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Technical Appendix

Water Infrastructure

Local Solutions for the Strafford Region

Adopted January 2015

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Strafford
REGIONAL PLANNING COMMISSION

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Introduction

Purpose

The Water Infrastructure chapter examines how investments in drinking water, wastewater, and stormwater systems support the sustainability of our communities and how such investments align with municipal and regional goals.

This chapter includes goals and implementation strategies that encourage municipalities to evaluate their water infrastructure needs and develop local and regional measures for management and protection of common water resources. The goals, principles, and standards developed within this chapter provide information to communities, which will enable them to address their water infrastructure vulnerabilities and incorporate local protection measures in their master plans and municipal codes.

Not all policy and implementation strategies will be applicable to all, and it is recommended that each municipality review and adapt those that are relevant to local conditions. Certain strategies can be tailored and made more specific to meet local needs.

Vision

The Strafford region seeks to protect and maintain resilient drinking water, stormwater, and wastewater systems and facilities, through investment and operations, for the public health and safety needs of a growing population. The region supports the protection of the important natural, cultural, and recreational resources that define the Great Bay coastal watershed.

Executive Summary & Existing Conditions

The Water Infrastructure appendix provides municipalities and local decision-makers with the best available information on ground and surface water resources and water infrastructure systems in the region to help prioritize critical future investments the region depends on.

Maintaining the integrity of the region's hydrologic system, which includes rivers, lakes, ponds, aquifers, and Great Bay Estuary, is vital to maintaining a high quality of life for people that live, work, and play in the region, as well as crucial to supporting the health of natural habitats. Water resources are protected through a combination of federal and state regulations, local policies, best management practices, and outreach and education. Both point and non-point source pollution contaminate the region's water resources. Nitrogen loading in the Great Bay Estuary is a particular concern. There are 30 facilities that discharge directly into waters in the region. Ten communities have small Municipal Separate Storm Sewer Systems (MS4) and have permits to implement management programs and practices to control polluted stormwater runoff.

Both surface and ground water sources supply the region's public drinking water system (PDWS). Approximately 65% of residents within the region are served by PWSs and 35% use private, household drilled or dug wells. There are five large drinking water treatment plants in the region. All PDWSs are required to comply with drinking water standards, water quality monitoring and reporting requirements, and operational and construction standards. Drinking water demand is expected to increase by 11% from 2005 to 2030. Within the region, there are approximately 58,880 acres of stratified-drift aquifer. Twenty-two percent of the acres available with very high yield wells are protected.

Approximately one-third of homes in the region are connected to the eight municipal wastewater systems in the region. These facilities discharge directly into rivers flowing into the Great Bay. Complying with new federal permit requirements to reduce nitrogen in Great Bay, replacing aging infrastructure, and meeting future demand are among the management needs and upgrades communities face. The average flow capacity used at Waste Water Treatment Facilities in the region is 63%, ranging from 36% in Durham to 90% in Milton. There are a total of 6.4 million gallons per day of flow capacity available for growth at the eight facilities in the region. Two-thirds of the region is served by private septic systems. Proper maintenance of septic systems is important for reducing water quality impairment.

Dams provide a number of uses and benefits in the region. Approximately 300 of the dams in the region are active dams, which are classified according to the extent of damage that would be imposed on developed areas downstream and within the potential inundated area should the dam fail. Most dams are classified as non-menacing structures. Eleven dams are classified as high hazard dams.

Communities should utilize the recommendations and implementation strategies in each key water infrastructure planning area when evaluating their water infrastructure demands. The objective of this document is to provide municipalities with information that addresses short and long term water infrastructure challenges and so that they can incorporate local protection measures in their master plans and municipal codes. This information should be used to support integrated and conforming management of water infrastructure.

Protecting Water Resources

Background

The Strafford Region is located in the Piscataqua region watershed. Rivers in the region drain into the Great Bay estuary and ultimately flow into the Atlantic Ocean. Estuaries, water bodies with at least one opening into the ocean, are prime habitats for a diverse range of plants and animal species. These coastal areas contain a mix of salt and fresh water, which combine to create a unique but fragile habitat for a wide array of wildlife. The Great Bay estuary is part of the National Estuary Program, recognized as an area in need of protection from manmade and natural pollutants because of its unique nature.[1]

Pollutants can enter waters from a variety of pathways. According to the EPA National Pollution Discharge Elimination System (NPDES), the term pollutant includes substances found in industrial, municipal, and certain types of agricultural waste discharged into water. For regulatory purposes, pollutants have been grouped into three general categories: *conventional*, *toxic*, and *non-conventional*:

- There are five conventional pollutants: biochemical oxygen demand (BOD), total suspended solids (TSS), pH, fecal coliform, and oil and grease (defined in 40 Code of Federal Regulations 401.16).
- Toxic pollutants are those defined in Section 307(a) (1) of the Clean Water Act and include metals and manmade organic compounds.
- Non-conventional pollutants are those which do not fall under either of the above categories, and include such parameters as ammonia, nitrogen, phosphorus, chemical oxygen demand, and whole effluent toxicity.[2]

These sources are generally categorized as either point sources or non-point sources.

