total of almost $2 million over 30 yrs for the municipality. Estimated cost for wastewater for Stratham to join Exeter is $6,035,000.
- Annual nonpoint costs to Exeter are estimated to be $163,000 for town controlled properties and $122,000 for private sector for a total of almost $4.9 million over 30 yrs for the municipality.
- Annual nonpoint costs to Newfields are estimated to be $23,000 for town controlled properties and $21,000 for private sector for a total of almost $690,000 over 30 yrs for the municipality.
- Watershed wide, estimated costs are approximately 10% for stormwater and 90% for wastewater both for construction and operation.
- Communities of Exeter, Stratham and Newfields contribute ~50% of the Nitrogen Load from 24% of the watershed area.
- Nearly 50% of the nitrogen load in the watershed comes from upstream communities, and water quality goals for the Squamscott-Exeter cannot be attained without broader participation throughout the watershed.

Lessons Learned/How to Use This Plan

This plan is intended to serve as a guide for the towns of Exeter, Stratham and Newfields to support nitrogen load reduction, permit compliance, and ultimately ecosystem recovery in the Great Bay estuary which could fulfill permit requirements for a Nitrogen Control Plan. Municipal officials in each community could use the plan to guide local and watershed decisions around water quality and permit compliance. Detailed analyses of alternatives, calculated load reduction and associated costs, coupled with monitoring and tracking to document progress provide assurance that selected actions will support overall permit compliance and restoration goals. For the Integrated Plan to receive EPA approval some critical next steps will be required.

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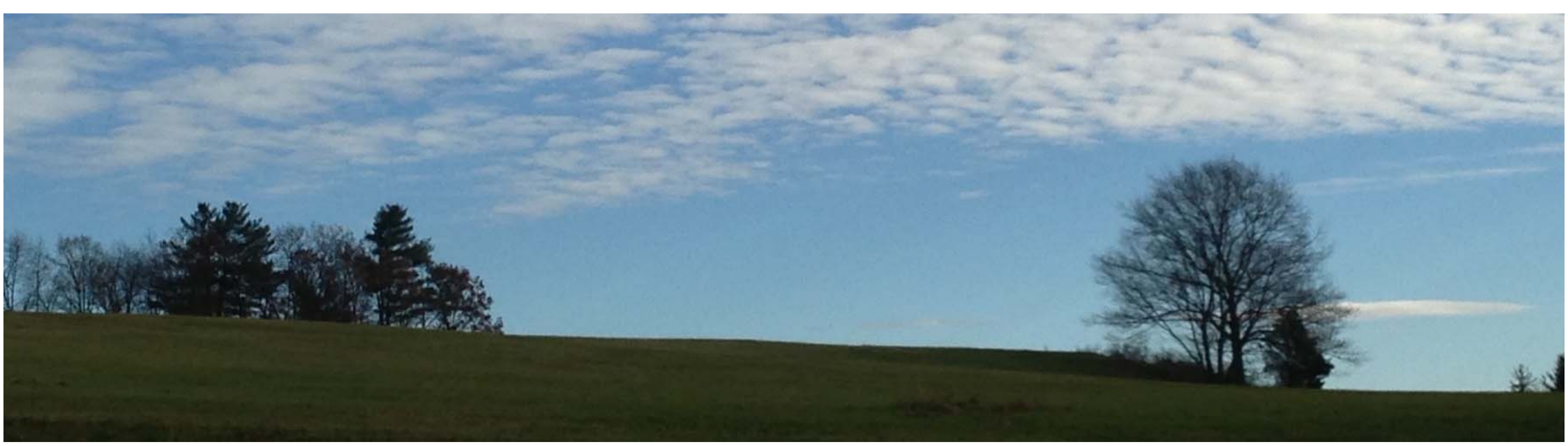

1. INTRODUCTION AND BACKGROUND

1.1 Overview

This document introduces the goals, background and primary elements of an Integrated Plan for the Lower Exeter and Squamscott River in the Great Bay estuary in southern New Hampshire. This Plan will support management of point and nonpoint wastewater sources in the communities of Exeter, Stratham and Newfields, and identifies and quantifies the advantages of the use of green infrastructure as a critical tool for nitrogen management and how collaboration between those communities could form the basis for an integrated permit application. The Plan will help communities meet new wastewater and stormwater permit requirements and improve water quality in the Squamscott River and the Great Bay, while supporting the economic viability of participating communities. This Plan has received tentative approval from EPA that it would fulfill the 2018 Nitrogen Control Plan requirements for Exeter and some future draft MS4 requirements for both Stratham and Exeter pending some critical next steps. The collaborative process used to develop this Plan was designed to provide decision makers at the local, state and federal levels with the knowledge they need to trust the Plan's findings and recommendations, and to enable discussions between stakeholders to continue.

This Plan includes the following information to guide local response to new federal permit requirements for treating and discharging stormwater and wastewater:

- Sources of annual pollutant load quantified by type and community;
- Assessment and evaluation of different treatment control strategies for each type of pollutant load;
- Assessment and evaluation of nutrient control strategies designed to reduce specific types of pollutants;
- Evaluation of a range of point source controls at the wastewater treatment facility based on regulatory requirements;
- Costs associated with a range of potential control strategies to achieve reduction of nitrogen and other pollutants of concern; and

- A preliminary implementation schedule with milestones for target load reductions using specific practices for specific land uses at points in time;
- Recommendations on how to implement a tracking and accounting program to document implementation;
- Design tools such as BMP performance curves for crediting the use of structural practices to support nitrogen accounting requirements.
- Next Steps for how to complete this Plan which has received preliminary EPA approval.

1.2 Coastal Management Problem

Like many other coastal regions, the Great Bay watershed has experienced population growth and an associated increase in development that has threatened the water quality and health of Great Bay. Impervious cover, residential landscaping and altered hydrology, including storm and sanitary sewer systems, have increased land runoff and wastewater discharged to the Great Bay Estuary. In 2009, NHDES concluded that the Squamscott and ten other sub-estuaries in the Great Bay Estuary were impaired by nitrogen, and in 2009 the Great Bay was placed on the CWA Sec. 303(d) list of impaired and threatened waters (NHDES, 2009).

In response to these findings communities and agencies in the region are working on developing nutrient management strategies and solutions that will support attainment of ecosystem goals in an effective and affordable manner. The focus of this study is on nitrogen pollutant loading in a portion of one Great Bay watershed. It also provides context and an example for collective action in an integrated watershed management framework. The benefits are quantified in this subwatershed as a cost and performance benefit.

1.3 Integrated Planning Goals in the Squamscott-Exeter Watershed

This Integrated Plan provides strategic planning and implementation of regulated point (discharges of both treated waste water and storm water) and unregulated nonpoint source (diffuse runoff and groundwater discharge) management for the three communities. The primary goal of this Plan is to support municipal efforts to:

- *Integrate planning and management of stormwater, wastewater, and nonpoint sources to facilitate cost-effective water quality management.* The plan provides load reduction, cost and benefit information for likely scenarios, and develops recommended implementation strategies for each scenario.
- *Monitor and assess progress towards environmental goals.* Recommended monitoring in the Squamscott and targeted tributaries will document ecosystem improvements, calibrate modeled loads, and track progress towards watershed load reduction.
- *Document compliance and ensure that all tracking, accountability and legal requirements are being met*. The tracking and accounting tool can be used to track progress towards permit goals under either individual or an integrated permit.
    - *Develop and sustain collaborative arrangements among communities to collectively and effectively meet local water resource needs.* The plan quantifies the cost differential between several levels of inter-municipal cooperation, including full integration of permit

requirement between all three towns, to separate permit compliance from each municipality.

- *Incorporate adaptive management founded on the best available scientific information and understanding of the interaction among stressors, management and the local ecosystem.* Monitoring of ecosystem response and tracking of load reduction targets will be used to evaluate progress towards restoration, and to support key decisions in the WWTF upgrade timeline.

1.4 Management of Uncertainty

Ecosystem restoration is an inherently uncertain process; ecosystem health and the role of nutrients and other impacts from urbanization are complex, and the time to recovery may be decades or longer. Management practices, based on best available science, will be applied to point and non-point sources of nitrogen, and nutrient reduction will be tracked and monitored and will lead to a greater understanding over time. Some aspects of ecosystem response, such as chlorophyll-a reduction in the Squamscott may occur very rapidly, while others, including long-term recovery of eelgrass have a much higher uncertainty. Permit requirements, on the other hand, require substantive assurance that goals will be met. EPA is required to issue permits that address a "reasonable potential to cause or contribute to impairments", while communities and residents naturally want a high level of confidence in the outcome of substantial investments in wastewater and stormwater.

Long-term implementation schedules and adaptive management are one means for communities and regulators to manage uncertainty in environmental management. A long-term schedule combined with monitoring supports an iterative process of management actions which reduces uncertainty over time and has potential cost savings. The phased effluent requirements in the administrative order on consent (AOC) specifically allow the Town of Exeter to submit a justification for an effluent limit higher than 3mg/l, based on progress towards target reductions and positive ecosystem trends. In this manner "when" or "if" management actions such as the requirement to operate the wastewater facilities at 3 mg/l will be informed by future information as to the need to achieve the designated uses of Primary Contact Recreation and Aquatic Life Use Support. The adaptive management process also provides a long-term strategy to address concerns about uncertainty in the understanding of the relative significance of nitrogen and its role in declining estuarine health.

1.5 Town, Agency, and Stakeholder Collaboration

This Plan was developed by a team of municipal leaders, engineers, scientists and agency representatives. It incorporates information and feedback from a wide range of stakeholders, and all participants have actively contributed to and reviewed these results. This collaborative foundation supports a Plan which could guide effective nutrient management in the region, and ultimately support attainment of permit requirements and ecosystem goals.

The towns recognize the value of inter-municipal collaboration and have a long history of collaboration that augurs well for future collaborative success and Integrated Planning for nutrient management could be a logical next step. They share a regional school district, the management of hazardous waste, and town recreation programs. The Towns of Exeter and

Stratham completed a co-funded inter-municipal wastewater treatment study (RPC 2012). The RPC study is in part based on the idea that future collaboration can help communities meet the needs of addressing aging infrastructure (Exeter and Newfields), new wastewater and MS4 permit requirements, nonpoint source management, facilities installation and upgrades, and support economic growth in the commercial districts. Stratham and Newfields are, for example, pursuing water and wastewater to support economic development goals along Route 108, which connects the three towns. Stratham in particular has redevelopment goals for a town center which are impeded by wastewater capacity.

2. REGULATORY FRAMEWORK

In response to the 2009 nitrogen impairment listing, new and revised discharge permits in the Great Bay watershed are subject to additional constraints related to nitrogen. The primary municipal permits, and the focus of this Plan, are National Pollutant Discharge Elimination System (NPDES) permits for wastewater treatment facilities, and Municipal Separate Storm Sewer Discharge (MS4) permits for stormwater.

2.1 Great Bay and Exeter-Squamscott River Regulatory Status

EPA is required to develop criteria (numeric or narrative) based on a determination that there exists a reasonable potential to cause or contribute to an impairment[1]. This determination is based on 'the best available science' at the time, which acknowledges that although our understanding of an ecosystem is necessarily incomplete, further delay in corrective measures will clearly contribute to increasing degradation. Permits may be issued to comply with numeric or narrative criteria. In 2009 NHDES developed draft numeric nutrient criteria for the protection of eelgrass and low dissolved oxygen conditions. In the absence of final numeric criteria EPA asserts the obligation and authority to issue effluent limitations based on narrative criteria and in 2012 EPA issued final WWTF discharge permits in Newmarket and Exeter based on a narrative TN nutrient criteria and a reasonable potential analysis. A 2014 Peer Review was critical of the draft numeric criteria after which the criteria were dropped as part of a 2014 settlement agreement between NHDES and the Municipal Coalition[2]. The standard upon which the Peer

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[1] Pg. 143, Section 5. Reasonable Potential Analysis and Effluent Limit Derivation, EPA. (2012). "Authorization to Discharge Under the National Pollutant Discharge Elimination System, The Town of Exeter, New Hampshire, Squamscott River." NPDES Permit No. NH0100871, Office of Ecosystem Protection, U.S. Environmental Protection Agency, Region I, Boston, Massachusetts.

[2] April 2014, Settlement Agreement between the Great Bay Municipal Coalition (Portsmouth, Dover, Rochester, NH) and the State of New Hampshire.

Review was tasked to review the draft numeric criteria was in part…" whether the available data support the conclusion that excess nitrogen was the primary factor that caused (1) the decline of eelgrass populations…"[3] This determination as the "primary factor that caused" is a higher standard than a "reasonable potential to cause or contribute". In 2012 the Environmental Appeals Board and 2013 the Supreme Court upheld the basis for this finding by EPA in determining effluent limitations[4].

2.2 NPDES Wastewater Permit and Administrative Order on Consent

EPA Region 1 issues individual facility-specific permits for the discharge of treated domestic and industrial wastewater in the State of New Hampshire. Under these individual permits, the discharges will be limited and monitored by the permittee. Of the three WISE watershed communities, the Towns of Exeter and Newfields operate and discharge treated domestic wastewater.

In 2012 after several years of study and negotiations, EPA issued a new NPDES discharge permit to the Town of Exeter with a total nitrogen (TN) effluent limit of 3 mg/l. The Town subsequently negotiated an Administrative Order on Consent (AOC) (Table 2-1) with the EPA that allows a staged approach to TN reduction which allows 5 years to construct a facility which will treat nitrogen to meet a limit of 8 mg/l TN, followed by continued upgrades and reductions in TN. The AOC requires tracking and monitoring to ensure that load reductions goals and ecosystem response are on target.

The Town of Newfields owns a WWTF operated by a Water and Sewer District. The facility is currently operating under an expired permit (issued March 1, 2007, expired February 29, 2012) and expects a new permit in the near future. The District anticipates that the updated permit will require nitrogen controls, and nonpoint source reduction consistent with the Exeter NPDES permit. The District has conducted a pilot study, in partnership with NHDES, which suggests that modifications to the current system, which incorporate fixed bed reactors, may provide enhanced nitrogen removal to 5mg/l.

An alternative strategy for both communities involves connecting to a regional treatment plant located outside the municipality. Current discussion include a regional facility and outfall in Portsmouth or Newington, or (for Newfields) a tie-in to an upgraded facility in Newmarket.

[3] Pg 46, section b) from the "Joint Report of Peer Review Panel-Great Bay Estuary", February 13, 2014 Victor J. Bierman, Robert J. Diaz, W. Judson Kenworthy, Kenneth H. Reckhow.

[4] (2012). "Upper Blackstone Water Pollution Dist. v. EPA." F. 3d, Court of Appeals, 1st Circuit, 9.

Table 2-1. Summary of Town of Exeter Administrative Order of Consent

Effective Date	AOC Element	Completion/ Submittal Date	Consequences for Non-Compliance
Effluent Limitations			
March 1, 2013	Comply with the interim total nitrogen effluent limitations ('report') and monitoring requirements contained in Attachment 1.a to the AOC	June 30, 2019 or until 12 months after substantial completion of the WWTF (whichever is sooner)	Exeter must fund, design, construct, and operate additional treatment facilities to meet the NPDES Permit limit of 3 mg/l as soon as possible and no later than 5 years from determination of non-compliance
June 30, 2016	Initiate construction of the WWTF's necessary to achieve interim effluent limits (8mg/l) set forth in AOC Attachment 1.a	Construction must be substantially completed by June 30, 2018	
June 30, 2019	Comply with the interim total nitrogen effluent limit (8mg/l) and monitoring requirements contained in AOC Attachment 1.a		
Tracking Tools			
March 1, 2013	Track all activities that affect total Nitrogen load to the Great Bay Estuary, including (but not limited to): • New/modified septic systems; • Decentralized WWTFs; • Changes to the amount of effective impervious cover; • Changes to the amount of disconnected impervious cover; • Conversion of existing landscape to lawn/turf and other new or modified BMPs.	Throughout schedule of compliance	

Table 2-2. Summary of Town of Exeter Administrative Order of Consent Effective March 1, 2013

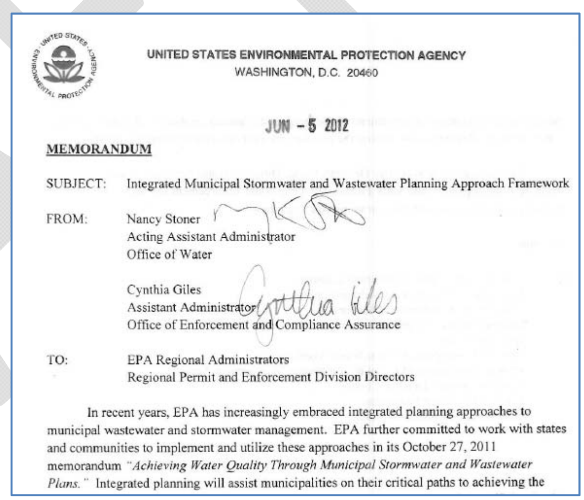
Effective Date	AOC Element	Completion/ Submittal Date	Consequences for Non-Compliance
Coordination Elements			
March 1, 2013	Coordinate with the NHDES, other Great Bay communities and watershed organizations in NHDES's efforts to develop and utilize a comprehensive subwatershed-based tracking/accounting system for quantifying nitrogen loading changes from Exeter to the Great Bay Estuary	Throughout schedule of compliance	
March 1, 2013	Coordinate with the NHDES to develop a subwatershed community based nitrogen allocation		
Control Plans			
March 1, 2013	Submit an annual Total Nitrogen Control Plan Report to EPA and NHDES (Section E.1).	January 31, 2014	
March 1, 2013	Submit a Total Nitrogen Nonpoint and Point Source Stormwater Control Plan to EPA and NHDES. Plan shall include a 5-year schedule for implementing specific control measures (Section D.4).	September 30, 2018	
March 1, 2013	Submit an Engineering Evaluation that includes recommendations for the implementation of any additional measures necessary to achieve compliance with the NPDES Permit, or a justification for leaving the interim discharge limit set forth in Attachment 1.a in place (or lower the interim limit to a level below 8.0 mg/L but still above 3.0 mg/L) beyond that date. (Section E.2) Items include: • Total Nitrogen concentrations in the Squamscott River and downstream are trending towards targets, • Documented significant improvements in dissolved oxygen, chlorophyll a, and macro algae levels, • Non-point source and stormwater point source reductions achieved are trending towards targets and mechanisms in place to ensure continued progress.	December 31, 2023	

2.3 Municipal Separate Storm Sewer System

Under the MS4 program, operated by EPA, towns with urbanized areas as defined by the US Census are required to obtain permit coverage for their stormwater discharges. The Towns of Exeter and Stratham are subject to the requirements of EPA's NH Small MS4 General Permit for stormwater discharges. The Town of Newfields received an MS4 permit waiver in 2013, but understands that MS4 requirements may be applied under future permit cycles. The permit expired in 2008 and is expected to be reissued by 2016. EPA released a draft permit in 2013 which contained new provisions for the 6 Minimum Measures (MM): 1) Public Education and Outreach, 2) Public Participation/Involvement, 3) Illicit Discharge Detection and Elimination, 4) Construction Site Runoff Control, 5) Post-Construction Runoff Control, 6) Pollution Prevention/Good Housekeeping. MM5 includes new requirements to develop Water Quality Response Plans (WQRPs) for stormwater outfalls that discharge to impaired water bodies. The WQRPs will assess all significant discharges to determine if they could contribute to the waterbody impairment and identify BMPs and a schedule for implementation to address the impairments.

2.4 EPA Integrated Planning Framework and Watershed Based Planning

The June 2012 EPA memorandum, "Integrated Municipal Stormwater and Wastewater Planning Approach Framework" provides guidance for EPA, States and local governments to develop and implement effective integrated plans that satisfy the CWA. The framework outlines the overarching principles and essential elements of a successful integrated plan which includes:


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN - 5 2012

MEMORANDUM

SUBJECT: Integrated Municipal Stormwater and Wastewater Planning Approach Framework

FROM: Nancy Stoner
Acting Assistant Administrator
Office of Water

Cynthia Giles
Assistant Administrator
Office of Enforcement and Compliance Assurance

TO: EPA Regional Administrators
Regional Permit and Enforcement Division Directors

In recent years, EPA has increasingly embraced integrated planning approaches to municipal wastewater and stormwater management. EPA further committed to work with states and communities to implement and utilize these approaches in its October 27, 2011 memorandum *"Achieving Water Quality Through Municipal Stormwater and Wastewater Plans."* Integrated planning will assist municipalities on their critical paths to achieving the

- Maintaining existing regulatory standards that protect public health and water quality.
- Allowing a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first.
- The responsibility to develop an integrated plan rests on the municipality that chooses to pursue the approach. EPA and/or the State will determine appropriate actions, which may include developing requirements and schedules in enforceable documents.
- Innovative technologies, including green infrastructure, are important tools that can generate many benefits, and may be fundamental aspects of municipalities' plans for integrated solutions.

The elements in the WISE plan are consistent with guidance issued by EPA to support integrated permit planning, as well as the Agency's nine-element watershed plans (Table 2.3)

Table 2-3. Comparison of EPA Integrated Planning (IP) Guidance Elements and EPA Nine-Element Watershed Planning.

EPA Integrated Planning Guidance Elements	EPA Nine-Element Watershed Planning
Element 1: A description of the water quality, human health and regulatory issues to be addressed in the plan	Element a: Identify causes and sources of pollution
Element 2: A description of existing wastewater and stormwater systems under consideration and summary information describing the systems' current performance	Element b: Estimate pollutant loads and expected load reductions
Element 4: A process for identifying, evaluating, and selecting alternatives and proposing implementation schedules	Element c: Describe management measures that will achieve load reduction Element d: Identify technical and financial assistance, and relevant authorities Element f: Project schedule Element g: Interim, measurable milestones
Element 5: Measuring success, which may include evaluation of monitoring data, information developed by pilot studies and other studies and other relevant information	Element i: Monitoring
Element 6: Improvements to the Plan	Element h: Identify indicators to measure progress
Element 3: A process which opens and maintains channels of communication with relevant community stakeholders	Element e: Information/education component

2.5 Municipal Regulations

For the Integrated Plan to be effective, future regulations will need to be adopted by Stratham and Exeter that include: 1) provisions for new and redevelopment projects to require nitrogen controls, and 2) a means for tracking changes in significant land use activities that will impact the nitrogen load to surface waters. The communities of Stratham and Exeter are participating in PTAPP (the Pollution Tracking and Accounting Pilot Program) which intends to develop a uniform approach and means that can be used by communities for MS4 and AOC tracking and accounting.

The Towns of Exeter, Stratham, and Newfields have a range of existing land use regulations and policies designed to protect water quality, including shoreland and buffer ordinances, stormwater management regulations, land conservation programs, storm drain stenciling projects, and educating residents about properly disposing of pet waste and the proper application of lawn fertilizers.

The Piscataqua Region Estuaries Partnership (PREP) recently completed an assessment of local land use regulations and programs related to natural resources protection in the watershed. The March 2015 Piscataqua Region Environmental Planning Assessment report (PREPA) includes an evaluation of water quality protection regulations in the 52 communities in New Hampshire and Maine that comprise the watersheds for the Great Bay and Hampton/Seabrook estuaries..

The Town of Newfields adopted stormwater management standards in 2014 (based on the SWA model ordinance), a conservation subdivision ordinance, and increased shoreland buffer protection. The PREPA Report recommends Newfields increase buffers to 100’ for all waterbodies, adopt 100’ fertilizer application buffers for all waterbodies, and increase setbacks for septic systems and structures to 100’ from wetlands.

Stratham started the process of revising the site plan and subdivision review regulations based on the SWA Model Ordinance in 2014 with the intention of completion during 2015, has adopted regulations to protect vegetated buffers along shorelands and maintains an active land conservation program. The PREPA Report recommends that Stratham increase buffers to 100 feet for tidal wetlands, increase setbacks for septic systems and primary structures to 100 feet for freshwater wetlands, and adopt the Southeast Watershed Alliance Model Stormwater Management Regulations.

Exeter has a draft tracking and accounting form developed that would be used to support the tracking and accounting reporting requirements of the AOC and is exploring stormwater ordinance revisions. The Town has designated Prime Wetlands per NH RSA 482-A:15, adopted buffer requirements of 100 feet on 1st and 2nd order rivers and 150 feet on third and fourth order and tidal rivers, established septic system setbacks and primary structure setbacks ranging from 150 feet to 300 feet. The PREPA Report recommends Exeter adopt fertilizer application buffers for all surface waters, increase the no vegetation disturbance to 100’ on tidal wetlands, and adopt the Southeast Watershed Alliance Model Stormwater Management Regulations.

2.5.1 Southeast Watershed Alliance Model Stormwater Management Regulations

The Southeast Watershed Alliance developed model stormwater standards in 2012 to provide minimum, consistent, and effective model stormwater management standards for communities in the Great Bay. These standards are intended to address some of the requirements for communities subject to MS4 permit. The model standards include 7 critical core elements:

Element A: Applicability Standards
Element B: Minimum Thresholds for Applicability
Element C: Best Management Practices
Element D: Applicability for Redevelopment
Element E: Stormwater Management Plan Approval and Recordation
Element F: Maintenance Criteria
Element G: Inspection of Infrastructure

2.6 Additional Regulatory Considerations

Additional Clean Water Act regulatory mechanisms which may be applied in the future include implementation of a Total Maximum Daily Load (TMDL) and Residual Designation Authority (RDA).

A TMDL is the amount of a pollutant, such as nitrogen, that can be discharged to a water body or segment that will meet water quality standards and support designated uses, such as fishable and swimmable. Prior to TMDL development, as is the case for the Great Bay watershed, management activities are directed to reduce pollutant loads relevant to an identified impairment from all permitted activities. TMDLs are generally written by the state water management agency, in this instance NHDES and must be approved by EPA. In the TMDL analysis, monitoring data, models and other assessment tools are used to quantify the present pollutant loading condition, primary sources, and management targets from those sources that will meet water quality standards. Two major waste sources are generally defined, and allocations set: 1) a wasteload allocation (WLA), which is generally defined as the sum of the pollutant load discharged from all "discrete conveyances" contributing to the impairment, such as discharge pipes or ditches and is regulated under a NPDES permit; and 2) a load allocation (LA), which is the sum of the remaining sources such as runoff, groundwater and atmospheric deposition that are more diffuse and not subject to regulation under a NPDES permit. This division occasionally causes confusion as certain classes of stormwater are regulated under the various stormwater permits (i.e., MS4, industrial stormwater, and construction stormwater) that were previously considered non-point sources. But, because they come under a permit, they become part of the WLA; nearly identical storm water sources in non-MS4 areas are not regulated and remain in the LA and are not subject to an NPDES permit in most cases. Truly diffuse sources, especially those transported in the groundwater such as nutrients from septic systems are solidly in the LA even if they originate in an MS4 area.

RDA and Anti-degradation allow a broader application of the law to extend regulatory authority to additional categories or sources of pollution that are determined by the permitting authority to be causing or contributing to water quality standards violations. Residual designation has been only been applied by EPA Region 1 (New England), and only in a few locations including Portland, Maine and the Charles River in Boston. In these instances RDA is used to address sources of pollution not covered under existing programs such as communities outside of the MS4 jurisdiction, and large impervious areas such as malls and shopping centers.

2.7 Impaired Waters

The Clean Water Act requires each state to submit a list of impaired waters to the U.S. Environmental Protection Agency every two years. Listing of impaired waters (303d list) includes surface waters that:

- Are impaired or threatened by a pollutant or pollutant(s),
- Are not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources and,
- Require development and implementation of a comprehensive water quality study (i.e., called a Total Maximum Daily Load or TMDL study) that is designed to meet water quality standards.

Maps of the 2008 surface water impairments for the three towns are provided in Appendix H: Maps of Surface Water Quality Impaired Waters. As of the final 2008 listing, the impaired waters within the Town of Exeter include: Dudley Brook; Norris Brook; Little River; Squamscott River; Wheelwright Creek- Parkman Brook; Exeter River; Colcord Pond; and Little River – Scamen Brook. Under the MS4, Exeter is required to manage the drainage area and infrastructure to receiving waters and implement controls to reduce sources of impairments.

The impaired waters within the Town of Stratham include: Squamscott River; Squamscott River tributary to Stuart Dairy Farm; Winnicutt River including Barton Brook, Thompson Brook and Marsh Brook and Cornelius Brook; and Wheelwright Creek – Parkman Brook.

Many of the streams in town of Newfields (and in the region) are listed as impaired for mercury; other specific impairments include the Squamscott River and an unnamed tributary to the Squamscott River (near Rt 108, impaired for bacteria).

3. WATERSHED STATUS AND ASSESSMENT

The communities of Exeter, Newfields, and Stratham have all experienced substantial growth during the past 50 years. Understanding and mitigating impacts due to population increase, changes in land use and cover, and imperviousness are an essential element of effective management strategies. Since 1960 all of these towns have experienced substantial population growth of 98%, 128%, and 602% and a 20 year increase in impervious cover of 108%, 177%, and 138% respectively for Exeter, Newfields, and Stratham (Figure 3-1).

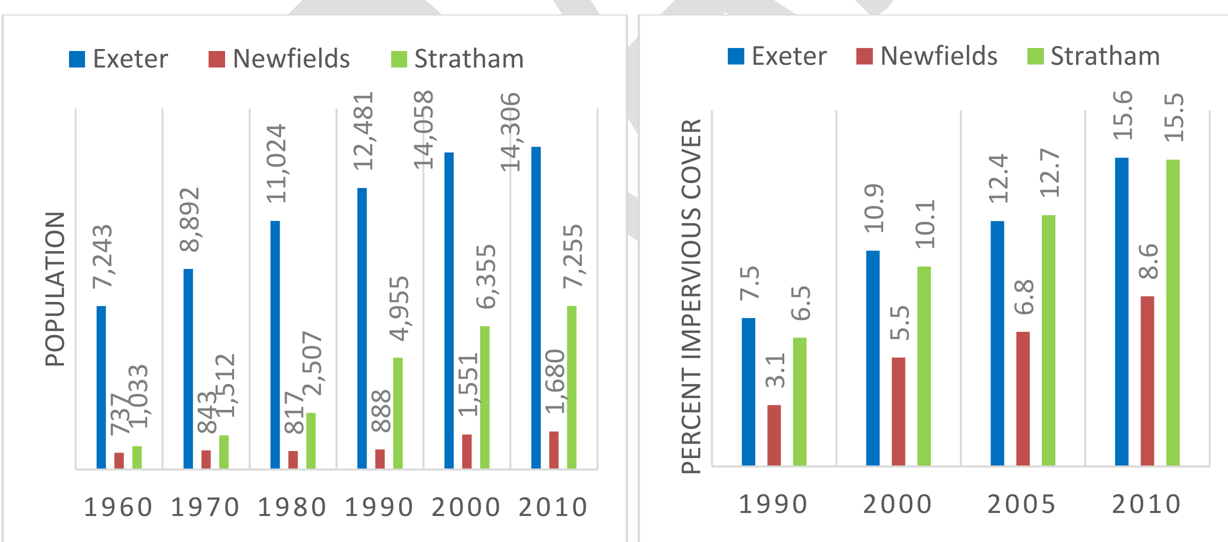


Figure 3-1. Population and Impervious Cover changes in the Towns of Exeter, Newfields and Stratham

The growth trends in the area will require planning efforts and administrative tools to protect water quality. The communities are all in need of cost-effective strategies from meeting permit requirements to assist in balancing the range of competing municipal demands.

Under the WISE project, a watershed level load model was developed to quantify the baseline load from point and nonpoint sources to the Squamscott-Exeter estuary. The model examines the load source and assigns ownership of these loads within each municipality. The results represent a baselines assessment for the municipalities to quantify the economic and performance advantages of integration of water resource planning both at the municipal and inter-municipal level.

3.1 Environmental Assessment

Monitoring and research conducted by various university, local, state and federal programs and projects have documented stresses in the Great Bay system. Prominent drivers of change include watershed modification and development resulting in increased impervious cover, increased nutrient and pollutant load from a rapidly growing coastal population, ecosystem instability and loss of diversity caused by invasive species, habitat destruction, disease, and others. Each stress drives additional physical, chemical and biological pressures on the Great Bay system, that have effects on environmental, lifestyle and economic benefits valued by the local communities. Environmental indicators used by the National Estuaries Program to identify and track ecosystem health clearly illustrate an ecosystem in trouble. In the most recent *State of Our Estuaries 2013* report (PREP, 2013), 12 of 16 indicators showed a declining or cautionary condition. Impervious cover, an indicator of development, shows a long-term increasing trend which is related to condition indicators including nutrient concentration, eelgrass, dissolved oxygen, and macroalgae that show either no improvement, or continued quality decline.

3.1.1 Designated Use and Nitrogen Load Targets

In absence of an approved TMDL target it was necessary to assume a subwatershed goal from which to base the nitrogen control strategies. The nitrogen loads listed in the 2012 Exeter and Newmarket NPDES Permits that are protective of eelgrass and dissolved oxygen were used as upper and lower targets. The permits include a Reasonable Potential Analysis that present the basis for the narrative nutrient criteria that describe a weight of evidence from 4 other similar jurisdictions and the DO and eelgrass targets from the NHDES 2009 draft numeric nutrient criteria for the Squamscott and Lamprey Rivers. The criterion for aquatic life use support in the Squamscott River for total nitrogen for maintaining dissolved oxygen levels is 0.45 mg/l, eelgrass habitats is 0.30 mg/l, and lists load targets of 140 tons and 88 tons respectively. The aquatic life use support criteria proposed by NHDES are consistent with EPA, Massachusetts', and Delaware's guidance.

3.1.2 Modeling Approach for Non-Point Nitrogen Load

To understand the pollutant load inputs from the Squamscott-Exeter subwatershed to the estuary, a watershed-scale pollutant load model and budget were developed, which provides the average annual load to the estuary from nonpoint and point sources for the subwatershed and by Town.

The pollutant load model was developed building on a number of existing studies and methods to account for surface water and groundwater loads to the estuary (Breaults et al 2002, NHDES 2014, VHB et al 2014, Valiela et al 2000, Exeter 2014). The various components are summarized below:

- Stormwater Load Model (Unattenuated), (SWMM5);
- Septic System Load Model (GBNNPSS);
- Agricultural Load Model (NRCS/WISE/GBNNPSS/ORIWMP);

- Attenuation in pathways in groundwater and surface water (GBNNPSS/NLM); and
- WWTF Load (Exeter/Wright Pierce).

The model was developed using a hydrologic response unit (HRU) approach, idealized 1-acre representative parcels, with varying combinations of land use, soil type, and impervious cover. Precipitation data from a local gage is used to perform a continuous rainfall-runoff simulation of the HRUs to estimate the amount of stormwater volume generated by each HRU. A full description of the modeling methodology is located in Appendix 8.2.

Unattenuated stormwater quality load was calculated using event mean concentrations (EMCs) or buildup and wash off functions specific to a land use type, for total nitrogen, total phosphorus, total suspended solids, and fecal coliform. Unattenuated load represents the pollutant load washed off the surface prior to any natural attenuation that occurs as the load migrates towards the receiving water. Once stormwater migrates from the surface on which it was initially generated, natural attenuation occurs as the water travels across pervious surfaces and vegetated buffers and through streams and natural waterways. Attenuation is caused by particulate settling, filtering, and biological uptake. By accounting for natural attenuation, the pollutant load which ultimately arrives at the receiving water can be estimated. Annual loads presented in this section have been adjusted to account for the estimated level of impervious surface disconnection in each town.

The modeled hydrologic response units (HRUs) are idealized catchments used in the model to estimate the amount of storm water runoff generated by precipitation. There are eight distinct HRUs representative of each combination of four hydrologic soil groups (HSG) and two imperviousness conditions (fully impervious and fully pervious). The HRUs are also used to generate water quality pollutant loads. In SWMM, a single catchment can be used to model multiple pollutants simultaneously. By treating the runoff quality from a given land use as a distinct pollutant in SWMM, a single HRU is capable of modeling the storm water runoff quality from multiple land uses in a single model run. In this respect, an HRU is not used to model a single specific land use, but to model all land uses that share the soil type and impervious cover of the given HRU.

The annual load derived from the use of septic systems was based on estimates provided by NHDES in the GBNNPSS. The process used to arrive at estimates of septic system loads is explained in Appendix G of GBNNPSS. NHDES delineated regions serviced by municipal sewer systems based on direct information from regional municipalities and information in the USGS Water Demand Model for New Hampshire Towns. The population outside of these service areas, as determined by 2010 US Census block data, was assumed to use septic systems for waste disposal. A per-capita excretion rate of 10.6 lb N per year was multiplied by the population using septic systems to calculate a nitrogen load to groundwater from septic systems. Water Demand Model for New Hampshire Towns (Hayes and Horn, 2009).

Agricultural loading data on the application of chemical fertilizer and manure were used to refine the estimate of nitrogen loading from agricultural surfaces. The USDA National Agricultural Statistics Service (NASS) Crop Type geospatial data layer was used to quantify the area of various crop types within the watershed. Major crops in the Exeter-Squamscott watershed consisted of corn, alfalfa, hay, and pasture land. Application rate of chemical fertilizer on each of the identified crop types were estimated using values reported in literature sources (Cornell University Cooperative Extension Agronomy Fact Sheets, GBNNPSS) and reported by local farmers. The NRCS Manure Calculator was used to calculate the manure generated and used in crop production (Smith 2014). Local farmers provided generous feedback on estimates of the number of animals (cattle, pigs, sheep, etc), the proportions of each crop, harvest number, and type and amount of fertilizer and manure applied. Application rates are determined by the area of each crop type in production to determine an annual deposited chemical fertilizer and manure load in combination with the nitrogen uptake based on crop type, yield, and the number of harvests.