Point Source Pollution

Point sources pollution is any single identifiable source of pollution from which pollutants are discharges.[3] Typical point source discharges include discharges from publicly owned treatment works (POTWs), discharges from industrial facilities, and stormwater discharges associated with industrial activity, construction and urban runoff. Under the NPDES Program, all facilities that discharge pollutants from any point source into waters of the United States must obtain a NPDES permit.

These waters include navigable waters and their tributaries, interstate waters, and intrastate lakes, rivers, and streams. The definition has been interpreted to include virtually all surface waters in the United States, including wetlands and intermittent streams. It is important to note that, in general, groundwater is not considered a water of the United States; therefore, discharges to groundwater are not subject to NPDES requirements.[4]

Wastewater Treatment Facilities

Wastewater treatment facilities discharge treated wastewater through pipes into rivers which flow into the Great Bay estuary. In the Strafford Region there are eight wastewater treatment facilities which release treated wastewater into nearby rivers. These treatment facilities outputs' are a major factor in nutrient loading in the Great Bay estuary which has led to decreased water quality and habitat loss.

For more information, refer to the Wastewater Infrastructure section.

Inventory of Point Sources

The table below contains a listing of the facilities discharging into waters in the region. Results are based on data extracted on July 19, 2014 from the modernized data system, Integrated Compliance Information System (ICIS), which reports data directly to the EPA.

Table 1: Facilities discharging under the NPDES Program.

Municipality	Water Body	Facility Name	Location	Environmental Interest Type	NPDES ID	Date of Issuance	Date of Expiration
*Dover	Piscataqua River	Huckleberry Hill Wastewater Treatment Plant	484 Middle Road	ICIS-NPDES Major	NH0101311	08/03/2006	09/30/2011
Dover	Bellamy River	Water Treatment Plant	Lowell Avenue	ICIS-NPDES Non-Major	NHG640003	02/21/2001	11/30/2005
Dover	Bellamy River	Pruven Aggregates	349 Mast Road	ICIS-NPDES Non-Major	NHR05A617	10/30/2000	10/29/2005
Dover	Bellamy River	Shell/Motiva Enterprises	46 Central Ave	ICIS-NPDES Non-Major	NHG910025	12/04/2008	09/09/2010
Durham	Oyster River	Wastewater Treatment Plant	50 Piscataqua Road	ICIS-NPDES Major	NH0100455	12/15/1999	01/29/2005
Durham	Oyster River	Dover Road Pump Station	50 Piscataqua Road	ICIS-NPDES Non-Major	NHG070041	08/06/2010	09/30/2013
Durham	Oyster River	Goss International	121 International Drive	ICIS-NPDES Minor	NHR05BM58	4/16/2010	n/a
Farmington	Cocheco River	Wastewater Treatment Plant	14 Baldwin Way	ICIS-NPDES Major	NH0100854	04/17/2007	06/30/2012
Milton	Salmon Falls	Wastewater Treatment Plant	White Mountain Highway	ICIS-NPDES Non-Major	NH0100676	08/03/2000	8/31/2005
New Durham	Merrymeeting River	Powder Mill State Fish Hatchery	288 Merrymeeting Road	ICIS-NPDES Non-Major	NH0000710	12/22/2011	12/31/2016
Newmarket	Lamprey River	Water Pollution Control Facility	95 Young Lane	ICIS-NPDES Major	NH0100196	11/16/2012	1/31/2018
Newmarket	Lamprey River	Water Treatment Facility	54 Packers Falls Road	ICIS-NPDES Non-Major	NHG640007	7/29/2010	9/30/2014
Northwood	North River	Motiva Enterprises Shell Station	137 First NH Turnpike	ICIS-NPDES Non-Major	NHG910043	09/09/2005	08/31/2010
Northwood	North River	No Limits Convenience Store	546 First NH Turnpike	ICIS-NPDES Non-Major	NHG910021	09/22/2006	09/09/2010
Rochester	Cocheco River	Wastewater Treatment Plant	175 Pickering Road	ICIS-NPDES Major	NH0100668	07/23/1997	6/30/2002
Rochester	Cocheco River	Turnkey Recycling and Environmental Enterprise	90 Rochester Neck Road	ICIS-NPDES Non-Major	NHL000001	02/08/1996	03/06/2000
Rochester	Cocheco River	Brox Industries	253 Old Rochester Neck Road	ICIS-NPDES Non-Major	NHR05A455	10/30/2000	10/29/2005
Rollinsford	Salmon Falls	Wastewater Treatment Plant	5 Lower Mill Road	ICIS-NPDES Non-Major	NH0100251	08/25/2000	08/31/2005
Rollinsford	Salmon Falls	Rollinsford Hydroelectric Project	Front Street	ICIS-NPDES Non-Major	NHG360030	09/27/2012	12/31/2014
Somersworth	Salmon Falls	Wastewater Treatment Plant	99 Buffumsville Road	ICIS-NPDES Non-Major	NH0100277	09/29/2000	10/31/2005
Somersworth	Salmon Falls	Somersworth Hydroelectric Project	82 Buffumsville Road	ICIS-NPDES Non-Major	NHG360028	09/27/2012	12/31/2014
Somersworth	Salmon Falls	General Electric Energy	130 Main Street	ICIS-NPDES Non-Major	NHG910055	10/01/2011	09/09/2015

*Communities that have draft NPDES Permits.