Attenuation rates were applied to all calculated loads to estimate the actual (attenuated) delivered loads to surface waters. Delivery factors from the GBNNPSS are for surface water runoff (87%), groundwater non-septic (10%), septic systems within 200 m of a receiving water (60%), and septic systems farther than 200 m (26%), reflecting the assumption that increased travel times will result in higher rates of natural attenuation.

3.1.3 Modeling Results of Nitrogen Load by Source

For the baseline assessment, the total nitrogen load to the Squamscott-Exeter River subwatershed from the three WISE towns was estimated at 93 tons per year, from both point and non-point sources. Wastewater treatment facilities from Exeter and Newfields, discharging to the Squamscott-Exeter River subwatershed, account for 57.2 tons of nitrogen per year or 61 percent of the total nitrogen load from subwatershed (Wright-Pierce, 2014; GBNNPSS, 2014).

Nitrogen loading to the subwatershed from non-point sources accounted for 39 percent or 36 tons. The non-point sources include stormwater load, groundwater load and septic system load. The total stormwater load from the three towns represents 19 tons per year. Of that 19 tons, 6.1 tons is from natural land uses (i.e., forest, wetlands, ponds) and the remaining 12.9 tons is from other land uses including urban runoff from impervious surfaces, lawns, agriculture and managed turf.

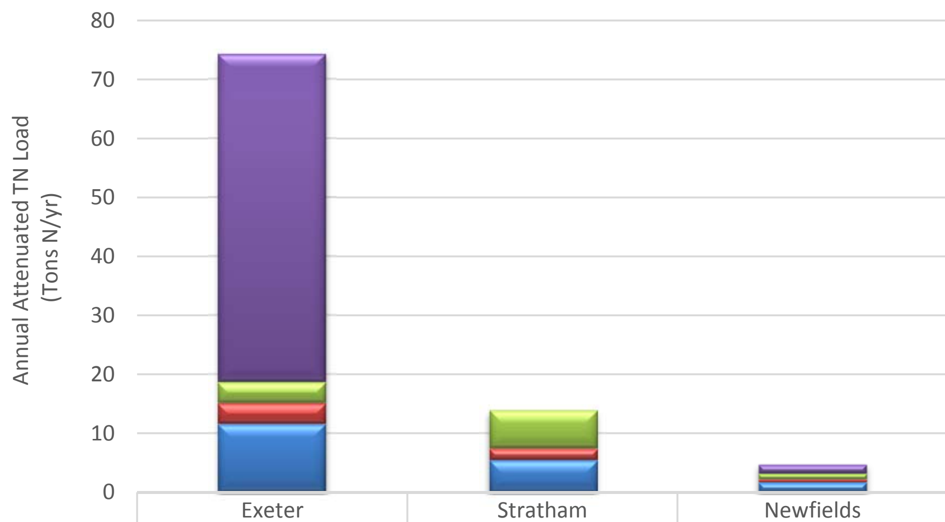
The annual load derived from the use of septic systems is based on estimates provided in the GBNNPSS (NHDES, 2014), which represents 11 tons per year. NHDES delineated regions serviced by municipal sewer systems based on direct information from regional municipalities and information from the USGS.

The groundwater non-septic load, which represents 6 tons per year, refers to nitrogen which originates from deposition on the ground surface and which is transported to the aquifer via infiltration. This quantity was not calculated in the WISE model, and relied on calculations performed by NHDES as part of the GBNNPSS.

The 93 tons is distributed between the three towns as presented in Figure 3-2. Exeter contributed the largest load, 74.5 tons per year or 80% of the total annual load, with the WWTF contributing the largest load (57 tons) followed by stormwater runoff (12 tons). The Town of Stratham contributes 14 tons per year (15% of the total annual load), with septic systems contributing the largest load followed by stormwater runoff. The Town of Newfields contributes 4.6 tons per year (5% of the total annual load), with stormwater runoff and wastewater contributing nearly equal loads.

The three WISE towns account for 24% of the total land area within the Squamscott-Exeter watershed. The upper portion of the watershed includes 9 towns with no current WWTFs or MS4 permits. Including the upper watershed communities, the total TN load to the Squamscott-Exeter watershed is 182 tons per year (Figure 3-3). The additional 89 tons from the upper watershed towns is primarily from the developed portions of the watershed (72.3 tons) and the remaining from the undeveloped natural portions of the watershed (16.6 tons). The unregulated upper watershed towns contribute 48% of the total load to the estuary and attainment of water quality goals for the Squamscott-Exeter watershed will require broader participation from these communities.

The baseline load from the watershed is 182 tons per year and exceeds both the dissolved oxygen load target (140 tons) and eelgrass target (88 tons). The regulated communities contribute 93 tons, an amount greater than required to meet the eelgrass target.



	Exeter	Stratham	Newfields
Wastewater Treatment Facility	55.7	0	1.6
Groundwater (Septic)	3.6	6.5	0.9
Groundwater (non-septic)	3.5	2.0	0.5
Stormwater	11.7	5.5	1.7

Figure 3-2. Annual Attenuated Load by Town; Total subwatershed load = 93 Tons per year

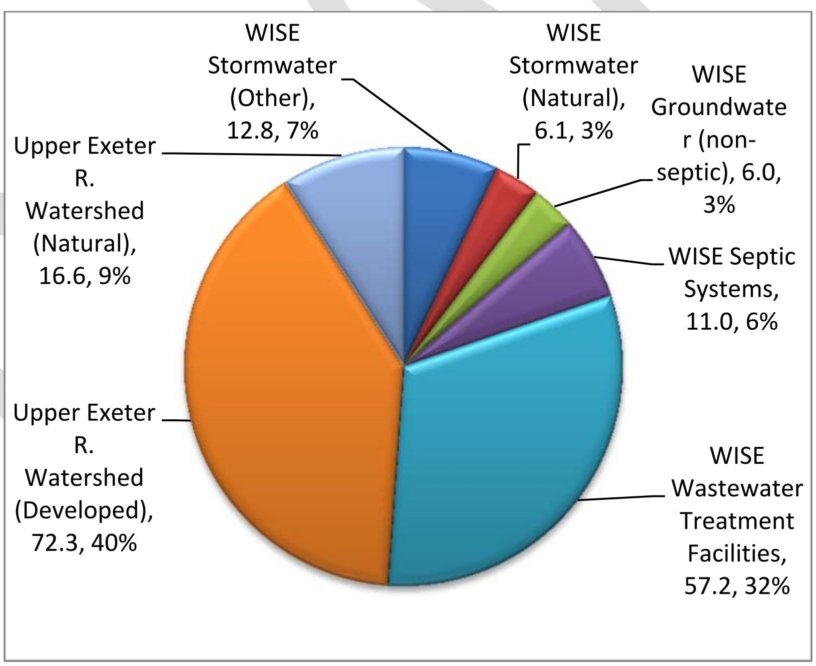


Figure 3-3. Baseline attenuated load (tons/year) from point and non-point sources from Squamscott-Exeter watershed; Total watershed load =182 Tons per year.

3.1.4 Agriculture and Its Role in Nitrogen Management

Involving farmers and the agricultural community in the review of WISE data and development of recommendations was important to the Project Team as agricultural land use and associated best management practices provide unique opportunities to reduce nutrient loads. As population and corresponding development have increased in the region, the number of farms and the amount of actively farmed acres has significantly decreased. Data from the USDA Census of Agriculture indicate a 75% reduction in farmland in Rockingham County between 1954 and 2012. Population in the County increased 321% in the same period. Hay production decreased 77%, corn production decreased 70%, and orchards decreased 74%. The number of cattle and calves decreased 81% and the number of chickens decreased by 99%. Over the same period, the number of horses in the region increased 285%, providing municipalities with an opportunity to engage horse owners and stable operators in a discussion about the need for proper manure management. Both the Rockingham County Conservation District and the Natural Resource Conservation Service can provide site specific manure management plans.

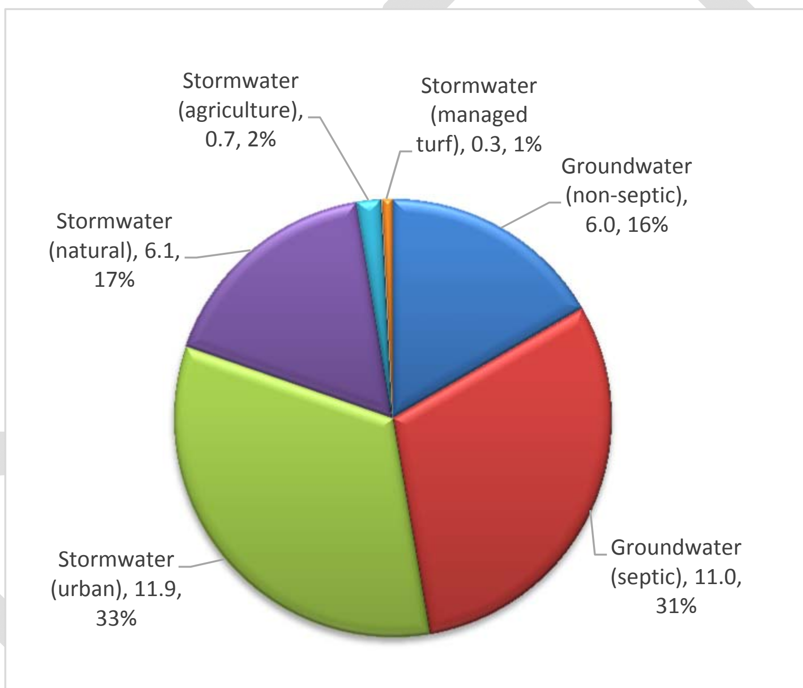


Figure 3-4. Annual attenuated load (tons/year) from non-point sources from 3 WISE communities =36 Tons per year.

Hundreds of acres of land in the subwatershed are still actively farmed, supporting hay, grain, vegetable crops, and livestock. Manure produced by livestock is spread on fields in Exeter, Stratham and Newfields that are farmed for livestock feed. Farmers work to achieve a balance to match livestock feed demands with manure production and crop demand to minimize need for expensive chemical fertilizer. Data collected for WISE indicates agriculture accounts for 2% of the annual attenuated total nitrogen load in the subwatershed, or 0.7 tons/year.

Consultation with farmers in the three towns and with staff from the Natural Resource Conservation Service and NHDES provided the Project Team with information on the best management practices being applied to farmland, including the use of cover crops, vegetated and wooded buffers, slow release nitrogen on fields, the planting of alfalfa as a nitrogen fixer, and the development and implementation of Comprehensive Nutrient Management Plans (CNMP). CNMPs are conservation plans unique to livestock operations. These plans document practices and strategies adopted by livestock operations to address natural resource concerns related to soil erosion, livestock manure and the disposal of organic-by-products. The development of a CNMP begins with a comprehensive engineering and conservation planning resource assessment of current site conditions. Farm operators work with NRCS to develop management options, including manure handling, transfer and storage, spreading manure on cropland, preventing soil erosion, and protecting water quality.

Buffers are a well-known cost effective planning tool for the protection of water resources. The New Hampshire Shoreland Protection Law and local zoning ordinances place strict requirements on what can be built (and how it will be built) in sensitive areas adjacent to wetlands and surface waters. In the instance of existing agricultural areas, this issue must be balanced with the pressure upon the farms, and the modest contribution of agriculture to the watershed nitrogen load. Some of the most productive farming lands exist in the valley bottoms closest to surface waters and limiting use of these areas could be financially disastrous for farms. Establishing and maintaining riparian or fenced buffers for grazing livestock is an important tool that will allow the continued farming of these productive areas and reduce impacts. When developing new farm land, the protection of existing buffers from livestock should be one of the first nutrient management practices considered.

One of the clear messages from the stakeholder groups during this process was that this community places a high value on protecting the remaining farms and that residents see the agricultural character as part of the fabric of the community. Keeping farms viable will prevent more sensitive land from being converted to development that places greater burdens on the estuarine system's health.

3.2 Municipal Infrastructure

A description of existing wastewater and drainage systems (i.e., stormwater) for each of the three Towns are described below. This summary includes: 1) characterization of their existing wastewater and drainage infrastructure; and 2) characterization of inputs and outputs from the infrastructure systems. Appendix E: Septic System Maps for Exeter, Stratham, and Newfields includes draft maps for each community.

3.2.1 Town of Exeter Infrastructure

The Town of Exeter has a well-established water, wastewater and drainage infrastructure. The Town's water system is largely built out and serves a large portion of the Town's population. The town of Exeter withdraws approximately 1.5 million gallons per day from the lower Exeter River, and relies on the quality and volume of flow in the river to support safe drinking water to over 3,000 households. Exeter's wastewater infrastructure includes a lagoon-based wastewater treatment facility, nine pump stations, and approximately 49 miles of collection system piping. However, the Town of Exeter is facing significant infrastructure upgrade needs for both its water and wastewater infrastructure; primarily associated with its treatment plants.

3.2.1.1 *Wastewater and Septic Systems*

The Town of Exeter owns and operates a wastewater collection, treatment and disposal system which serves the Town of Exeter as well as small portions of the Towns of Stratham and Hampton (Wright Pierce, 2014). The collection system includes 9 pumping stations and approximately 49 miles of sewers and approximately 3,600 wastewater accounts.

The wastewater treatment facility (WWTF) is an aerated lagoon facility with disinfection that was constructed in 1964 and comprehensively upgraded in 1988. The WWTF discharges effluent into a tidally-influence segment of the Squamscott River (Class B), upstream of the Great Bay. The effluent must meet standards set forth in state and federal water quality legislation, including the Clean Water Act. The WWTF effluent quality requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit which is issued by the US Environmental Protection Agency (EPA).

The Town's wastewater collection system and pump stations are all operating well. Infiltration and Inflow (I/I) is a significant issue in Exeter. This results in extraneous flows being treated at the WWTF on an average basis, as well as significant peak flows after rain events that must be managed by the pump stations and WWTF. The Town is currently constructing pipe replacement, pipe rehabilitation, service line replacement, and drainage improvements in the areas of Town to reduce I/I. Upgrades are also occurring to remedy hydraulic bottlenecks in the collection system.

In October 2014, the Town of Exeter completed a draft Wastewater Facility Plan (Wright-Pierce, 2014), which evaluates the cost for Exeter to upgrade their existing WWTF to comply with their AOC requirements.

The Town of Exeter has subsurface septic systems, which serve approximately 1195 properties or 29 percent of the Exeter properties. Of the total number of septic properties within Exeter, approximately 89 percent are located within the Squamscott-Exeter River watershed; of these properties, approximately 33 percent are located within 200 meters (656 feet) of the Squamscott-Exeter River or its larger tributaries (i.e. approximately 350 properties in Exeter have septic systems and are located within 200 meters of the Squamscott-Exeter River or its major tributaries).

3.2.1.2 *Drainage*

In 2003, the Town of Exeter was designated as a MS4 community in accordance with the 2000 US Census. Exeter has been operating under the expired 2003 permit since that time. Exeter's MS4 designated area is located south of Route 101 in the urbanized part of Town. The storm sewer system includes miles of stormwater collection system piping ranging from 12 to 48 inch diameter. The storm sewer system contains 1,080 catch basins, drain manholes, 2 treatment units, and 64 stormwater outfalls which drain to waters of the State.

3.2.2 Town of Stratham Infrastructure

The Town of Stratham is characterized by largely rural, residential area, a historic New England town feel, and an agriculturally based culture. The Town of Stratham has no centralized water or wastewater infrastructure and almost all of the homes and commercial facilities in Town use wells for their potable water supply, with the exception of three locations in Stratham where the

Town of Exeter supplies water, including the business park housing Lindt and Timberland. Fire suppression, with the exception of four commercial developments, is provided by dry hydrants tied into local ponds and cisterns.

Wastewater management is provided with individual on-site subsurface disposal systems (i.e., septic systems). In 2010, the Town of Stratham passed a new zoning ordinance establishing the Gateway Commercial Business District overlay district. The Gateway District had been discussed within the Town of Stratham for over five years, and was established to "enhance the economic vitality, business diversity, accessibility, and visual appeal of Stratham's built environment, in a manner that is consistent with the landscape and architecture of the Town's agricultural tradition."

The new zoning encourages greater density development within the Gateway District using a village-style developed environment comprised of closely spaced structures housing a mix of retail, commercial, and residential uses. In order for the Gateway District to succeed, it is acknowledged that centralized water, fire suppression, and wastewater services are required.

3.2.2.1 Wastewater and Septic Systems

The wastewater generated by residents and businesses in the Town of Stratham is currently managed entirely by subsurface septic systems. In 2011, the Town completed a preliminary report entitled *Wastewater Management Concept Plan* (Wright-Pierce, 2011), to evaluate the feasibility of a wastewater collections system for the Town's primary commercial corridor, General Commercial District (GCM), along Route 108 (Portsmouth Avenue) and extends 800 feet on either side of Route 108 north of Route 101 to Bunker Hill Avenue. This plan looked at the Town installing sewers and a wastewater treatment facility in the Town of Stratham. The plan included a stepwise approach to:

1) Install sewers up to Frying Pan Lane and construct a new forcemain and wastewater treatment plant with a groundwater discharge disposal field;
2) Expand sewers up to Bunker Hill Avenue;
3) When flows dictate, expand the groundwater discharge disposal field; and
4) Expand sewers to the Town Center.

In 2012, an Intermunicipal Water and Wastewater Systems Evaluation Study (Kleinfelder, 2012) was completed for the Towns of Exeter and Stratham to provide an analysis of the costs and benefits of a cooperative approach to meet the future water and wastewater needs of the two towns. This approach looked at the cost and benefits of Stratham using Exeter's wastewater treatment facility, as opposed to building their own, as outlined in the 2010 concept plan and is discussed in 3.2.4 Inter-Municipal Water and Wastewater Management.

The Town of Stratham does not have a municipal sewer system and is entirely dependent on septic systems for wastewater treatment. Of the total number of Stratham properties, which are serviced by septic systems, approximately 66 percent are located within the Squamscott-Exeter River watershed. Of these, approximately 27 percent are located within 200 meters of the Squamscott-Exeter River (or its major tributaries). In the summer of 2014, Geosyntec reviewed all of the available septic system records at the Stratham Planning and Zoning Department; 51

properties were identified, which are located within 200 meters of the Squamscott-Exeter River (or its major tributaries) and are most likely greater than 25 years old.

3.2.2.2 Drainage

The Town of Stratham is a newly designated MS4 community as per the 2010 Census. The MS4 designated area is comprised primarily of the residential part of town and excludes the commercial district. It is widely recognized that future stormwater management efforts will need to include the commercial district in large part because the district has a very high impervious cover and has tremendous redevelopment potential. The drainage areas and infrastructure conveying stormwater to these impaired waters needs to be managed under the MS4 permit. Outside of the commercial district, Stratham's drainage infrastructure consists primarily of country drainage (i.e., roadside swales) and does not include an extensive network of catch basins, manholes and pipe network.