[Source: NPDES Permits in New England]

National Pollutant Discharge Elimination System Water Permit Program in New England

As part of the NPDES program, all municipal, industrial and commercial facilities that discharge wastewater directly from a point source into a receiving waterbody are issued an NPDES permit. Facilities that discharge wastewater to a publicly owned treatment works (POTW), which in turn discharges into the receiving waterbody, are not subject to NPDES permits; rather they are controlled by the national pretreatment program.

The state or federal agencies that issue permits determine the volume of effluent that can be discharged from a given facility and set limits in the permit to ensure that water quality is not compromised. In the State of New Hampshire, the Environmental Protection Agency issues permits. The permits expire after five years.

National Pollutant Discharge Elimination System Requirements [NPDES – Phase 1]

Phase I of the U.S. Environmental Protection Agency's (EPA) stormwater program was created in 1990 under the Clean Water Act. Phase I relies on National Pollutant Discharge Elimination System (NPDES) permit coverage to address stormwater runoff from: (1) "large" and "medium" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or greater, (2) construction activity disturbing 5 acres of land or greater, and (3) ten categories of industrial activity.

In New Hampshire there are no large or medium MS4 permits. The EPA New England regulates the following permits:

- City of Worcester
- Boston Water & Sewer Commission (BWSC)

New Hampshire communities are subject to the provisions pertaining to operators of small MS4s, who are covered by the NPDES – Phase II (will be discussed further in a subsequent chapter).

Non-Point Source Pollution

Non-point source pollution is the contamination of surface or groundwater supplies originating from land use activities and/or through atmospheric deposition, having no well-defined point of entry. These pollutants include:[5]

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff and energy production;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks;
- Salt from irrigation practices;
- Chloride and other ions from residential water softening treatment backwash brine in unsewered areas;
- Acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems;

Because it is the depository for pollution in the Strafford region, Great Bay suffers from the effects of nitrogen loading. From 2009-2011, 1,225 tons of total nitrogen were deposited into the estuary each year. Approximately 48% of the nitrogen entering the bay was dissolved inorganic nitrogen. Overall, 68% of the nitrogen loading originated from nonpoint sources, and the remaining 32% resulted from sewer treatment plants. Nonpoint sources caused 48% of these contaminants, 52% from sewer treatment plants.[6] From 1982 to 2010 the concentrations of dissolved inorganic nitrogen increased by 44%. In the five years from 2005-2010, the total nitrogen load into the Great Bay increased by 42%.[7]

The high nitrogen levels in the Great Bay negatively impact the region through the loss of wildlife habitat, closure of shellfish beds, and the decline of water quality in the estuary. The damaging effects of pollution are evidenced by decreased water clarity due to excess algae and phytoplankton. Consequentially there has been a disappearance of the eelgrass habitat from Little Bay, the Piscataqua River, and tidal rivers. Toxic contaminants in sediments and in the tissues of shellfish as well as the depressed oyster and clam populations have also been a concern in the region.[8]
According to the State of Our Estuaries Report 2013, there are two primary ways that nitrogen enters the Great Bay:

- Fertilizers from lawns and farms, septic systems, animal wastes, and air pollution from the whole watershed are carried into the bay through rain and snowmelt runoff, river flow, and groundwater flow.
- Municipal wastewater treatment facilities that discharge treated wastewater out through pipes either into the bay or into rivers that flow into the bay.

Why is Nitrogen Important?

Nutrients, such as nitrogen, are essential for plant and animal development in our estuaries. However, high levels of nitrogen may cause significant problems such as overstimulation of growth of aquatic plants and algae. This excessive growth can lead to clogged water intakes, deprive fish species the necessary oxygen needed to survive, and can also block light into deeper waters, which can lead to the loss of eel grass meadows and other important habitats.

The Report notes these major contributors are related to population growth and associated building and development patterns. At this time the Great Bay Estuary exhibits many of the classic symptoms of too much nitrogen: low dissolved oxygen in tidal rivers, increased macro-algae growth, and declining eelgrass. While the specific links between nitrogen loading and the issues seen in the Great Bay are not fully understood, it is widely agreed that the goal should be a reduction in nitrogen loads to the estuary and the ocean so that adverse, nutrient-related effects do not occur. Additional data collection and research will be needed to better understand where the most effective reductions can be achieved.

The *State of Our Estuaries Report* calculates that the non-point sources (2009-2011) are accounting for approximately 68% (835 tons/yr) of the nitrogen entering the system and only 32% (390 ton/yr) from wastewater treatment facilities. A summary of the total nitrogen loads to the Great Bay Estuary can be found in Table 2.

Table 2: Summary of Nitrogen Loads to the Great Bay Estuary (2009-2011)

Source	Delivered Load (tons/yr.)	Delivered Load (%)
Non-Point Sources	835	68%
Wastewater Treatment Facilities	390	32%
*TOTAL	1,225	100%
*Nitrogen loads to the Great Bay Estuary from Different Sources in 2009-2011		

[Source: PREP – 2013]

While it is easier to monitor and analyze the amount of total nitrogen discharged from wastewater treatment facilities, determining how much nitrogen each non-point source type contributes to the estuary is much more difficult.