3.2.3 Town of Newfields Infrastructure

3.2.3.1 Wastewater and Septic Systems

The Newfields wastewater plant is owned and operated by the Water and Sewer District and serves approximately 170 households (30% of the town population). The District encompasses residences and businesses in the downtown area adjacent to the Squamscott River. In 2014, the District was expanded to add a connection to the Rt 108 corridor, anticipating future growth in that region. The extension also provides the potential for future transfer of septic systems to wastewater treatment. The Town of Newfields has subsurface septic systems, which serve approximately 555 properties or 68 percent of the Newfields properties. Of the total number of septic properties within Newfields, approximately 59 percent are located within the Squamscott-Exeter River watershed; of these properties, approximately 31 percent are located within 200 meters of the Squamscott-Exeter River or its larger tributaries (i.e. approximately 100 properties in Newfields have septic systems and are located within 200 meters of the Squamscott-Exeter River or its major tributaries.

3.2.3.2 Drainage

The Town of Newfields is a newly designated MS4 community as per the 2010 Census, but has received a waiver under the current permit cycle. The remaining land area drains to the Piscassic, and ultimately the Lamprey River. The drainage areas and infrastructure consists primarily stormwater drains in the urbanized downtown, and country drainage (i.e., roadside swales) in other areas.

3.2.4 Inter-Municipal Water and Wastewater Management

In 2012, an Inter-municipal Water and Wastewater Systems Evaluation Study (Kleinfelder, 2012) was completed for the Towns of Exeter and Stratham to provide an analysis of the costs and benefits of a cooperative approach to meet the future water and wastewater needs of the two towns. Both Towns have significant water and wastewater needs to meet their desired goals and obligations, and many key decisions on how the towns will meet these needs will need to be made. Exeter is facing up to $60 million in infrastructure investment and Stratham is facing over $30 million. If there is untapped water or wastewater capacity that can be shared, cooperation between the two towns could benefit both.

The Study clearly showed that both towns would benefit financially by pursing the Inter-municipal option or District option over the independent options. The study recommends that the towns focus on the development of an inter-municipal agreement (IMA). Currently the towns are in negotiations to establish an inter-municipal agreement; however, regional wastewater options are also being pursued in parallel, as discussed in Section 3.2.5.

3.2.5 Regional Wastewater Treatment

In November 2014, the Towns of Exeter and Stratham hired Underwood Engineers to conduct a study to evaluate a regional wastewater treatment strategy (Underwood, 2014). The study evaluates the scope and costs necessary for the conveyance of wastewater to the City of Portsmouth's Pease WWTF. Based on this study, the recommended next steps were to (1) compare regional costs from the study to those presented in the Exeter WWTF plan; (2) continue to discuss opportunities with Portsmouth; and (3) monitor Portsmouth's discussion on conveying Pierce Island's sanitary waste to Pease, which may have additional cost incentives to a regional Pease option. Revised costing numbers are expected from Portsmouth in May of 2015 at which time the regional and local options will be further reviewed.

4. PRELIMINARY NITROGEN CONTROL PLAN

The Preliminary Nitrogen Control Plan detailed in the following sections is intended to meet the requirements of the NPDES Permit No. NH0100871 and associated Administrative Order on Consent and the requirements for Post Construction Stormwater Management (Minimum Measure 5) in the 2013 draft NH Small MS4 permit. As per the AOC Section D.4*, a Total Nitrogen Non-point Source and Point Source Stormwater Control Plan*, shall include:

- *5 year schedule for implementing specific control measures as allowed by state law to address identified non-point source and stormwater Nitrogen loadings in the Town of Exeter that contribute total nitrogen to the Great Bay estuary, including the Squamscott River.*
- *If any category of de-minimis non-point source loadings identified in the tracking and accounting program are not included in the Nitrogen Control Plan, the Town shall include an explanation in the Plan of any such exclusions. The Nitrogen Control Plan shall be implemented in accordance with the schedules contained therein.*

A Nitrogen Control Plan includes a plan to implement total nitrogen non-point source and point source controls. Detailed in this section is a comprehensive watershed-scale Nitrogen Control Plan for the 3 regulated communities with specific implementation of nutrient control measures to meet permit requirements and achieve water quality improvements. The Nitrogen Control Plan evaluates numerous management scenarios and presents a recommended Preliminary Implementation Schedule to meet the receiving water quality targets established in the Exeter AOC and the requirements for Post Construction Stormwater Management (Minimum Measure 5) in the 2013 draft NH Small MS4 permit.

This Nitrogen Control Plan addresses the necessary requirements outlined in the AOC including:

- The pounds of total nitrogen discharge from the WWTF during the implementation period;
- A description of the WWTF operation changes;
- A description of the non-point source controls;

- A description of the total pounds of nitrogen removed from point and non-point sources;
- A description of the adaptive monitoring to track and account for reductions in total nitrogen; and
- A description of the tracking and accounting system.

4.1 Management Scenarios

A range of management scenarios were evaluated for both wastewater and non-point source strategies over three different permitting and planning scenarios. The scenarios include:

(1) Subwatershed Integrated Planning (IP) – evaluates the three towns working together to develop an integrated plan to manage their four permits. The pollutant loads and costs are compiled by subwatershed.

(2) Traditional Permitting (T) – evaluates the three towns working independently to manage their permits (i.e., silo approach). The permits (i.e., wastewater and MS4) within the towns are managed separately and credit across permits is not considered.

(3) Town Integrated Planning for Exeter (EX) – evaluates the Town of Exeter using an integrated plan to manage their two permits (i.e., wastewater and MS4).

The permitting scenarios were evaluated for a range of management scenarios (Table 4-1) which consider varying WWTF load targets, receiving water load targets and non-point source sizing criteria. Additional management scenarios were evaluated and are presented in Appendix 8.2 and considered additional WWTF load targets and non-point source implementation to meet receiving water load target goals. The management scenarios assume that the WWTFs are in the process of meeting the regulatory milestones outlined in the AOC, by designing a WWTF Plan to operate at 8 mg/L by 2019. The WWTF targets in all scenarios with the exception of IP-3/5/8 are to be implemented during a single permit cycle. Scenario IP-3/5/8 has an implementation schedule across multiple permit cycles and begins with 8 mg/l at 2019, transitions to 5 mg/l at 2029, and ends at 3 mg/L by 2042. The extended implementation schedule allows for ecosystem monitoring and adaptive management at each critical stage and for participation by upper watershed communities. This is described in greater detail in Section 0. The receiving water load targets will be met by a combination of point source reductions due to the upgrades made to the WWTF and through implementation of non-point source controls which are required under by the WWTF AOC and the MS4 permit.

Under the management scenarios a receiving water load target of 88 tons per year was used, which is the target for protection of eelgrass. This load target is for the entire Squamscott-Exeter River watershed, not just the subwatershed comprised of the three towns (Exeter, Stratham and Newfields).

Table 4-1. Management scenarios listed by wastewater limits and stormwater criteria

Scenario ID	Planning Level	WWTF Concentration Target (mg/L)	Non-point Source Sizing Criteria
IP-3/5/8	Integrated Planning	Phased from 8mg/L @2019, to 5 mg/L @ 2029 and 3mg/L @ 2042	Maximum Extent Practicable (MEP)
IP-3	Integrated Planning	3 mg/L @2019 (w/ Stratham WW District)	Maximum Extent Practicable (MEP)
IP-5	Integrated Planning	5 mg/L @2019	Maximum Extent Practicable (MEP)
IP-RO	Integrated Planning	<1 (Regional Outfall)	Maximum Extent Practicable (MEP)
EX-3	Town of Exeter Integrated Planning	3 mg/L @2019	Maximum Extent Practicable (MEP)
EX-5	Town of Exeter Integrated Planning	5 mg/L @2019	Maximum Extent Practicable (MEP)
T-5	Traditional Permit	5 mg/L @2019	MS4 1" WQV for all developed areas
T-3	Traditional Permit	3 mg/L @2019	MS4 1" WQV for all developed areas
T-RO	Traditional Permit	<1 (Regional Outfall)	MS4 1" WQV for all developed areas

The non-point source sizing criteria varies by the permitting scenario. Under the two Integrated Planning scenarios (IP and EX), the integrated planning framework allows the permittee the ability to credit across permits and for flexibility on the sizing requirements of stormwater best management practices for non-point source control. Therefore, the level of non-point source controls necessary to meet the receiving water quality load target was evaluated for varying water quality volume sizes, as described in Section 4.2, and level of implementation based on the highest unit performance and least cost mix of management strategies or to the maximum extent practicable (MEP) and described in Section 4.2.

Under the Traditional Permitting (T) scenarios with a receiving water load target of 88 tons per year are evaluated through implementation of non-point source management strategies to meet the requirements under the MS4 permit and by standards in the New Hampshire Stormwater Manual (NHDES, 2008), which requires sizing stormwater BMPs to capture and treat the volume from a 1 inch storm. The Traditional Permitting scenario does not allow include an MEP analysis or cross permit load reduction crediting.

The management scenarios were evaluated for the pollutant load reduction capability to the estuary and the economic impact of the scenario on the Towns. The management scenarios were then compared to determine the most viable path forward for the Towns, whether it be an integrated planning scenario or a traditional permitting path and the pros and cons of each of the scenarios.

Point sources were evaluated first and for each WWTF design load target the pollutant load reductions and the economic cost to implement and maintain that system were estimated. The design loads and costs of the WWTF targets were taken from the Draft Exeter Wastewater

Treatment Facilities Plan (Wright-Pierce, 2014) for the Exeter WWTF upgrades and for the Regional Outfall from the regional wastewater study (Underwood, 2014).

The point source load reductions were subtracted from the baseline pollutant load for the watershed (182 tons) and compared to the receiving water quality goal target (88 tons) to determine the non-point source control load target necessary to meet the estuary water quality pollutant load targets.

An analysis was conducted to determine the cost of installation and implementation of non-point source strategies for achieving a full range of reductions including management of all impervious areas and significant sources. To evaluate this, a linear optimization (LO) model was developed which analyzes a range of pollutant load reduction targets with a range of land use types, soil types, non-point management measures and capture depth sizes.

4.2 Optimization and Maximum Extent Practicable

One of the core elements of integrated planning is the allowance that a permittee can take credit for actions associated with one permit (i.e., wastewater) and may also receive credit in another (i.e., MS4). For example, installation of green infrastructure (i.e., biofiltration to treat road runoff, or drywells to treat roof tops) for non-point source management under the WWTF permit would also satisfy requirements for Post Construction Stormwater Management (Minimum Measure 5) in the 2013 draft NH Small MS4 permit . This has the potential to be more economical than traditional permitting because it satisfies elements of both the MS4 and wastewater permits and it helps manage the uncertainty of environmental response.

Integrated planning also allows for flexibility as to when and what nutrient management measures are implemented so long as the goal is the protection of public health and water quality. This approach allows for the use of various sizes (i.e., capture depths) of nutrient controls to allow for a greater number of smaller systems in replace of fewer systems designed to treat larger volumes.

To use this approach, an optimization model was developed which selects the most cost effective management measures for a range of increasing load reduction. The optimization model runs repeatedly, changing the target load reduction with each iteration. It evaluates the nitrogen control strategies based upon user defined constraints including available land for implementation, pollutant load reduction capability based on capture depth of the nutrient control measure; and cost to implement the strategy. This is first applied at the system level to develop a series of BMP performance curves. It is next applied at the land use scale to identify the most cost effective options for each particular land use. The optimization is then conducted at the watershed scale for the range of nutrient control measures, and the range of land uses. The optimization process is then repeated for each of the management scenarios described in Table 4-1 to determine total cost of implementation. Figure 4-1 illustrates one of the Project tools that is intended to be used by designers when reporting nitrogen load for a development proposal. Example 1 below illustrates the process of how optimization of the size of a bioretention system can occur based on varying the capture depth of the water quality volume. Example 2 and Figure 4-2 illustrate how the optimization occurs at a residential land use scale.

An example of optimization at the watershed scale is presented as a Pareto curve in Figure 4-3 as annual load reduction vs. implementation capital cost. The Pareto curve illustrates the concept of diminishing returns (i.e. the most cost-effective options are pursued first) and each additional pound of nitrogen reduction will have a higher differential cost. Higher target load reduction amounts result in BMP combinations that have a higher average cost per acre treated. Figure 4-3 was used to define the "maximum extent practicable" for the implementation of non-point sources for each of the management scenarios.

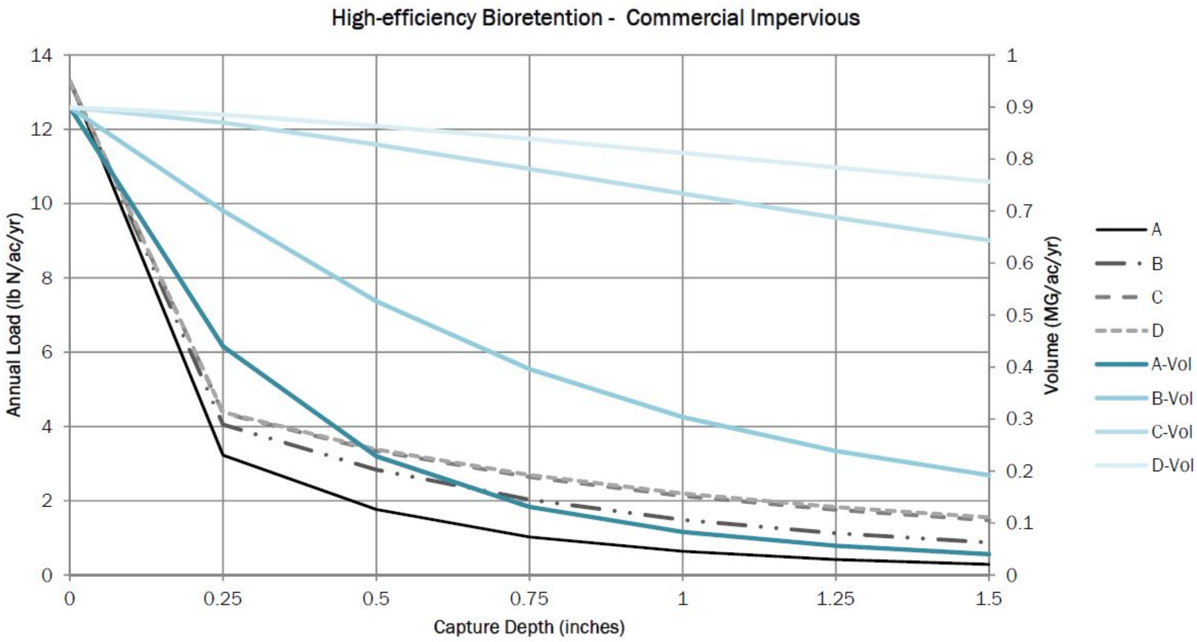


Figure 4-1. BMP Performance Curve for high-efficiency bioretention on commercial impervious areas illustrating annual exported load (lbs Nitrogen/acre/year) and volume (million gallons/acre /year) based on water quality volume (aka capture depth)

Example 1: BMP optimization for high-efficiency bioretention at 0.25" and 1" water quality volumes

From the BMP performance curve for a high-performance bioretention we can see that 4 systems designed to treat a 0.25" water quality volume in replace of one system to treat a 1" water quality volume would remove an additional 27 lbs of Nitrogen per year at nearly equivalent costs, or approximately 315% greater optimization. A single system treating a 1" water quality volume for 1 acre will remove approximately 12.7 lbs N/acre/year. Whereas 4 smaller systems across 4 acres designed to treat 0.25" water quality volume per acre will each remove 10 lbs N/acre/year for a total of 40 lbs N per year.

Example 2: BMP optimization for a range of nitrogen control measures for residential land use

Figure 4-2 is an example of an optimization for a residential land use which shows the cost to achieve reduction in relation to the nitrogen management practices ordered in terms of cost efficiency. This process enables the identification of the MEP, or the point at which cost effectiveness and pollutant reduction is greatest and the feasibility to implement cost effective and pollutant load reduction management practices begins to decline. In this example, 10,000 pounds of nitrogen can be reduced at a cost of about 7 million dollars ($700 per pound reduced); whereas, 15,000 pounds is at a cost of nearly 44 million dollars ($2,930 per pound reduced).