Calculating Nitrogen

The Great Bay Nitrogen Non-Point Source Study has customized a Nitrogen Loading Model (NLM) to track nitrogen inputs from atmospheric deposition, chemical fertilizers, human waste being discharged through septic systems, animal waste, and also incorporate a stormwater/surface water transport pathway. According this study, local data on atmospheric deposition rates, septic systems, and recreational fields were developed as inputs to the model. The model output was found to match field measurements of non-point source nitrogen loads from eight watersheds within the relatively small model uncertainty of +/-13%.

For the watershed draining to the Great Bay Estuary, the model predicted a non-point source nitrogen load of 900 tons per year (+/-100 tons/yr). This estimate corresponds well with the most recent field measurement of non-point source load (835 tons/yr), referenced in PREP's 2013 State of Our Estuaries Report. The breakdown of nitrogen non-point sources from the model of delivered loads to the estuary is summarized in the following table.

Table 3: Summary of Non-Point Source Nitrogen Loads to the Great Bay Estuary

Non-Point Source	Delivered Load (tons/yr)	Delivered Load (%)	Comments
Atmospheric Deposition	280 +/- 40	33%	Out-of-state sources account for 63% of this source
Human Waste	240 +/- 30	27%	This load is exclusively from septic systems because loads from wastewater treatment facilities were not considered in this study. The nitrogen load to the estuary from wastewater treatment facilities was 390 tons/yr in 2009-2011 (State of Our Estuaries, 2013). The combined contribution of nitrogen from human waste is 240 + 390, or 630 tons/yr.
Chemical Fertilizer	230 +/-30	27%	Lawns and agricultural areas each contributed 48% of this load. Recreational fields were responsible for 4%.
Animal Waste	110 +/- 10	13%	Livestock accounted for 80% of this load. Only a small fraction of the load was from pet waste.
Non-Point Source Load Delivered by Stormwater = 26%			

[Data Source: Great Bay Nitrogen Non-Point Source Study. May, 2013]

The model predicts that stormwater delivers 26% of the non-point source nitrogen to the estuary. Stormwater is a transport pathway for nitrogen applied to lawns, agricultural lands, and urban lands. Urban stormwater runoff, runoff from agricultural lands, and runoff from lawns each account for approximately one-third of the nitrogen in stormwater.

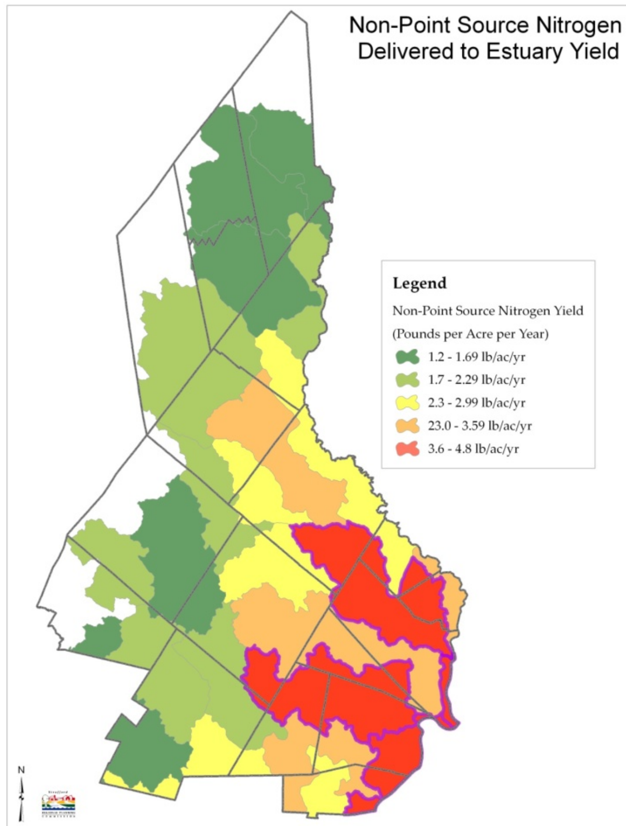
As a way to identify potential "hot spot" areas, the yield of non-point source nitrogen from each small HUC12 watershed was calculated. The yield is the number of pounds of non-point source nitrogen delivered from the subwatershed to the estuary divided by the area of the subwatershed. For the entire Piscataqua Region study area, the top twenty percent of subwatersheds had delivered non-point source yields between 3.6 and 4.8 lb/ac/yr.

In the region, there were 5 HUC12 subwatersheds with yields in this highest category.

- Great Bay Drainage (HUC# 010600030902)
- Lower Cocheco River (HUC# 010600030608)
- Oyster River (HUC# 010600030902)
- Portsmouth Harbor (HUC# 010600031001)
- Squamscott River (HUC# 010600030805)

A map displaying the region's wastewater treatment facilities and non-point source nitrogen yield draining into Great Bay is shown in Figure 1.