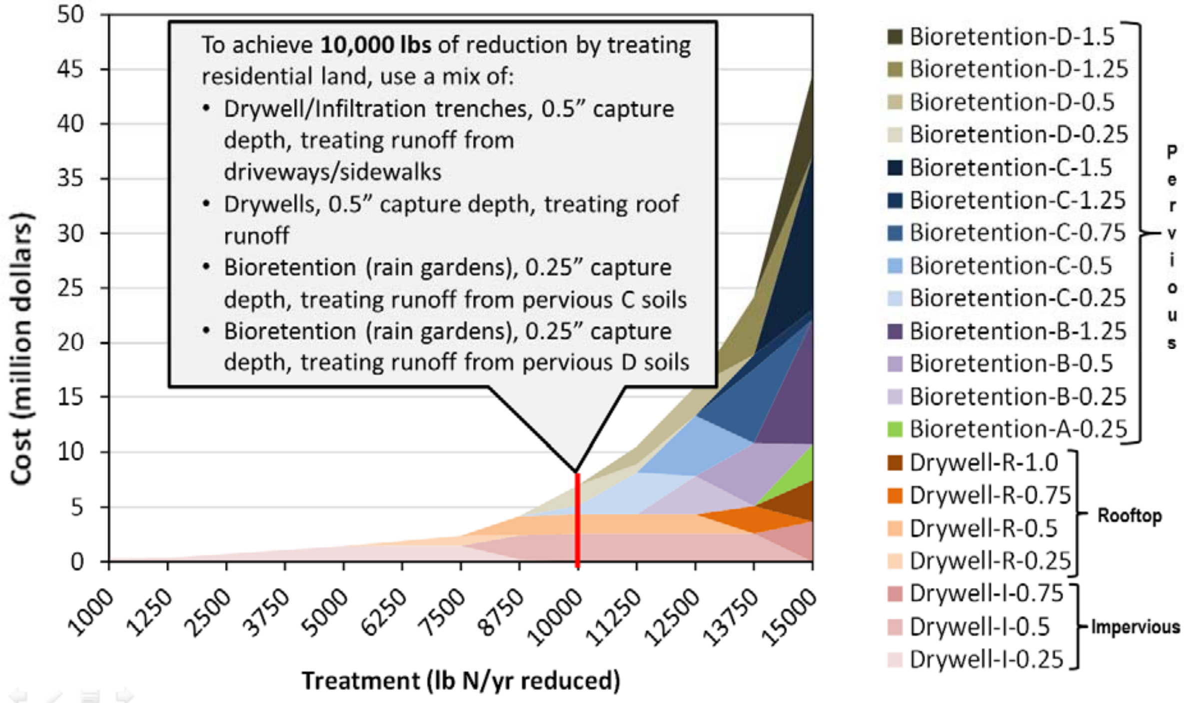


Figure 4-2. Residential-scale BMP optimization example

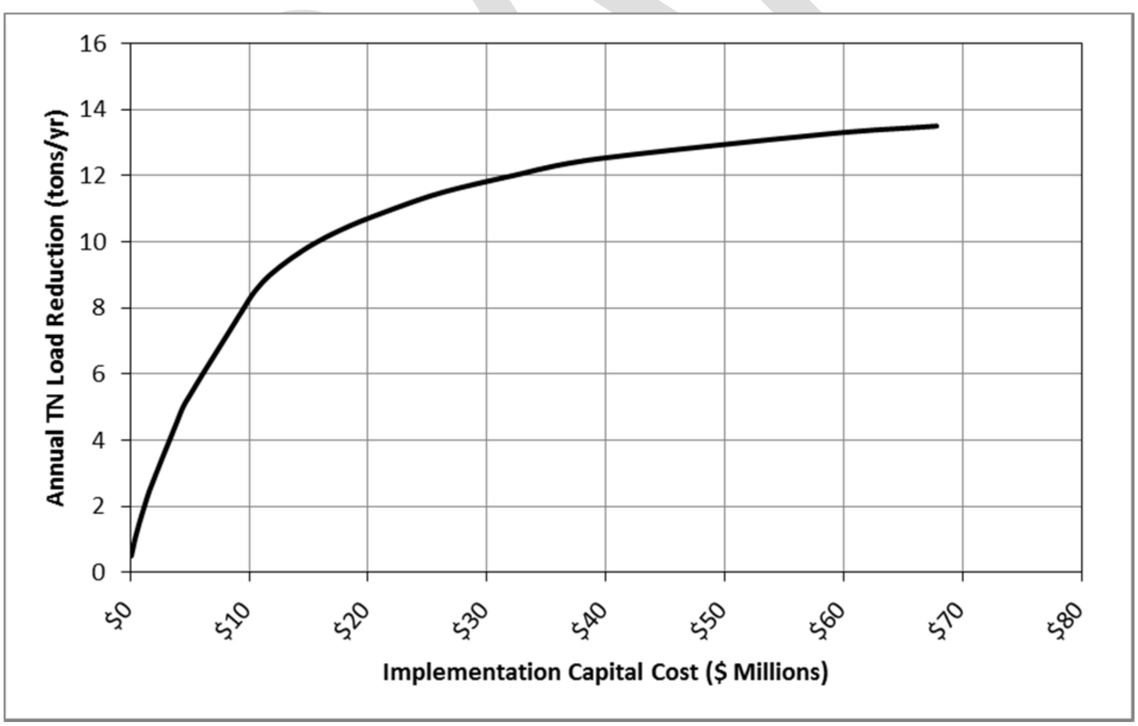


Figure 4-3. Watershed-scale annual total nitrogen load reduction from non-point source management strategies

4.3 Nutrient Control Measures

Nutrient control measures, or BMPs, as part of the WISE project focused on both point and nonpoint sources. A matrix of BMPs was developed in collaboration with the three towns to identify BMPs they would accept and felt were feasible in respective land uses (Table 4-2). The management measures, both structural and non-structural, look to reduce pollutant load from wastewater treatment facilities, subsurface septic systems, and stormwater sources including agriculture, managed turf (i.e., golf courses, lawn), impervious and pervious surfaces, residential, commercial/industrial/institutional, roads, and outdoor recreational spaces (i.e., parks). A detailed overview of the nitrogen control measures examined are included in Appendix 8.1.

A wealth of BMP sources exists in the literature and locally at the UNH Stormwater Center and this Plan does not attempt to repeat that information. Furthermore strict adherence to design specifications can limit innovation which will be essential to effective nutrient management in the future. For this reason we encourage the use of performance specifications detailing the nitrogen load reduction required and encouraging innovation in design. A foundation of practices can be found in the New Hampshire Stormwater Manual is from the NHDES website at www.des.nh.gov/organization/divisions/water/stormwater/manual.htm.

Other stormwater practice design standards may be accepted at the discretion of the DPW and may include techniques or practices in use and accepted by other jurisdictions, (ie state agencies, municipalities, EPA) that have been demonstrated to have treatment benefits. This may include promising innovative practices (proprietary and non-proprietary) allowing for the continued advancement of the practice.

As part of the 2013 draft NPDES Small MS4 general permit for New Hampshire, the permit requires management of existing stormwater runoff in impaired watersheds. While new development is required to manage stormwater on-site, existing developments may have been constructed before stormwater management was required or modern criteria were established. Retrofits include new installations or upgrades to existing BMPs in developed areas where improved stormwater treatment is needed.

Table 4-2. Matrix of structural nutrient control measures by land use

CATEGORY		COVER TYPE	STRUCTURAL NUTRIENT MANAGEMENT MEASURES									
			Wet Pond	Gravel Wetland	Subsurface Infiltration	Sand Filter	Biofiltration	High Efficiency Biofiltration	Tree Pits	Raingarden	Dry Well	Permeable Pavement
LAND USE	Residential	Pervious						•		•	•	
		Impervious						•		•	•	
		Roof						•		•	•	
	Residential Subdivision	Pervious					•	•				
		Impervious					•	•				•
		Roof					•	•			•	
	Commercial/ Industrial/ Institutional	Pervious	•	•	•	•	•	•	•			
		Impervious	•	•	•	•	•	•	•			•
		Roof			•		•	•			•	
	Road/ Freeway	Impervious	•	•			•					
	Outdoor/ Other Urban Land	Pervious		•	•	•	•	•	•			
		Impervious		•	•	•	•	•	•			•

4.3.1 Municipal/Commercial/Industrial/Institutional Strategies

The following management strategies in the municipal, commercial, industrial, and institutional sectors were used to manage both roof tops, impervious surfaces and pervious surfaces and include: dry wells, subsurface infiltration, wet ponds, gravel wetlands, porous pavements, biofiltration, and high efficiency bioretention

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Figure 4-4. Residential Educational Brochure

4.3.2 Residential Strategies

In residential areas raingardens, dry wells, gravel wetlands, and porous pavements were identified as the primary strategies. A valuable resource for homeowners includes the *New Hampshire Homeowner's Guide to Stormwater Management, Do-It-Yourself Stormwater Solutions for Your Home (NHDES 2001)*, which provides information on the common causes of stormwater problems and their effects and fact sheets for structural controls that residential homeowners can install to mitigate the effects of stormwater.

NHDES has a program called "Soak up the Rain" which will provide resources for residential homeowners interested in installing LID.

4.3.3 Septic System Strategies

Prior to 1967, onsite septic systems were installed without regulatory guidelines or governing restrictions. Before the standards were developed by the Department of Environmental Services (DES), many systems were not installed properly, maintained, or adequately documented. Failing subsurface septic systems exhibit foul odors, wastewater backup, and contribute largely to non-point source pollution of nitrogen and phosphorus. These discharges can be decreased through the implementation of advanced and innovative reduction technologies. Advanced and innovative treatment systems differ from conventional septic systems because they incorporate an additional treatment step to further the removal of nitrogen.

4.3.4 Agriculture Strategies

Nitrogen is one of the most important crop inputs; yet, it is also one of the most complex. It is susceptible to environmental losses, and its effectiveness is impacted by soil types and weather. Feasible and widely used agricultural BMPs identified by stakeholders include slow release fertilizer and the use of cover crops. Slow release fertilizer recommended by UNH Cooperative Extension contains at least 15% of the fertilizer to be of a reduced water solubility that allows the gradual release and uptake of nitrogen and phosphorous which in turn reduces excess nutrient washoff. (https://extension.unh.edu/resources/files/Resource000494_Rep516.pdf)

Cover crops are one of the most valuable management practices available for protecting water quality, especially groundwater quality, from non-point sources of soluble nutrients like nitrate nitrogen. Cover crops reduce soil erosion in several ways. They protect the soil surface from raindrop impact, increase water infiltration, trap and secure crop residues, improve soil aggregate stability and provide a network of roots which protect soil from flowing water (USDA, 2013).

4.3.5 Street Sweeping

Figure 4-5. Trash from street sweeper being dumped. (Source: Chesapeake Stormwater Network)

Frequent street sweeping of the dirtiest roads and parking lots within a community can be an effective strategy to pick up nutrients and sediments from street surfaces before they can be washed off in stormwater runoff (Chesapeake Stormwater Network, 2015). Under the draft NH MS4 permit (EPA, 2013), increases in the frequency of street sweeping and catch basin cleaning were included and protocols for proper disposal of street sweeping and catch basin refuse. Street sweeping and catch basin cleanout practices rank among the oldest practices used by communities for a variety of purposes to provide a clean and healthy environment, and more recently to comply with MS4 permits. For the purposes of WISE, street sweeping and catch basin cleaning was assumed to be completed bi-weekly to maximize reduction of particulates along roadways.

4.3.6 Disconnect, Distribute and Decentralize Impervious Cover

Impervious surfaces such as roadways, parking lots, rooftops, sidewalks, driveways, and other pavements impede stormwater infiltration and generate surface runoff. Research has shown that total watershed impervious area is correlated with a number of negative impacts on our water resources such as increased flood peaks and frequency, increased sediment, nutrient, and other pollutant levels, channel erosion, impairments to aquatic biota, and reduced recharge to groundwater (Center for Watershed Protection, 2003).

The amount of runoff and associated pollutants from a project can be reduced by disconnecting impervious surfaces. Disconnection of rooftop down spouts and impervious cover are common practices. Disconnection of impervious surfaces increases the amount of EIC on a site, which allows for filtering and infiltration prior to discharging to the receiving water.

The draft NPDES Small MS4 permits for New Hampshire require regulated communities to estimate the number of acres of impervious area (IA) and directly connected impervious area (DCIA) that have been added or removed each year due to development, redevelopment, and or retrofitting activities.

Why Quantify Your IA & DCIA?

New construction, redevelopment, and restoration activities can change existing IA and DCIA – potentially exacerbating or reducing existing watershed impairments. Understanding watershed imperviousness is important for communities because it:

- Informs management of impaired waterbodies and prioritization of watershed restoration efforts;
- Facilitates investigation of existing chronic flooding and stormwater drainage problems, and avoidance of new problems;
- Indicates potential threats to drinking water reservoirs/aquifers; commercial fisheries, and recreational waters;
- Demonstrates progress toward achieving future **Total Maximum Daily Load (TMDL)** allocations based on impervious cover thresholds;
- Serves as an educational tool for encouraging environmentally sensitive land use planning and **Low Impact Development (LID);**
- Facilitates equitable derivation of possible stormwater utility fees based on parcel-specific impervious cover; and
- Provides guidance for stormwater retrofit efforts.

Figure 4-6. Impervious Cover Facts (Source: EPA, 2014)

4.3.7 Protection of Sensitive Areas and Valuable Resources/LID Planning

Buffers and riparian corridors are vegetated ecosystems along a waterbody that serve to protect the waterbody from the effects of runoff by providing water quality filtering, bank stability, recharge, rate attenuation and volume reduction, and shading of the waterbody by vegetation (Audubon et.al, 1997). Riparian corridors also provide habitat and may include streambanks, wetlands, floodplains, and transitional areas.

To minimize stormwater impacts, new and re-development projects should avoid affecting or encroaching upon areas with important natural stormwater functional values (floodplains, wetlands, riparian areas, drainage ways and buffers) and with stormwater impact sensitivities (steep slopes, adjoining properties, others) wherever practicable. Development should not occur in areas where sensitive resources exist so that their valuable natural functions are not lost and increasing stormwater impacts.

4.4 Cost and Performance Comparison of Management Scenarios

One of the most significant challenge in management of nutrients for communities is balancing competing resource needs. Some cost estimates developed in light of pending requirements total hundreds of millions of dollars. As part of the Integrated Plan management scenarios were evaluated for both the implementation cost and the water quality load reduction to identify both a range of strategies and an implementation schedule that would be feasible. An essential element of this is the application of nutrient control measures in a manner that prioritizes and applies those with the greatest cost benefit first. To accomplish this management scenarios were evaluated over a range of permitting scenarios to determine cost to implement wastewater upgrades and non-point source controls and assessed for unit cost performance in terms of cost per nitrogen reduction.

Comparisons for the range of management scenarios identified strategies which achieve the greatest benefit for the lowest cost. Using a present worth analysis, annual costs were developed associated with debt service for wastewater and nonpoint source management.

When comparing and evaluating the management scenarios the following list of assumptions were used:

- Operating the WWTF at 3 mg/L or sending the wastewater load to the regional treatment facility does not eliminate the needs for long-term implementation of non-point source controls to satisfy the obligations under the Administrative Order of Consent and the MS4 general permit.
- Under the MS4 program, non-point source controls implemented under the integrated planning scenarios (both IP and EX) can be credited towards meeting Minimum Measure 5: Post-Construction Stormwater Management.
- The use of flexible sizing of structural management measures (i.e., capture depth range of 0.25 to 1.50 inches) can be achieved through an Integrated Planning (IP and EX) scenario. Whereas, under the traditional permitting scenarios, a fixed capture depth of 1.0 inch is used, in accordance with the NH Stormwater Manual.
- Maximum extent practicable is the most cost effective mix of nutrient management measures, including wastewater treatment, non-point source controls and stormwater controls, with flexible sizing over a range of specific land uses.
- Total cost includes capitol cost and operation and maintenance.
- A present worth analysis was conducted for NPS assuming a 2% discount rate and a 50-year present worth implemented over a 30-year schedule. NPS operations and maintenance costs were conservatively estimated to be 5% of the capital cost annually.
- Costs associated with wastewater capital and operations and maintenance were from Wright Pierce (2014) and Kleinfelder (2012).

4.4.1 Cost and Load by Subwatershed for Nutrient Management Scenarios

The management scenarios, presented in Section 4.1, were compared to determine the most cost-effective scenario for managing receiving water load from the three towns and the watershed as a whole. Presented in Table 4-3 are the management scenarios ranked by unit performance based on total 50-year present worth cost and the receiving water total annual load. All the management scenarios trend towards a receiving water load target of 88 tons per year however none achieve that goal. As mentioned previously, the 3 communities cannot achieve the load target without participation from the upper watershed. The scenarios examined achieve between 53% (EX-3) and 74% (T-RO) load reduction.

The total annual receiving water load ranges from 114 tons per year up to 133 tons per year, with the greatest reduction representing the regional outfall (T-RO) with the highest cost to implement at $257 million or $3.75 million per ton of nitrogen reduced (68 tons and 74% reduction). The most cost effective scenario is IP-3/5/8 which phases in wastewater treatment and implements NPS control measures over 2000 acres over 6 permit cycles throughout the subwatershed. This scenario has an annual receiving water load of 126 tons per year (56 tons and 60% reduction) and a total 50-year present worth cost of $105 million or $1.88 million per ton reduced.

The least expensive scenario is EX-5 which has a total 50-year present worth cost of $97.6 million or $1.99 million per ton reduced and an annual receiving water load of 133 tons (49 tons and 53% reduction). This scenario considers only the Town of Exeter and does not include potential WWTF upgrades in Newfields, a wastewater district Stratham or non-point source controls in either of the towns.

Figure 4-7 presents the management scenarios with the relative sources (wastewater, NPS, upper watershed) compared to a baseline watershed load and a pristine (undeveloped) watershed load. The baseline watershed load represents the current condition of the entire watershed including the three towns in the subwatershed and the communities in the Upper Exeter River watershed. The dashed line on the figure represents the receiving water quality load target of 88 tons per year to support eelgrass habitat. The pristine annual load represents the undeveloped watershed condition before human impacts. It can be seen that the three towns alone do not have the ability to reduce the nitrogen load to meet the receiving water quality load target to support eelgrass habitat. The management scenarios evaluated have the potential to provide 53% to 74% reduction in the subwatershed load. from the three towns. As presented in Figure 4-7, the upper watershed load contributes 89 tons per year of nitrogen to the estuary of which a 42% reduction (38 tons) would be required to meet the load target.

Table 4-3. Ranked comparison of scenario unit performance ($$/Ton)

Management Scenario	WWTF Discharge (mg/L)	Wastewater Management District	Wastewater Load (tons N/yr)	NPS Load (tons N/yr)	Load from Upper Exeter R. Watershed (tons N/yr)	Total Load (Tons N/yr)	Cost (Total PV: Capital + O&M, 50 yrs) ($M)	$M/Ton Reduced
IP-3/5/8	Phased from 8 to 5 to 3	YES	10	27	89	126	$105.0	$1.88
EX-5	5	NO	13	31	89	133	$97.60	$1.99
IP-5	5	NO	13	27	89	129	$104.9	$1.99
EX-3	3	NO	8	31	89	128	$112.70	$2.08
IP-3	3	YES	10	27	89	126	$126.4	$2.27
IP-RO	<1	YES	3	27	89	119	$150.6	$2.40
T-3	3	NO	8	22	89	119	$226.80	$3.61
T-5	5	NO	13	22	89	125	$211.30	$3.68
T-RO	<1	NO	3	22	89	114	$257.0	$3.75

Table 4-4 and Figure 4-8 present the management scenario total present value cost broken down by capital cost and operation and maintenance cost for the wastewater treatment facility and non-point source management measures.