Figure 1: Non-Point Source Nitrogen Yield for Subwatersheds in the Region



[Source: Great Bay Nitrogen Non-Point Source Study. DRAFT, 2013. NHDES.]

Figure 1 displays the nitrogen yield per subwatershed in the region as a result of non-point source causes. Nitrogen yield totals, measured in pounds per acre per year, are higher near the Seacoast than in further inland watersheds. Figure 1 shows a trend of nitrogen levels increasing as watersheds drain into one another flowing from inland sources to the estuary. Portsmouth Harbor, the Great Bay, the Lower Cocheco River, Squamscott River, and the Oyster River watersheds have the largest nitrogen yields in the region. High nitrogen totals near the Great Bat estuary threaten water quality and wildlife habitat in the estuary.

Nitrogen yields are related to the geography of the watershed, population, and development. The coastal watersheds, where the largest cities in the region are located, have the highest nitrogen yield. The Lower Cocheco River watershed spans Rochester, Somersworth, and Dover, which have the largest populations in the region, as well as the highest impervious surface levels. The Oyster River watershed and the Great Bay watershed include Durham which also has a high population and large impervious surface levels. Population density and impervious surface levels are drivers for the pollution which is carried by stormwater runoff into the waterways in the region.

Figure 1 indicates that more rural towns in the region, which are located farther inland, yield less nitrogen from non-point source pollution than the larger cities near the coast. Part of the explanation for the greater coastal levels is that nitrogen flow from the rural communities builds up near the seacoast. Nonpoint source pollution as a result of human waste from septic systems, chemical fertilizers, animal waste, and atmospheric deposition all are contributing factors to the high nitrogen levels flowing into the Great Bay estuary.

In summary, the NLM output for the watershed draining to the Great Bay Estuary provides useful information on non-point sources of nitrogen feeding the estuary. It is now clear that human waste from both septic systems and wastewater treatment facilities accounts for 51% of the total nitrogen load to the estuary. The second biggest source, atmospheric deposition, is largely due to out-of state sources but is declining due to improved emissions controls. Chemical fertilizers are the third biggest source. Fertilizer use on recreational fields and golf courses is a small contributor compared to fertilizer use on lawns and agricultural lands. Animal waste is the smallest source. The predicted load from animal waste is within the error of the model, especially for pet waste. Finally, the non-point source nitrogen yield was not constant across the whole watershed. Lands closer to the estuary contributed more nitrogen per unit area than lands farther away because of the larger populations and denser development.

National Pollutant Discharge Elimination System Requirements [NPDES-Phase 2]

The Stormwater Phase II program covers all small municipal separate storm sewer systems (MS4s) located within an urbanized area, through the use of NPDES permits to implement programs and practices to control polluted stormwater runoff.

An **urbanized area (UA)** is a densely settled core of census tracts and/or census blocks that have population of at least 50,000, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core. It is a calculation used by the Bureau of the Census to determine the geographic boundaries of the most heavily developed and dense urban areas.

In the region, operators of Phase II-designated small MS4s and small construction activity are required to apply for NPDES permit coverage, most likely under a general rather than individual permit, and to implement stormwater discharge management controls. Specific requirements for each type of discharge are listed below.[9]

<u>Small MS4s</u>

- A regulated small MS4 operator must develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from their MS4 to the “maximum extent practicable,” to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. The rule assumes the use of narrative, rather than numeric, effluent limitations requiring implementation of BMPs.

- The small MS4 stormwater management program must include the following six minimum control measures: public education and outreach; public participation/involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping.

- A regulated small MS4 operator must identify its selection of BMPs and measurable goals for each minimum measure in the permit application. The evaluation and assessment of those chosen BMPs and measurable goals must be included in periodic reports to the NPDES permitting authority.

Small Construction Activity

- The specific requirements for stormwater controls on small construction activity will be defined by the NPDES permitting authority on a State-by-State basis.

- Many NPDES permitting authorities have adapted their existing Phase I general permits for large construction activity for small construction activity. Where this has occurred, a stormwater pollution prevention plan is required for small construction activity.

NPDES Phase II Automatically Designated MS4 Areas in the Region

According to the 2010 Census, there are ten communities in the region who have designated MS4 areas within urbanized areas. Three of those communities have received a waiver. All communities are listed below:

Town of Barrington
Town Population – 8,576
Regulated Population – 159
Barrington has received a formal waiver granting the Town from the requirement to obtain coverage under a NPDES permit for the MS4 in their small urbanized area.

City of Dover
City Population – 29,987
Regulated Population – 29,869

Town of Durham
Town Population – 14,662
Regulated Population – 12,520

Town of Lee
Town Population – 4,330
Regulated Population – 24
Lee has received a formal waiver granting the Town from the requirement to obtain coverage under a NPDES permit for the MS4 in their small urbanized area.

Town of Madbury
Town Population – 1,771
Regulated Population – 289
Madbury has received a formal waiver granting the Town from the requirement to obtain coverage under a NPDES permit for the MS4 in their small urbanized area.

Town of Milton
Town Population – 4,591
Regulated Population – 1,527

Town of Newmarket
Town Population – 14,527
Regulated Population – 7,465

City of Rochester
City Population – 29,732
Regulated Population – 24,369

Town of Rollinsford
Town Population – 2,527
Regulated Population – 2,318

City of Somersworth
Town Population – 11,886
Regulated Population – 11,598

Additional Information & Resources

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Reference Documents & Websites

EPA's Stormwater Website

Stormwater Phase II Final Rule Fact Sheet Series

Urbanized Areas Maps

MS4 Webcasts

MS4 Program Evaluation Guidance

MS4 Permit Improvement Guide

Stormwater Case Studies

Stormwater Runoff

Stormwater is the primary source of non-point pollution and is generated by precipitation, surface runoff, and snow melt from land, pavement, building rooftops and other impervious surfaces. As the rain moves across the landscape it picks up and carries contaminants, which are finally deposited into lakes, rivers, wetlands, coastal waters, and underground sources of drinking water. When untreated, polluted stormwater enters bodies of water it can cause water quality impairments.

Stormwater pollution is one of the leading causes of water pollution nationally. Unlike pollution from industry or sewage treatment facilities, i.e., point source pollution, which is caused by a discrete number of sources that are easily identified, stormwater pollution is caused by the daily activities of people everywhere. Because of this, the responsibility of managing stormwater falls on everyone. New Hampshire, communities, businesses and property owners are experiencing the challenge of managing stormwater to protect the state's water resources while balancing the need for a healthy environment and for social and economic growth. Stormwater management is important to protect water quality and water resources throughout the region.[10]

Regulatory Programs

Phase II Federal Stormwater Regulations

Under the Clean Water Act the US Environmental Protection Agency regulates stormwater. Since the implementation of Phase II stormwater regulations in March 2003, municipalities and developers in NH have been subject to additional and evolving stormwater requirements.

- Municipal Separate Storm Sewer System (MS4) - A Small MS4, located outside of urbanized areas, is defined as "a publicly owned conveyance or system of conveyances from ditches, curbs or underground pipes that divert stormwater into the surface waters of the state." (Stormwater, NH DES Website) A small MS4 operator is required to obtain a permit if the potential for significant water impairment exists. A small MS4 permit differs from a MS4 general permit which is required within urban areas. General MS4s call for the Notice-of-intent (NOI) which require general information about the MS4, such as location, owner and operator, and the surface water into which the MS4 discharges.[11]

- Multi-Sector General Permit (MSGP) - MSGPs require regulation of runoff from eleven categories of industrial activity. This includes:[12]
  - Light industrial activity
  - Construction
  - Treatment works
  - Transportation facilities
  - Steam electric plants
  - Recycling facilities
  - Landfills, hazardous waste, treatment, and disposal facilities
  - Mineral, metal, oil, and gas activities
  - Manufacturing
  - Facilities with effluent limitations

- Construction General Permit (CGP) - Construction activity that disturbs one or more acres of land requires a CGP. This includes clearing, grading, and excavating as well as other land disturbance activities.[13]

Surface waters that are impaired or threatened by pollution for one or more designated uses. Water quality impairment results in decreased recreational opportunities and can be harmful to human health and ecosystems.

Alteration of Terrain

- The New Hampshire Alteration of Terrain Bureau (AoT) issues permits protecting surface and ground water by managing stormwater runoff and soil erosion from developed areas. A permit from AoT is required whenever more than 100,000 square feet of contiguous terrain is proposed to be disturbed by construction. If the project is within protected shore land a permit is required for a proposed 50,000 square feet of disturbance, or if there is a 25 percent or higher grade within 50 feet of surface water. This permitting program applies to industrial, commercial, and residential developments as well as sand, gravel, and rock quarries.[14]

Stormwater Utilities

A stormwater utility generates funding through user fees typically based on the impervious surfaces (e.g., roofs, roads, driveways, parking lots) of each property within the stormwater utility district. Revenues generated from the user fees are placed in a dedicated fund to implement a stormwater program that directly supports maintenance and upgrades of existing storm drain systems, development of drainage plans, flood control measures, and, water quality programs that service the users.

Stormwater utilities are similar to the dedicated municipal funds for public water and sewer utilities. The funding from stormwater utilities can be used for catch basin cleaning, street sweeping, stormwater infrastructure upgrades, and a variety of other stormwater management activities, in addition to the administrative costs of running a stormwater program.

Municipal Stormwater Utility Feasibility Study: City of Dover, New Hampshire

In 2009, the City of Dover sought and obtained funding from the New Hampshire Department of Environmental Services (NHDES) Watershed Assistance Grants Program to evaluate the feasibility of developing a stormwater utility as a funding source for its municipal stormwater program. The Dover Stormwater Utility Feasibility Study was undertaken to evaluate the feasibility of establishing a municipal stormwater utility and to identify a preferred approach for funding the City's stormwater program.

During the development of the feasibility study a committee was formed, it met five times over a six month period and concluded in a final report to the City Council that a budget increase was necessary to adequately fund storm water operations and that establishing a utility would provide the most equitable and reliable funding method for the City of Dover. Many good things came out of the feasibility process. A citizen committee representing various stakeholder groups that would be affected by the outcome of the committee's recommendation was able to work cooperatively, and, despite concerns and misgiving, unanimously voted to support the formation of a storm water utility.