Table 4-4. Total 50-Yr Present Value Cost by Subwatershed-Scale

MANAGEMENT SCENARIO	ANNUAL TOTAL LOAD TO RIVER (TONS)	TOTAL COST PV ($M)	WWTF PV CAPITAL COST ($M)	WWTF O&M COST ($M)	NPS CAPITAL COST ($M)	NPS O&M COST ($M)
EX-5	133.1	$97.6	$40.0	$49.0	$4.1	$4.4
IP-5	129.4	$104.9	$41.0	$50.3	$6.6	$7.1
EX-3	127.9	$112.7	$46.0	$58.1	$4.1	$4.4
IP-3	126.4	$126.4	$52.6	$60.2	$6.6	$7.1
IP-3,5,8	126.4	$105.0	$43.8	$47.6	$6.6	$7.1
T-5	124.8	$209.1	$40.0	$49.0	$57.9	$62.1
T-3	119.4	$226.8	$47.2	$59.6	$57.9	$62.1
IP-RO	119.4	$150.6	$48.1	$88.9	$6.6	$7.1

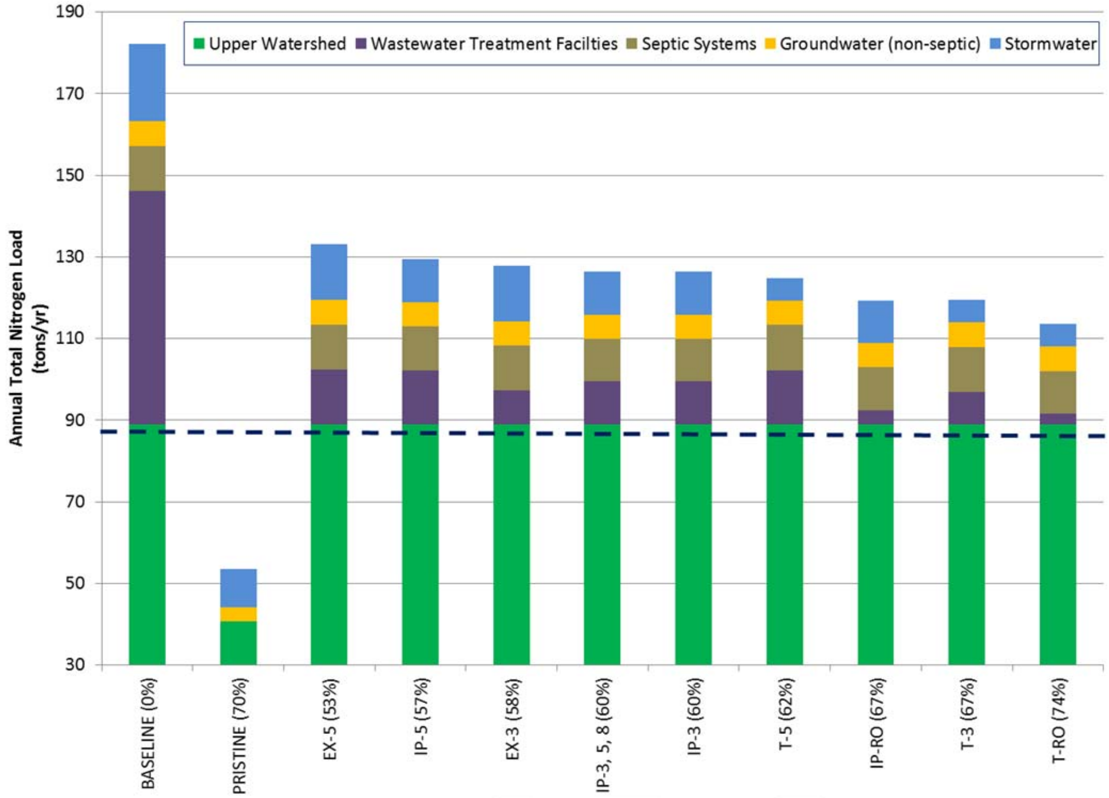

Figure 4-7. Ranked scenario by annual load reduction (% reduction relative to subwatershed load)

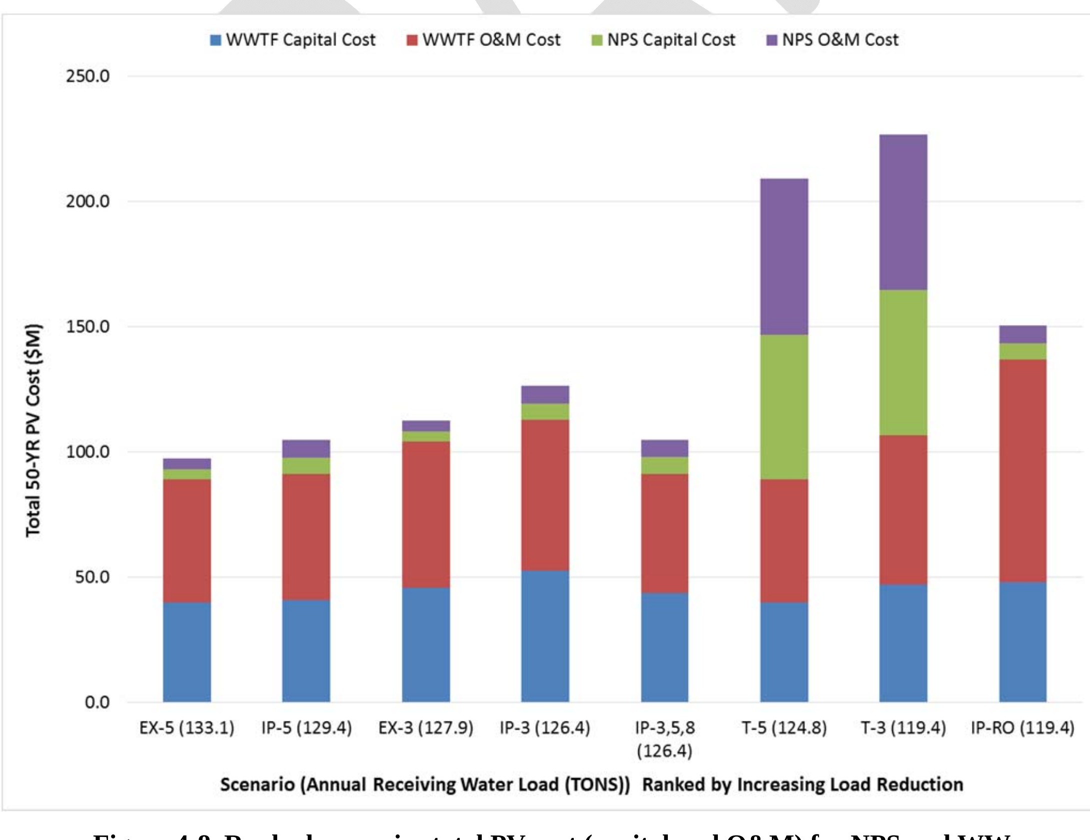

Figure 4-8. Ranked scenarios total PV cost (capital and O&M) for NPS and WW

4.4.2 Cost by Town for Nutrient Management Scenarios

To provide a better understanding of the total cost for municipal planning and decisions making, the management scenario total present value cost was divided up by Town for total cost, capital cost and operation and maintenance cost. Further, the cost is subdivided by implementation costs anticipated to be incurred by private (i.e., commercial, industrial, residential) property owners and by the municipal sector (i.e., roads, parks, municipal buildings) based on estimated area for which the municipality will likely be required to manage. With this approach the total cost of NPS management is covered by the land uses which generate stormwater runoff, both private and municipal sector. The approach assumes that the expenses would be part of the redevelopment cycle as with any code and modernization requirements with which owners and operators are familiar. This type of planning would require revisions to any existing stormwater ordinances and regulations, to require management of nitrogen for new and redevelopment including municipal capital improvement projects that impact stormwater management.

4.4.2.1 Cost Comparison for Town of Exeter

To meet the regulatory and water quality load targets through either an integrated planning or traditional permitting scenario, the estimated cost of implementation for the Town of Exeter is from $94 to $178 million (Table 4-5). The estimated annual cost per year for the Town of Exeter ranges from $3.13 to $5.93 dollars inclusive of capital improvements and operation and maintenance over six permit cycles or 30 years, for both wastewater treatment and non-point source controls.

All of the management scenarios presented in Table 4-5, with the exception of T-3, use integrated planning with the use of NPS management to the maximum extent practicable through an optimization approach. The T-3 scenario does not include an optimization approach and selection is not based on the greatest unit cost efficiency. Instead for the T-3 it assumes stormwater management will be conducted on all areas with no flexibility on sizing. Due to this, the cost of NPS controls for the T-3 scenario are 90% more ($65.3 million), significantly increasing the cost for implementation of this scenario.

Table 4-5. Total 50-Yr Present Value Cost by Scenario for Exeter Individually

Management Scenario	WWTF Total Cost ($M, 50-YR PV)	NPS Total Cost ($M, 50-YR PV)	Total Implementation Cost ($M, 50-YR PV)	Average Annual Implementation Cost ($M, 50-YR PV)
IP-3,5,8	$85.5	$8.6	$94.0	$3.13
IP-5	$89.0	$8.6	$97.6	$3.25
IP-3	$104.1	$8.6	$112.7	$3.76
IP-RO	$121.7	$8.6	$130.3	$4.35
EX-3	$104.1	$8.6	$112.7	$3.76
T-3	$104.1	$73.9	$178.0	$5.93

Presented in Table 4-6 are the capital cost and operation and maintenance cost over 30 years for both wastewater and non-point source controls for each of the management scenarios. The operation and maintenance costs for the non-point source controls generally represent 50% of the total implementation cost for the management measures. The same is generally true for the wastewater operation and maintenance costs with the exception of the regional outfall scenario, which represents 64% of the total wastewater cost.

Table 4-6. Total 50-Yr Present Value Capital and Operation & Maintenance Cost by Scenario for Exeter Individually

Management Scenarios	WWTF Capital Cost ($M, 50-YR PV)	WWTF O&M Cost ($M, 50-YR PV)	NPS Capital Cost ($M, 50-YR PV)	NPS O&M Cost ($M, 50-YR PV)
IP-3,5,8	$39.5	$46.0	$4.2	$4.4
IP-5	$40.0	$49.0	$4.2	$4.4
IP-3	$46.0	$58.1	$4.2	$4.4
IP-RO	$42.8	$79.0	$4.2	$4.4
EX-3	$46.0	$58.1	$4.2	$4.4
T-3	$46.0	$58.1	$35.2	$38.7

Table 4-7. Total Annual NPS Present Value Cost over 30-Year Plan for Exeter

Management Scenario	Total Annual NPS Cost ($M)	Annual NPS Municipal Cost ($M)	Annual NPS Private Cost ($M)
IP-3,5,8	$0.285	$0.163	$0.122
IP-5	$0.285	$0.163	$0.122
IP-3	$0.285	$0.163	$0.122
IP-RO	$0.285	$0.163	$0.122
EX-3	$0.285	$0.163	$0.122
T-3	$2.463	$0.816	$1.648

Presented in Table 4-7 are the annual non-point source implementation costs for each of the management scenarios. The proposed integrated planning alternatives (IP and EX management scenarios) have an annual NPS cost of $285,000 for the Town of Exeter (Table 4-7). Based on the results from the optimization model, $163,000 or 57% of the total annual non-point source implementation cost (capital and O&M) will be incurred by the municipality for controls on municipally owned land (i.e., roads, parks, schools), or a total of $4.89 million over 30-years. An additional $122,000 annually is estimated to be covered by the private sector for the redevelopment and operation and maintenance of non-town owned properties occurring primarily in commercial, industrial, and residential areas for a total of $3.66 million over a 30-year period. Based on the traditional permit scenario (T-3) the Town of Exeter is expected to have an annual $2.46 million cost for implementation and operation and maintenance of non-point source controls, with an expected $816,000 incurred by the municipality and an additional $1.65 million covered by the private sector.

Currently the Town of Exeter has an annual stormwater management budget of $25,000. Under the integrated planning scenarios, the Town's stormwater management budget would increase by 6.5 times the current budget, to meet the non-point source implementation at the maximum extent practicable rate. The traditional permitting alternative would be nearly an increase of 33.6 times the current stormwater budget, which in general terms is not financially feasible or practicable. Therefore, for the Town of Exeter the integrated planning alternatives are favorable due to the use of adaptive management which reduces wasteload allocations for municipal stormwater and wastewater management and allows for flexibility in management strategies and crediting across permits.

4.4.2.2 Cost Comparison for Town of Stratham

To meet the regulatory and water quality load targets through either an integrated planning or traditional permitting scenario, the estimated cost of implementation for the Town of Stratham is from $3.7 to $35.1 million (Table 4-8). The estimated annual cost per year for the Town of Stratham ranges from $125,000 to $1.17 million inclusive of capital improvements and operation and maintenance over six permit cycles or 30 years, for wastewater treatment and non-point source controls.

All of the management scenarios presented in, with the exception of T-3, use integrated planning with the use of NPS management to the maximum extent practicable through an optimization approach. The T-3 scenario does not include an optimization approach and selection is not based on the greatest unit cost efficiency. Instead for the T-3 it assumes stormwater management will be conducted on all areas with no flexibility on sizing. Due to this, the cost of NPS controls for the T-3 scenario are greater than 80% more ($31.4 million), significantly increasing the cost for implementation of this scenario. Scenarios IP-5 and T-3 do not have wastewater treatment costs as it is assumed that Stratham would continue to operate with septic systems only for these scenarios.

Table 4-8. Total 50-Yr Present Value Cost by Scenario for Stratham

Management Scenario	WWTF Cost ($M, 50-YR PV)	NPS Cost ($M, 50-YR PV)	Total Implementation Cost ($M, 50-YR PV)	Average Annual Implementation Cost ($M, 50-YR PV)
IP-3,5,8	$3.26	$3.7	$7.0	$0.233
IP-5	-	$3.7	$3.7	$0.125
IP-3	$6.0	$3.7	$9.7	$0.323
IP-RO	$12.2	$3.7	$15.9	$0.530
T-3	-	$35.1	$35.1	$1.17

Presented in Table 4-9 are the capital cost and operation and maintenance cost over 30 years for both wastewater and non-point source controls for each of the management scenarios. The operation and maintenance costs for the non-point source controls generally represent 52% of the total implementation cost for the management measures. The operation and maintenance for the wastewater connection operation and maintenance costs represents 10% of the total wastewater cost.

Table 4-9. Total 50-Yr Present Value Capitol and Operation & Maintenance Cost by Scenario for Stratham

SCENARIO	WWTF CAPITAL COST ($M, 50-YR PV)	WWTF O&M COST ($M, 50-YR PV)	NPS CAPITAL COST ($M, 50-YR PV)	NPS O&M COST ($M, 50-YR PV)
IP-3,5,8	$3.1	$0.2	$1.8	$1.93
IP-5	-	-	$1.80	$1.93
IP-3	$5.5	$0.6	$1.80	$1.93
IP-RO	$4.3	$7.9	$1.80	$1.93
T-3			$16.93	$18.15

Table 4-10. Total Annual NPS Present Value Cost over 30-Year Plan for Stratham

Management Scenario	Total Annual NPS Cost ($M)	Annual NPS Municipal Cost ($M)	Annual NPS Private Cost ($M)
IP-3,5,8	$0.125	$0.065	$0.060
IP-5	$0.125	$0.065	$0.060
IP-3	$0.125	$0.065	$0.060
IP-RO	$0.125	$0.065	$0.060
T-3	$1.17	$0.605	$0.564

Presented in Table 4-10 are the annual non-point source implementation costs separated by municipal and private sector expense for each of the management scenarios. The proposed integrated planning alternatives (IP) have an annual NPS cost of $125,000 for the Town of Stratham. Based on the results from the optimization model, $65,000 or 52% of the total annual non-point source implementation cost (capital and O&M) will be incurred by the municipality for controls on municipally owned land (i.e., roads, parks, schools), or a total of $1.95 million over 30-years. An additional $60,000 annually is estimated to be covered by the private sector for the redevelopment and operation and maintenance of non-town owned properties occurring primarily in commercial, industrial, and residential areas for a total of $1.8 million over a 30-year period. Based on the traditional permit scenario (T-3) the Town of Stratham is expected to have an annual $1.17 million cost for implementation and operation and maintenance of non-point source controls, with an expected $605,000 incurred by the municipality and an additional $564,000 million covered by the private sector.

Currently the Town of Stratham does not have an annual stormwater management budget, as they are currently pending receipt of the draft MS4 general permit. Therefore the additional costs associated with the implementation of non-point source controls will be much more favorable under the integrated planning scenarios. The traditional permitting alternative would be nearly an additional increase of 8.3 times the integrated planning amount, which in general terms is not financially feasible or practicable. Therefore, for the Town of Stratham the integrated planning alternatives are favorable due to the use of adaptive management which reduces wasteload allocations for municipal stormwater and wastewater management and allows for flexibility in management strategies and crediting across permits.

4.4.2.3 Cost Comparison for Town of Newfields

To meet the regulatory and water quality load targets through either an integrated planning or traditional permitting scenario, the estimated cost of implementation for the Town of Newfields are from $3.6 to $13.7 million (Table 4-11). The estimated annual cost per year for the Town of Newfields ranges from $120,000 to $460,000 inclusive of capital improvements and operation and maintenance over six permit cycles or 30 years, for wastewater treatment and non-point source controls.

All of the management scenarios presented in Table 4-11, with the exception of T-3, use integrated planning with the use of NPS management to the maximum extent practicable through an optimization approach. The T-3 scenario does not include an optimization approach and selection is not based on the greatest unit cost efficiency. Instead for the T-3 it assumes stormwater management will be conducted on all areas with no flexibility on sizing. Due to this, the cost of NPS controls for the T-3 scenario are 88% more ($9.7 million), significantly increasing the cost for implementation of this scenario.

Table 4-11. Total 50-Yr Present Value Cost by Scenario for Newfields*

Management Scenario	WWTF Cost* ($M, 50-YR PV)	NPS Cost ($M, 50-YR PV)	Total Implementation Cost ($M, 50-YR PV)	Annual Implementation Cost ($M, 50-YR PV)
IP-3,5,8	$2.6	$1.3	$4.0	$0.13
IP-5	$2.3	$1.3	$3.6	$0.12
IP-3	$2.6	$1.3	$4.0	$0.13
IP-RO	$3.1	$1.3	$4.4	$0.15
T-3	$2.6	$11.0	$13.7	$0.46

* Cost for Newfields wastewater are estimated based on ratios of flow to joining Exeter. Costs for Newfields alone were not available at the time and are assumed to be the same and will need to be updated.

Presented in Table 4-12 are the capital cost and operation and maintenance cost over 30 years for both wastewater and non-point source controls for each of the management scenarios. The operation and maintenance costs for the non-point source controls generally represent 52% of the total implementation cost for the management measures. The operation and maintenance for the wastewater connection operation and maintenance costs represents 55% of the total wastewater cost.

Presented in Table 4-13 are the annual non-point source implementation costs for each of the management scenarios broken down by municipal and private sector contribution. The proposed integrated planning alternatives (IP) have an annual NPS cost of $44,000 for the Town of Newfields. Based on the results from the optimization model, $23,000 or 52% of the total annual non-point source implementation cost (capital and O&M) will be incurred by the municipality for controls on municipally owned land (i.e., roads, parks, schools), or a total of $690,000 over 30-years.

Table 4-12. Total 50-Yr Present Value Capitol and Operation & Maintenance Cost by Scenario for Newfields

SCENARIO	WWTF CAPITAL COST* ($M, 50-YR PV)	WWTF O&M COST* ($M, 50-YR PV)	NPS CAPITAL COST ($M, 50-YR PV)	NPS O&M COST ($M, 50-YR PV)
IP-3,5,8	$1.2	$1.5	$0.64	$0.69
IP-5	$1.0	$1.2	$0.64	$0.69
IP-3	$1.2	$1.5	$0.64	$0.69
IP-RO	$1.1	$2.0	$0.64	$0.69
T-3	$1.2	$1.5	$5.33	$5.71

*Cost for Newfields wastewater are estimated based on ratios of flow to joining Exeter. Costs for Newfields alone were not available at the time and are assumed to be the same and will need to be updated. It is presumed that those costs are undervalued for Newfields alone.

Table 4-13. Total Annual NPS Present Value Cost over 30-Year Plan for Newfields

Management Scenario	Total Annual NPS Cost ($M)	Annual NPS Municipal Cost ($M)	Annual NPS Private Cost ($M)
IP-3,5,8	$0.044	$0.023	$0.021
IP-5	$0.044	$0.023	$0.021
IP-3	$0.044	$0.023	$0.021
IP-RO	$0.044	$0.023	$0.021
T-3	$0.368	$0.190	$0.177

An additional $21,000 annually is estimated to be covered by the private sector for the redevelopment and operation and maintenance of non-town owned properties occurring primarily in commercial, industrial, and residential areas for a total of $630,000 over a 30- year period. Based on the traditional permit scenario (T-3) the Town of Newfields is expected to have an annual $368,000 cost for implementation and operation and maintenance of non-point source controls, with an expected $190,000 incurred by the municipality and an additional $177,000 million covered by the private sector.

Currently the Town of Newfields does not have an annual stormwater management budget, as they received a waiver from the draft MS4 general permit requirements. However, in the future Newfields expects that a waiver may not be granted and therefore the additional costs associated with the implementation of non-point source controls will be much more favorable under the integrated planning scenarios. The traditional permitting alternative would be nearly an additional increase of 7.2 times the integrated planning amount, which in general terms is not financially feasible or practicable. Therefore, for the Town of Newfields the integrated planning alternatives are favorable due to the use of adaptive management which reduces wasteload allocations for municipal stormwater and wastewater management and allows for flexibility in management strategies and crediting across permits.

4.4.3 Costing of Nutrient Control Measures

To evaluate the cost of each control measure and management scenarios, costing data was collected from typically at minimum 5 sources using local data, design reports and professional judgment (EPA 1999, FB Environmental 2009, Filterra 2011, Herrera 2011, TetraTech 2009, UNHSC 2012, CRWA 2014, Geosyntec 2014) (Appendix 8.1). Costing information varies substantially by area and as such professional judgment was used in the final estimation of the cost range. Cost ranges were scaled based on capture volume. New and redevelopment costs were considered for porous pavements. As such redevelopment costs are total cost while new development costs are a limited cost differential over standard pavement as that would be covered separately. Figure 4-9 presents the cost per pound removed range for the nutrient management strategies evaluated as part of the optimization model. Figure 4-9 presents a single cost for non-structural measures and a cost range, defined by the length of the bar, for structural management measures. The structural practice cost range is defined by the management measure capture depth and the potential for pollutant removal is defined by structural practice type, underlying soil type (i.e., infiltration rate) and land use.

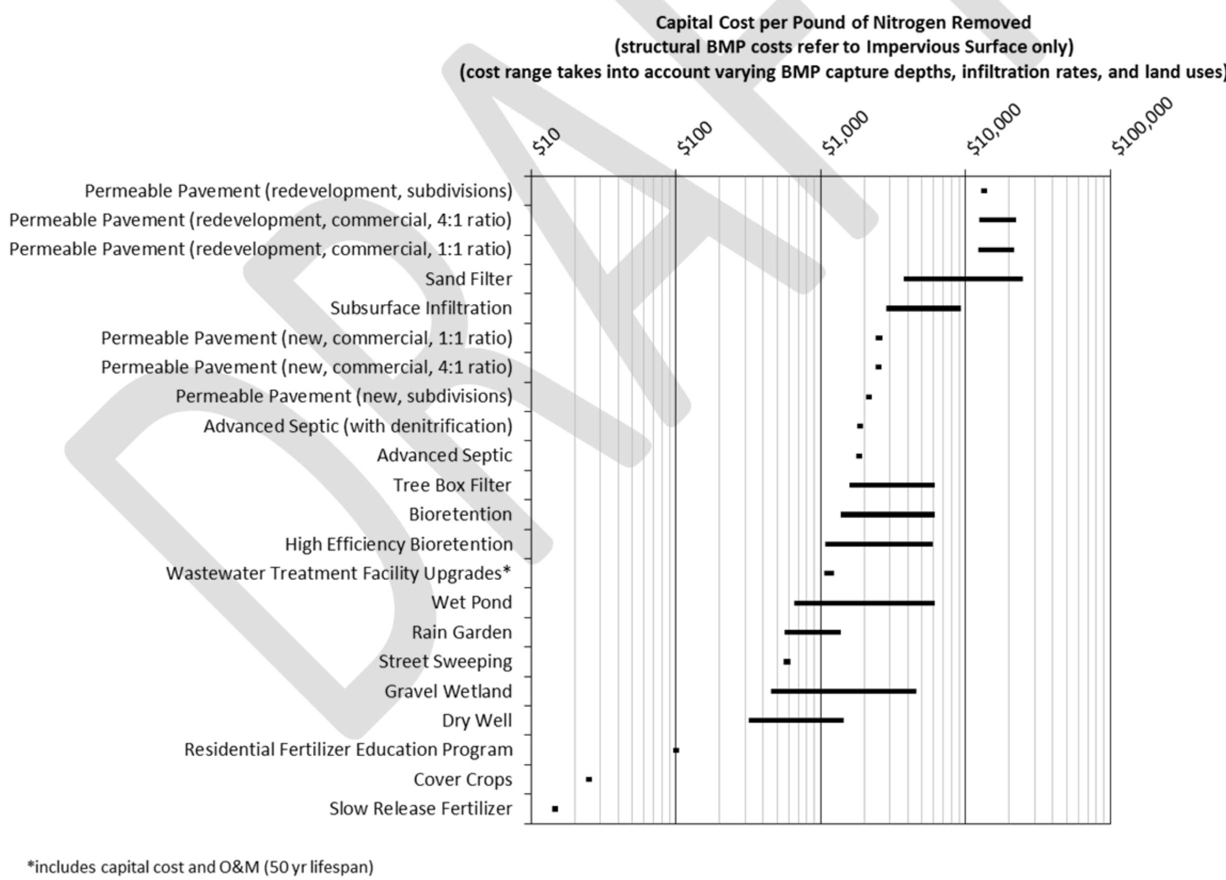

Figure 4-9. Nutrient Management Strategy Capital Cost for Nitrogen Removal

4.5 Recommended Scenario, Preliminary Implementation Plan and Schedule

The recommended alternative for nonpoint source (NPS) and stormwater (SW) management is the integrated planning scenario IP-3/5/8 for the three communities. This scenario achieves a 60% load reduction (56 tons) over a 30 year implementation period with the highest unit cost performance. This would require approximately 67 acres per year treated starting in 2017 with specific target milestones listed in Table 4-14.

Scenario IP-3/5/8 has a phased implementation of both WW and NPS across 6 permit cycles. It begins with 8 mg/L at 2019, transitions to 5 mg/L at 2029, and ends at 3 mg/L by 2042. The extended implementation schedule allows for ecosystem monitoring and adaptive management at each critical stage and for participation by upper watershed communities. The schedule provides approximately 5 years for monitoring at each stage at which point a decision point would occur as whether it is needed to design and build for the next stage over another 5 year period. IP-3/5/8 satisfies elements of both the MS4 and wastewater permits for $105 million which is approximately 50% of the estimated value for individual permitting that assumes no cost sharing of wastewater, and no cost savings in the MS4 achieved by optimization from integrated planning (Table 4-3). IP-3/5/8 is about $7 million less than if Exeter chooses to manage alone. It represents about an 80% reduction in NPS management costs for Stratham and nearly $2.7 million less in wastewater costs. This approach uses combined wastewater at the Exeter wastewater treatment facility for the three communities and least cost mix (MEP) of NPS controls.

The preliminary implementation schedule parallels key milestones in the Exeter Administrative Order on Consent. For the Integrated Plan to receive EPA approval, a formal analyses using established guidance for scheduling by performing a financial capability analyses (FCA) (EPA 2014). An FCA Framework will be conducted to evaluate the impact on residential rate payers using indicators including household income, existing rates and taxes, as well as allowing a flexibility of schedule to be responsive to circumstances unique to a community, while advancing the goal to protect clean water. The schedule will provide metrics and milestones that must be tracked and accounted for and reported in the Annual Report on the Nitrogen Control Plan (NCP).

One of the critical elements of the preliminary schedule is that an extended implementation period makes use of the private sector redevelopment cycle. Specifically as redevelopment occurs enhanced stormwater management measures will be required due to revised municipal stormwater regulations. The revised stormwater regulations will require management of nitrogen for new and redevelopment including municipal capital improvement projects that impact stormwater management. As an example, in Exeter approximately 50% of the improvements would occur in the private sector. The municipal areas are associated with management of NPS for municipally owned and managed land such as parks, schools, roads, municipal offices, and the impervious areas in the urban center typically managed by the municipality. With this approach the total cost of NPS management is covered by the land uses that generate stormwater runoff, both municipal and private sector.

Table 4-14. Preliminary Implementation Schedule and Key Milestones

YEAR	WWTF GOALS	NPS/SW LOAD REDUCTION (TONS)	NPS/SW AREA TREATED (ACRES)	CUMULATIVE LOAD REDUCTION (TONS)	COST ($M)
2016	Design for 8 mg/L	Begin MEP implementation	0	0	$0.5
2019	Operate at 8 mg/L	0.85	200	36.9	$37.3
2023	Design for 5 mg/L	1.98	467	38.0	$45.9
2029	Operate at 5 mg/L	3.68	867	47.6	$61.9
2039	Design for 3 mg/L	6.52	1533	50.4	$83.3
2044	Operate at 3 mg/L	7.93	1867	55.2	$100.6
2046	Operate at 3mg/L, Stratham WW District	8.50 Complete	2000	55.8	$105.0

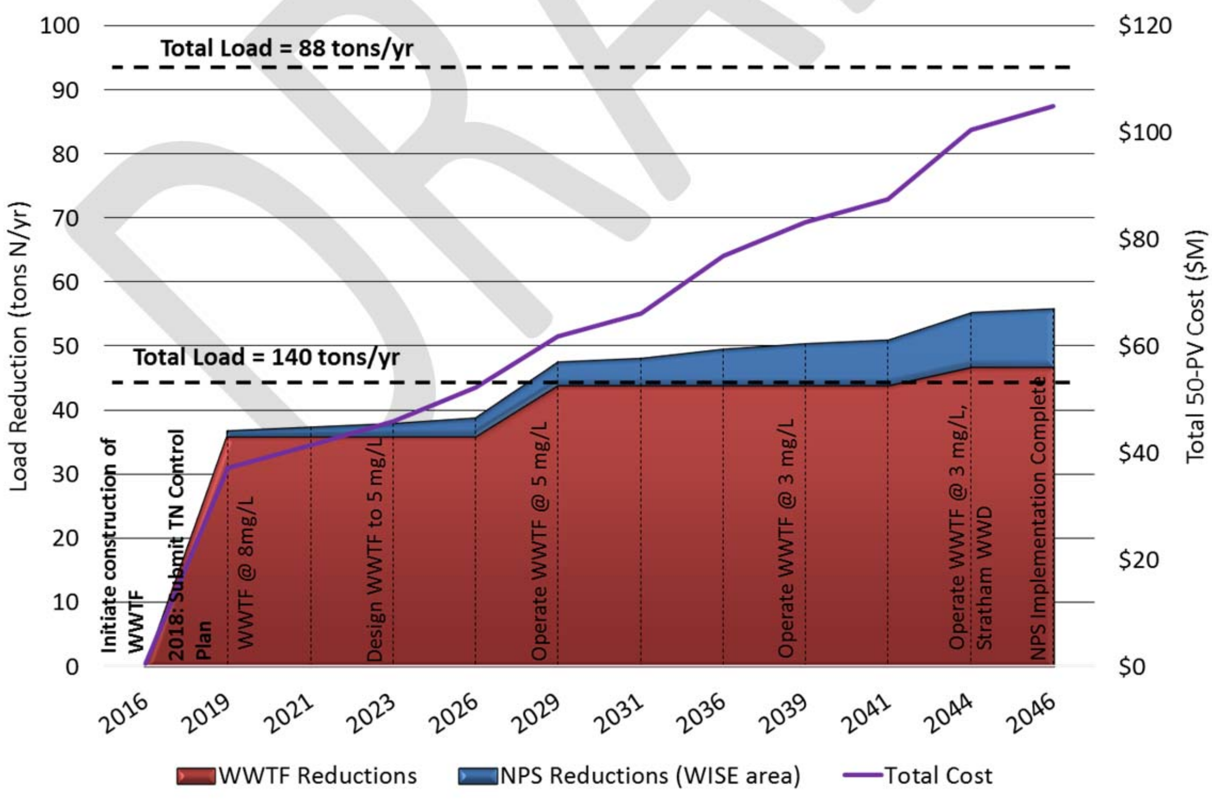

Figure 4-10. Preliminary Implementation Schedule and Key Milestones

4.5.1 Source Areas Identified for Stormwater Management and Retrofit

To achieve the targeted load reduction source areas have been identified that will have the greatest benefit for stormwater management and retrofitting with nutrient control measures. Table 4-15 presents the recommended least cost mix of nutrient management measures selected from the optimization model. Specific land use area targets, nitrogen control measures, and capture depths are presented along with available acreage for tracking purposes. The measures, both structural and non-structural, target a wide variety of land uses and if implemented would provide 17,000 lbs (8.5 tons) of nitrogen removal from 2,000 acres of developed land in the subwatershed. Over a 30 year period approximately 67 acres per year will need to be treated across the three towns, with about half due to redevelopment. The structural measures selected are sized to treat a capture depth or water quality volume equivalent to 0.25-0.5 inches, which is more cost effective than sizing and constructing larger structural measures as the largest pollutant load is typically in the “first flush” of a storm event.

For example, proposed future developments that apply for Town building permits should be directed to use the recommendations below for determining which practices should be considered for their projects. It is in the best interest of the project applicants to follow the recommendations as they represent cost savings that can be achieved when compared with other practices.

Town staff will be Stormwater management is often opportunistic and may not be implemented based on the recommendations below. The recommendations represent the lowest cost alternative which need not be strictly adhered to. Tracking and accounting of retrofit implementation over time will enable adaptive management of the various nutrient control strategies and adjust practices as necessary.

A detailed Implementation Plan with specific details as to location and timing of nitrogen control practices will need to be developed for this Plan to fulfill the AOC requirements and receive EPA approval.

Table 4-15. Proposed Target Areas for Retrofit and Management Listed by Land-Use Use, Area and Water Quality Volume Treated; Total Present Value of NPS Management (including O&M): $13.6 M, Total Load Reduction from NPS Management: 17,000 lb N/yr, Total Acres Treated: 2,000 acres

BMP TYPE	SIZE	LAND USE	COVER	ACRES TREATED	ACRES AVAILABLE	%
Cover Crops	-	Agriculture	-	28	28	100%
Slow Release Fertilizer Program	-	Agriculture	-	253	253	100%
Gravel Wetland	0.25	Commercial	Impervious	104	144	72%
High Efficiency Bioretention	0.25	Commercial	Impervious	29	144	20%
Subsurface Infiltration	0.25	Commercial	Impervious	12	144	8%
Dry Well	0.25	Commercial	Roof	36	36	100%
Gravel Wetland	0.25	Industrial	Impervious	47	47	100%
Dry Well	0.25	Industrial	Roof	25	25	100%
Gravel Wetland	0.25	Institutional	Impervious	94	113	83%
High Efficiency Bioretention	0.25	Institutional	Impervious	19	113	17%
Dry Well	0.25	Institutional	Roof	39	39	100%
Gravel Wetland	0.25	Outdoor and Other Built-up Land	Impervious	30	30	99%
Raingarden	0.25	Residential	Impervious	300	369	81%
Raingarden	0.5	Residential	Impervious	69	369	19%
Dry Well	0.25	Residential	Roof	252	252	100%
Lawn Fertilizer Program	-	Residential	-	-	-	-
Bioretention	0.25	Road	Impervious	112	658	17%
Gravel Wetland	0.25	Road	Impervious	546	658	83%
Street Sweeping Program	-	Road	Impervious	658	658	100%

4.5.2 Guidance for Developing an Implementation Schedule

Scheduling approaches include guidance for CSO management, Integrated Planning, and MS4 implementation.

- Wastewater scheduling typically follows the FCA analysis. "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development" (FCA Guidance) (EPA 832-B-97-004)
- Integrated planning is using similar info FCA Framework 2014. Financial Capability Assessment Framework for Municipal Clean Water Act Requirements (EPA, 2014)
- MS4 implementation for NH currently does not indicate a specific implementation schedule. No minimum period for an implementation schedule for Post Construction Stormwater Management (Minimum Measure 5) is currently required in the 2013 Draft NH MS4 General Permit. We have heard from EPA in the public forum that an extended period of time will be allowable.
- Similarly, EPA Headquarters, and Region 1 Leadership spoke at the September 2013 NACWA Integrated Planning Workshop in Portsmouth, NH, that extended implementation periods similar to CSO implementation are conceivable in the range of 4 or more permit cycle period. Environmental Monitoring

4.6 Long-Term Operations and Maintenance

To ensure long-term protection of water quality and the effectiveness of best management practices (BMPs), regular inspections and maintenance is necessary. Generally, inspection and maintenance falls into two categories: expected routine maintenance and non-routine (repair) maintenance. Routine maintenance is performed regularly to maintain both aesthetics and their good working order. Routine inspection and maintenance helps prevent potential nuisances (odors, mosquitoes, weeds, etc.), reduces the need for repair maintenance, and insures long term performance.

Under the EPA MS4 Phase II rules, owners and operators of small MS4 facilities are responsible for implementing BMP inspection and maintenance programs and having penalties in place to deter infractions. The rules recommend that all stormwater BMPs should be inspected on a regular basis for continued effectiveness and structural integrity. In addition to regularly scheduled inspections, all BMPs should be checked after each storm event. Scheduled inspections will vary among BMPs. Structural BMPs such as storm drain drop inlet protection may require more frequent inspection to ensure proper operation.

5. MONITORING AND TRACKING AND ACCOUNTING

5.1 Monitoring

This Plan proposes options for monitoring necessary not only to ensure specific legal requirements for tracking management measures and load allocations are met, but also to meet public goals and expectations for environmental quality at targeted locations of interest to residents and managers. The Plan includes monitoring of nutrient concentrations and loads and biological response indicators (e.g., algae). This monitoring strategy will provide an assessment of current conditions and progress towards targets and overall goals. To meet the objective of a monitoring program with enough information to detect changes in water quality and ecosystem improvements in an affordable way, we recommend municipalities take advantage of existing monitoring efforts. This will inform the adaptive management process and the ongoing nutrient control strategies.

5.1.1 Monitoring Objectives

The goal of this monitoring plan is to provide advice and guidance for municipalities to develop an effective monitoring plan. The key is to obtain accurate and informative data across the area of interest over an extended period of time that meets regulatory requirements, assure management goals are being attained, evaluate ecosystem condition, and equitably allocate pollutant loads.

Specific objectives are to:

- Meet existing and expected regulatory requirements associated with discharge from wastewater treatment plants, and expected requirements under a draft MS4 permit;
- Estimate loads from existing sources to prioritize management strategies, allocate responsibility and validate models;
- Support and improve integrated watershed understanding of human-caused ecosystem impacts and their solutions in the Exeter and Squamscott Rivers and Great Bay;

- Support adaptive management opportunities that help ensure cost-effective and productive management strategies and accountability; and
- Support interactive tracking and assessment and potentially provide a framework for "trading" of reduction credits.