The committee report was presented to the City Council and public meetings were held to educate and inform the citizens. These meetings were well attended with concerned citizens who were strongly opposed to establishing the utility. Considering the overwhelming negative response at the public hearing, the Council voted down the formation of a storm water utility in Dover. The City Council felt that much was learned during the feasibility study process but that establishing a utility at that time in Dover was premature.

As a result of looking into the creation of a Stormwater Utility, the City has since created a Stormwater Division within the Community Services Department. As a result, costs associated with stormwater from the Highway/Streets Division were accounted for separately, allowing municipal staff to clearly identify the costs for maintaining their drainage system. See the Dover New Hampshire Stormwater Utility Feasibility Study Final Report for more information.

Stormwater Management

New Hampshire Stormwater Manual

The New Hampshire Stormwater Manual is intended as a planning tool for communities, developers, designers, and members of regulatory boards, commissions, and agencies involved in stormwater programs in New Hampshire. The Manual addresses measures to manage stormwater runoff through site design, pollutant source controls, structural Best Management Practices (including associated operation and maintenance measures), and construction-phase practices. These practices are expected to be applied to meet specific objectives under current state and federal regulatory programs. However, if any discrepancies are found between this manual and the New Hampshire Code of Administrative Rules for the programs discussed here, the Rules should be followed. The Manual is issued in three volumes:

Volume 1: Stormwater and Antidegradation: presents an overview of New Hampshire's stormwater program together with related federal program requirements; describes New Hampshire's "Antidegradation Provisions" with respect to controlling water quality impacts due to stormwater discharges; and provides an introduction to the non-structural and structural measures for managing stormwater.

Volume 2: Post-Construction Best Management Practices Selection and Design presents a detailed description of the structural Best Management Practices (BMPs) applicable for use in New Hampshire for the prevention, control, and treatment of stormwater. Volume 2 describes information applicable to the screening, selection, design, and application of particular post-construction BMPs.

Volume 3: Erosion and Sediment Controls During Construction provides a selection of practices applicable during the construction of projects, to prevent adverse impacts to water resources as a result of the land-disturbance activities typically associated with development and redevelopment projects.

State Revolving Fund Loans

The New Hampshire Department of Environmental Services under the Clean Water State Revolving Fund recently started accepting applications for stormwater and nonpoint source projects. Usually this program funds landfill closures and wastewater treatment but starting in 2010 it became available for nonpoint and stormwater projects. These are low interest loans, and principal forgiveness for a portion of the loan may be available to the applicant.[15]

Other General Stormwater References

Innovative Land Use Guide for Local Stormwater Model Ordinance - Communities are encouraged to adopt a local stormwater management ordinance instituting stormwater controls for projects of all sizes, and, during all phases of development. The model ordinance should satisfy EPA's requirements under Phase II of the National Pollutant Discharge and Elimination System (NPDES) for small municipal separate storm and sewer systems (MS4) to regulate land disturbances greater than one acre.

Guidelines and Standard Operating Procedures: Illicit Discharge Detection and Elimination and Pollution Prevention/Good Housekeeping for Stormwater Phase II Communities in New Hampshire - This Manual not only assists municipalities in meeting the Stormwater Phase II regulations, but encourages them to use targeted best management practices (BMPs) within the watershed with the long-term goal of consistent application by all regulated entities within the watershed. The manual of Guidelines and Standard Operating Procedures helps promote behavior that will improve the water quality of New Hampshire's lakes, ponds, streams, rivers, and estuaries.

Public Education, Resources, and Outreach Materials

The University of New Hampshire Stormwater Center a research, testing and educational facility serves as a technical resource for water managers, planners, and design engineers in New England and throughout the United States. The UNH Stormwater Center is dedicated to the protection of water resources through effective stormwater management. The primary functions of the center include: (i) research and development of stormwater treatment systems, (ii) delivery of resources to the stormwater management community currently challenged by the effective design and implementation of required stormwater management.

The Stormwater Center's field site is a unique technical resource for stormwater practitioners and is unlike any other stormwater research site in the country. The site is designed to allow direct, side-by-side comparison of different technologies. Satellite research sites are used to test several additional treatment technologies, including different types of porous pavements. To date, the research facility has collected detailed performance data on over 80 storms, and has evaluated over 30 different types of stormwater treatment systems.

The Center actively participates in the design and implementation of advanced stormwater management. The Center works with public and commercial partners in the design and install of Low Impact Development technologies. These activities include design, review, construction oversight, and guidance for long-term maintenance.

Best Management Practice

2011 Road Management Plan for Brackett and Pond Roads: Wakefield, NH

In 2010, the Acton Wakefield Watersheds Alliance was awarded a NHDES Watershed Assistance grant to partner with the UNH Stormwater Center to find solutions to the chronic drainage problems along Brackett and Pond roads and develop a road management plan.

The Road Management Plan addresses the declining water quality of Lovell Lake caused by runoff from Brackett and Pond Roads carrying sediment and phosphorus. Unimproved roads are commonplace in the Lakes Region of New Hampshire, an area with a substantial seasonal population.