5.1.2 Point Source Monitoring

5.1.2.1 MS4 Outfall Monitoring and Interconnection Screening and Sampling

The final Municipal Separate Storm Sewer System (MS4) permit may require outfall monitoring at locations required to meet programmatic requirements including the Illicit Discharge Detection and Elimination (IDDE) program. IDDE screening shall include collection of grab samples and their analysis for *E. coli* (a bacterial indicator for freshwater receiving waters) or enterococcus (an indicator for saline or brackish receiving waters), or some other accepted surrogate indicated of wastewater. These items are being explored to improve the simplicity of initial screening efforts.

Screening and sampling tests for interconnections are required under the IDDE program. IDDE programs must include written procedures for screening and sampling of outfalls and interconnections in the MS4 during dry and wet weather conditions to provide evidence of illicit discharges and sanitary sewer overflows (SSOs). This screening procedure is used for baseline outfall and interconnection screening, confirmatory screenings, and follow-up screening to maintain an inventory of problems and their status.

More detailed discussion of sampling requirements under each of these components is included in Appendix 8.4.

5.1.2.2 WWTF Outfall Monitoring

NPDES permits contain specific requirements for effluent monitoring of wastewater treatment facilities (WWTF) for compliance with permit conditions, and often broader, supplementary monitoring requirements, usually negotiated in the permit writing process or added as a consent agreement that demonstrate progress towards meeting water quality goals. Effluent monitoring is generally prescriptive as to parameters, frequency and methodology, continues for the life of the permit and is technically and legally sufficient to assess compliance with defined discharge criteria and limits. Beyond compliance verification use, any required demonstration of progress towards receiving water goals will likely require a combination of targeted monitoring and administrative tracking of implementation actions.

The new Exeter WWTF permit and associated Administrative Order on Consent (AOC) requires effluent monitoring of total nitrogen at a prescribed frequency "…from March 1, 2013 until June 30, 2019 or until 12 months after substantial completion…" of the Exeter WWTF, whichever is sooner. This provides documented evidence that the Town of Exeter is complying with their interim total nitrogen effluent limit supported by the monitoring requirements outlined in Appendix 8.4. After June 30, 2019 (or 12 months after completion of construction), the average monthly effluent concentrations may not exceed 8 mg TN/L between April 1 and October 31.

5.1.2.3 Squamscott River Monitoring Program

Receiving water monitoring in the Squamscott River (the estuarine portion of the Squamscott-Exeter River system) will document progress required under the Exeter AOC and provide support for adaptive management objectives. The AOC requires the permitee to evaluate and document, with monitoring and administrative tracking, progress towards meeting nitrogen load allocations and attaining water quality goals for aquatic life use support in the estuary, including areas in Great Bay. All source reduction must be documented by monitoring at key locations that will demonstrate the success of collective point, stormwater and nonpoint source management measures (e.g. WWTF upgrade, stormwater control, septic upgrades, buffer implementation etc.). Water quality will also be monitored in the tidal Squamscott and downstream into Great Bay using field chemistry for conventional parameters (e.g., temperature, dissolved oxygen, salinity) and bench chemistry analyses for chemical analytes including nutrients. The AOC further requires that ecological indicators be monitored to assure that progress towards attaining the relevant designated use goal of aquatic life use support is made. Among the indicators required by the AOC are nutrient concentrations, chlorphyll-*a*, macroalgae, and dissolved oxygen but as part of the WISE project the use of other indicators of nutrient enrichment are being considered, and one (attached algae) was tested over the past year.

Project investigators conducted monitoring of the Squamscott-Exeter River for nutrients on two occasions during the summer of 2014 and piloted monitoring studies of attached algae (periphyton) and macroalgae (seaweeds) as potential ecological indicators of nutrient enrichment. Nine stations were established on the main stem and tributaries; six were in the freshwater portions of the Exeter River basin (Haigh Road to Exeter) and the remaining three were in the tidal Squamscott River (below Great Dam to the Squamscott River Railroad Bridge (Appendix 8.4). Additional stations were paired with GBNERR System-Wide Monitoring Program (SWMP) stations including the mouths of the Oyster and Lamprey Rivers and central Great Bay and two comparison stations were set in the Lamprey River at Wiswall Dam and Packers Falls.

The initial sampling results show a general increase in TN in the downstream sections of the river, and increasing downstream load in both tidal and non-tidal waters. These results are consistent with model loads, and are discussed in more detail in the Appendix. Recommended sampling locations, methods and costs are described in detail in the monitoring Appendix, and summarized here.

<u>Focus Area I. Squamscott River</u> involves both monthly grab sampling and long-term installation of a datasonde in the Squamscott River. The recommended location is at the Route 101 bridge, just downstream of the WWTF. Previous monitoring at this location found high levels of chlorophyll-a, and fluctuating oxygen levels, apparently related to effluent discharge from the plant (Hydroqual, 2012). Monitoring here will establish the pre-upgrade baseline and document the anticipated improvements in water quality associated with upgrades to the facility. Monitoring at this location provides crucial information about the impact of the existing facility on the tidal river.

Focus Area II. Exeter/Squamscott Watershed requires measurements at selected locations within the watershed to meet management objectives. These objectives include tracking progress, as required in the AOC permit, but watershed scale improvements are unlikely to be detected in time frames of less than several years, and possibly decades. More immediate objectives are to quantify loads into the system, and identify opportunities for targeted management measures. Potential monitoring locations are listed in Table 4. These locations were selected by the Project team, including municipal representatives, to meet permit requirements, or to answer specific management questions. Several of the identified sites are currently sampled under the VRAP program. VRAP sampling does not always include nutrients, but could be augmented for inclusion in this program.

Focus Area III. Great Bay monitoring measures the overall trends in water quality and ecosystems in Great Bay. Great Bay monitoring has been conducted over the past several decades by several agencies including NH DES, PREP, GBNERR and UNH. However, this monitoring program was designed to provide data for research and assessment of the estuarine system: the existing regional monitoring program was not intended to guide management decisions. As the region moves forward with costly wastewater and non-point source control measures, a deeper understanding of the ecosystem stressors and interactions will guide effective measures that lead to tangible improvements in water quality, and ultimately, to removal of the impairment listing. The sampling methods and locations include nitrogen, dissolved oxygen, marcoalgae and eelgrass. The exact methods and locations will depend on the number of partners and funding available to the monitoring collaborative.

5.1.3 Ecosystem Indicators

Ecological indicators add value, and more certainty of outcome, to water management strategies. Just as the bathroom scale shows that meeting caloric intake targets of a diet has had the desired effect, ecological indicators show that nutrient reductions have the desired ecosystem response. Further, monitoring of living indicators along with a related suite of chemical and physical attributes can:

- Identify emerging habitat and water quality impairments.
- Grow understanding of physical, chemical and biological processes to link cause and effect and support more targeted and effective management.
- Identify ways to protect and restore vital ecosystem services that proactively allow and demonstrate that communities are meeting legal environmental obligations and all incumbent social and economic benefits.
- Identify the potential for restoration so reasonable and effective management targets and strategies can be constructed.

For trend-tracking purposes, and assessment of progress towards attaining designated use support, ecosystem indicators, especially biological indicators provide many advantages, especially as an integrator of all stressors that affect ecosystem health. The data will also inform adaptive management approaches that can home in on adjusted targets that reflect the measured response, and progress, from cumulative implementation activities.

As noted above, the WISE project funded a pilot program to help develop an ecological indicator that addresses a central question of the link between nutrients and water quality in the Region:

The relationship between nutrient, loads concentrations and algae growth. The project team sampled algae abundance and species, in conjunction with nutrient and water quality parameters at locations within the watershed and Great Bay to evaluate a broad ecological indicator under a range of conditions. Methods and water quality results are detailed in Appendix (Monitoring), Although taxonomic results were not finalized in time for inclusion in this report, preliminary chemical indicator data show promise that attached algae are a sensitive indicator of nutrient loading that can provide that elusive link between sources and effects that will support adaptive management and the most effective outcomes for Great Bay at the lowest cost.

5.2 Tracking and Accounting

The Towns are currently or will be soon required to document pollutant load reductions to Great Bay to record progress towards achieving water quality goals. Specific detailed requirements are listed in the AOC and the draft NH MS4. An essential element of this will be developing a system for tracking progress for nutrient control strategies for point-source and non-point source parameters. A second essential element is the accounting for total nitrogen reduction based on the tracking measures.

Tracking and accounting by town staff should be guided by the recommendations of source areas targeted for stormwater management in Table 4-15. Specific land use area targets, nutrient control measures, and capture depth are recommended.

For this to occur there is a need to identify a uniform approach to calculating and crediting reductions associated with the various control strategies. The tracking tools and accounting metrics provided in will provide the Towns with a consistent, watershed-wide method to account for both the existing gray and green infrastructure in place in their communities and provide a process to add new treatment infrastructure and changes of land use. These communities are actively participating in PTAPP for this purpose which should assist in developing strategies to efficiently and effectively address their permit requirements and leverage these existing efforts by the end of 2015.

5.2.1 Relevant Activities for Tracking and Accounting

A number of tracking and accounting resources have been developed for the WISE communities to assist with MS4 and AOC requirements.

- Appendix 8.6 Checklist for NPDES Permit No. NH0100871, Administrative Order on Consent Docket No. 13-010.
- Appendix 8.7 Checklist for 2013 Draft NH Small MS4 General Permit Requirements.

EPA has provided guidance to communities on expected activities for tracking and accounting which are summarized below.

1. Property Use Information
    a. Existing Use
    b. Proposed Use
    c. Is the existing land use being converted to another type of land uses
    d. % of current Land use being converted to another type of land use
    e. Parcel Area (acres)
    f. Existing Total Impervious Cover (acres)
    g. Existing Total Disconnected Impervious Area (acres)
    h. Proposed Total Impervious Area (acres)
    i. Proposed Total Disconnected or Treated Impervious Area (acres)

2. Environmental Sensitivity
    a. Is the property in the Shoreland Protection District?

b. Name of Receiving Water(s) where stormwater runoff from the property discharges too
c. Distance from Receiving Water (feet)
d. Buffer Size
e. Public or Private waste water. Does the property have a septic system ?
f. Percent runoff to outfall

3. Septic System Information (if applicable)

   a. Septic System Type
   b. Septic System Size (gallons)
   c. New or Replacement
   d. Date of Installation
   e. Distance of septic system from closest down-gradient or cross-gradient water body
   f. Name of closest down-gradient or cross-gradient water body
   g. Maintenance Requirements
   h. Maintenance Schedule

4. Proposed BMP Information - Treatment for Nitrogen

   a. Calculated Annual Nitrogen Load for entire Parcel (lbs N/year)
   b. Calculated Annual Nitrogen Load to BMP (lbs N/year)
   c. Best Management Practices Type
   d. Assumed BMP Efficiency (% Removal Efficiency)
   e. Calculated Annual Nitrogen Load Reduction (lbs N/year)
   f. Operations and Maintenance Plan
   g. Suggested Maintenance Schedule

Non-structural strategies may include fertilizer controls, street sweeping efforts and good housekeeping measures.

5.2.2 Recommendations for Tracking and Accounting Procedure

A number of possible systems could be developed to facilitate municipal tracking and accounting. The systems range from simple paper-based approaches that would involve less up front resources but would require more time to assemble the necessary reporting information. More complex electronic web-based or database systems would require greater upfront resources but would be capable of generating reports and compiling the necessary accounting elements with greater ease.

5.2.2.1 Paper Based Tracking and Accounting

The simplest approach for tracking and accounting would be to revise the stormwater regulations for the towns and include a requirement for submission of a checklist that would include the vast majority of the tracking elements. The project applicant would have all of the requisite information for *Property Use, Environmental Sensitivity, and Septic System Information.* The applicants engineers would have most of the *Proposed BMP Information and Treatment for Nitrogen.* The nitrogen load and volume reduction calculations can be developed independently or by use of the BMP Performance Curves (Appendix 8.3) The checklist information statistics would then need to be recorded and compiled for annual reporting.

5.2.2.2 Web- Based or Electronic Tracking and Accounting

A more sophisticated approach would be the use of a webbased tracking and accounting system that would require an applicant to submit the requisite items through a webportal. The data would be marked as provisional data until reviewed and approved by municipal staff, presumably in relation to planning board approval of a given project. The webbased system could be built on a database that would be developed to generate reports and statistics for the tracking elements which would in turn be used in annual reporting.

6. RECOMMENDATIONS FOR A PATH FORWARD

The IP has developed the framework for both a Nitrogen Control Plan that could meet the requirements for the AOC as well as including stormwater and nonpoint source management as required by the pending MS4 permit (MM5). Certain additional steps are required for the IP to fully satisfy those two permit elements. Those items are detailed below and include 1) a financial capability analysis to determine the rate at which improvements can be made, 2) a detailed implementation plan with specific details as to location and timing of nitrogen control practices. Once the IP contains these final elements, and is reviewed and approved by EPA, the following items are recommended.

Specific items that should be included in a future comprehensive plan include:

- Wide public input. While the WISE project incorporates extensive input and engagement from municipal officials, and will provide information and tools which should be incorporated into a broader public process, direct public engagement is not part of the project. A community forum is recommend to be held at the end of the project to present the outputs, and initiate a broader public discussion.
- Discussion and planning for long term funding. Sustainable funding is a crucial component of a long term implementation plan.

6.1 Credit Trading

6.1.1 Overview

Nitrogen trading has great potential and has been discussed by resource managers for many years. Some of the greatest potential exists for the preservation of undeveloped areas and protection of riparian buffers to prevent future increases in nitrogen load in the unregulated communities. For nitrogen trading to be an effective mechanism to meet permit requirements and broader water quality goals by drawing in unregulated sources, several guiding principles drawn from the EPA trading policy should be considered (Willamette Partnership, The Freshwater Trust, 2014). Trading should:

1. More effectively accomplish regulatory and environmental goals
2. Be based on sound science
3. Provide sufficient accountability that water quality improvements are delivered
4. Not produce localized water quality problems
5. Be consistent with the CWA regulatory framework

But the challenges of the local setting, which must be amendable to market mechanisms while capably navigating regulatory requirements, should not be underestimated. Stacey (in press) identified eight conditions that were essential to the successful point-to-point source trading program framework in Connecticut:

1. All participating sources must contribute to a common water quality problem
2. The pollutant reduction target (WLA) must be attainable
3. Compelling member benefits from trading, especially economic, must exist
4. Sources must be easily quantified and tracked
5. Credit costs must be based on established and agreed upon protocols
6. Credit costs among participating sources, equalized by trading ratios if appropriate, must be diverse enough to create viable supply and demand conditions
7. Overall implementation cost must be reduced
8. Transaction, administrative and operational costs, including monitoring and tracking, must be low relative to credit prices

The lack of successful trading programs illustrates the policy, legal, and logistical challenges that come to bear. As pointed out by Stephenson et al. (2010), if the market isn't predisposed and robust enough to balance supply and demand and stay under a cap (e.g., a TMDL target or permit limit), the program may shift to an offset program for new growth and will not be able to sustainably remain under a regulatory cap or limit.

6.1.2 Potential Programs in the Exeter-Squamscott Watershed

For trading to move forward in the Squamscott-Exeter watershed, a more detailed assessment would be a first step towards developing a framework, and determining potential success of a program. Based on this study, management actions will need to be devised to meet suggested nitrogen loading targets, which appears to be uncertain for dissolved oxygen and may be out-of-reach for eelgrass. A viable trading market would be challenging on a three municipality basis because demand seems to far outweigh potential supply. However, if the trading geography is expanded to the entire watershed, there would be more, and perhaps better, opportunities for trading that might prove economically beneficial. Because nutrient management by nature is so difficult and costly to begin with, there may also be some potential for thinking more holistically at the value added from environmental benefits for a wider suite of ecosystem services and environmental outcomes. In trading, this process, known as “credit stacking”, more than one credit may be derived for a management action because of the value attributed to co-benefits of that action. For example, in addition to removing nitrogen, some practices may sequester carbon, protect endangered species habitat, remove phosphorus and sediments, provide for flood protection, and have recreational or aesthetic value, thus producing marketable benefits. Credit stacking is still a controversial concept that some call “double-dipping”, and the premise of creating ecosystem service value when nitrogen reductions are not met, for example, may be subject to legal challenges. However, opportunities for injecting additional cash flow into a nitrogen trading program derived from these other benefits should not be ignored in the pricing and marginal cost assessments.

6.2 Climate Change, Adaptation Planning and Community Resiliency

Climate change has already and is expected to have significant impacts on infrastructure, natural resources, cultural resources, and social issues in our seacoast region over the next century. Sea level has been rising for decades and is expected to continue to rise well beyond the end of the 21st century. Rising seas pose significant risks to coastal communities, ecosystems, utilities, and roadways. The New Hampshire coast is subjected to both nor’easters and hurricanes. The winds from nor’easters and hurricanes drives ocean water to the land resulting in a short-term rise in water levels called storm surge. Storm surge adds to the impacts of SLR and can cause catastrophic impacts if they occur during a high tide. Over the last 100 years mean annual precipitation in the Northeast has increased by about 5 inches or more than 10%. During this period the region also experienced a greater than 50 % increase in the annual amount of precipitation from storms classified as extreme events. Projected increases in annual precipitation could be as high as 20 % in the period 2071-2099 compared to 1970-1999. In general, total annual precipitation is expected to increase as are extreme precipitation events. Climate-related increases in precipitation, as well as sea level rise and storm surge, are increasing stress on already overburdened stormwater and wastewater infrastructure. These climate stressors should be taken into consideration in integrated planning.

Climate resilience means building the ability of a community to "bounce back" after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts after they occur. A community that is prepared will have a greater ability to rebound quickly from weather and climate-related events. The ability to rebound can reduce negative human health, environmental, and economic impacts. Because all communities are going to face hazards, resilience is important. Resilience is our ability to prevent a short-term hazard event from turning into a long-term community-wide disaster. While most communities effectively prepare themselves to respond to emergency situations, many are not adequately prepared to recover in the aftermath.

There are many tools that municipalities can utilize to build resilience and deal with climate related stressors. The use of Green Infrastructure (GI) is one, and it provides multiple benefits. GI methods not only help resolve water quality issues but they also can build resilience by mimicking natural processes. Using GI to control stormwater will benefit communities in many ways. Existing stormwater management systems designed to control runoff and protect life and property are not always able to handle extreme precipitation events. Better water resource management will reduce infrastructure costs and help to alleviate flooding. Treating and reducing runoff will protect water quality, which for many communities is a required action under the new MS4 permit.

There are many resources that municipalities can use to help develop integrated plans that include resilience components. New Hampshire has state and federal agencies, as well as numerous other organizations and collaborations that offer outreach and education, or technical assistance on resilience building and climate adaptation. NHDES, the EPA through the regional office as well as the local National Estuary Program PREP, NOAA through Sea Grant and the GBNERR, the University of New Hampshire through multiple programs such as UNH Stormwater Center and Cooperative Extension, and the New Hampshire Coastal Adaptation Workgroup which is a local collaboration of over 20 agencies and organizations that help municipalities prepare for and adapt to climate change, all are available local resources.

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