A range of strategies exist to reduce impacts ranging from practical road maintenance techniques, to road and drainage improvements, and non-structural approaches (i.e. catch basin cleaning, vegetative stabilization) targeted to minimize erosion and sedimentation. This Road Management Plan (RMP) presented recommendations for Brackett and Pond Roads, and a review of locations identified to be primary problem areas. The locations were prioritized for cost and sediment load.

The approaches and techniques recommended in the RMP can be implemented by existing Town staff. Recommendations include additional equipment and labor demands, both available for purchase or hire. The equipment expenses range from minimal to the equivalent of a large service vehicle.

A generalized management approach for Brackett and Pond Roads is described below. At most sites, treatment strategies were very similar and consisted of: 1) establishing stable, adequately sized drainage, 2) with upstream sedimentation structures (i.e. hooded deep sump catch basins, gravel check dams), 3) installation of road crossings for surface runoff, 4) use of water quality controls post culvert that could filter, infiltrate and dissipate high velocity flows, and 5) stabilized conveyance to the lake.

Stormwater Management for Homeowners - Education of homeowners is important to reduce the effects of stormwater erosion and pollution. To lower a household's effect on the environment, homeowners can utilize these do-it-yourself home management practices.

Pet Waste Outreach Campaigns - Just like human sewage, untreated pet fecal matter is harmful to waterways. Rain washes dog waste and the associated disease-causing organisms, such as giardia and salmonella, into rivers, beaches and bays via storm drains. Enough bacteria make water unsafe for drinking and swimming and contributes to shellfish bed closures. These campaigns promote owner responsibility to prevent dog waste from washing into waterways.

Other Stormwater Fact Sheets

Federal Storm Water Permits

Best Management Practices (BMPs) for Groundwater Protection

Low Impact Development and Stormwater Management

Impervious Surfaces Impacts and Coverage Datasets

As the region continues to develop, the resulting increase of impervious surfaces within these urbanizing watersheds will pose significant threats to stream quality and the natural environment. Communities and local governments concerned with water resource protection will need to address the adverse impacts of increased stormwater runoff, reduced water quality, degraded aquatic habitats, and the weakened visual appeal of lakes, streams, and natural landscapes.

> Impervious surfaces are areas covered by material that impedes the infiltration of water into soil. Common examples of impervious surfaces are buildings, pavement, concrete, and severely compacted soils.

For the region to successfully manage growth, the effects of development on the environment must be widely understood. According to a public outreach and awareness brochure titled, "The Impacts of Impervious Surfaces on Water Resources", released in 2007 by the Piscataqua Region Estuaries Partnership (then known as the New Hampshire Estuaries Project)[i], there are four distinct ways that impervious surfaces can impact water resources:

- **Altering the Natural Flow of Water**: The addition of impervious surfaces, especially coupled with urban drainage systems (i.e. curbs, gutters, and storm drain pipes), alters the natural hydrology in a watershed by increasing the volume of stormwater runoff and reducing groundwater recharge. The result is more frequent flooding, higher flood peaks, lower base flow in streams, and lower water table levels.

- **Aquatic Habitat Loss**: Impervious surfaces and urban drainage systems add to the volume of stormwater during rain events and can reduce stream flow in dry weather. These hydrologic extremes can damage plant, fish, and invertebrate habitat. The increase in water volume during storm events causes erosion of stream banks and changes the stream channel's shape. The released sediment can smother habitat and stress aquatic organisms. During dry periods, low flows reduce deep water and swift-flowing habitats. In addition, stream edge habitat and stream channel protection is lost when the natural, vegetated stream buffer is replaced by impervious surfaces.

[i] PREP is part of the U.S. Environmental Protection Agency's National Estuary Program, which is a joint local/state/federal program established under the Clean Water Act with the goal of protecting and enhancing nationally significant estuarine resources.

- **Decreased Water Quality**: Impervious surfaces and urban drainage systems accelerate the delivery of pollutants from the watershed to rivers, lakes, and estuaries. For estuaries and their freshwater tributaries, the pollutants of greatest concern are fecal coliform bacteria and nutrients. Shellfish beds are commonly closed to harvesting after rainstorms due to elevated amounts of fecal coliform bacteria washed into the estuary by stormwater. Excessive nutrients from backyard and farm fertilizers, septic systems, and animal wastes, can cause algae blooms, which block sunlight, deplete dissolved oxygen, inhibit the growth of other aquatic plants, and can adversely affect recreational activities. Other pollutants of concern are toxic contaminants, such as metals and oil, from vehicles and business or homeowner activities, which are washed off impervious surfaces into water bodies by stormwater.

- **Loss of Biological Diversity**: The Center for Watershed Protection reports that hydrologic alteration, habitat loss, and decreased water quality "stresses aquatic species and collectively diminishes the quality and quantity of habitat." Therefore, increasing impervious surface coverage generally results in reduced biological diversity, changes in the biological community, and a shift toward pollution-tolerant species.

Studies throughout the country have documented that converting as little as 10% of a watershed to impervious surfaces, affects stream water quality and stream channel structure, causing species habitat to begin to deteriorate. However, sensitive species can be affected in watersheds with less than 10% imperviousness, especially when the surfaces are located adjacent to water bodies. When the percentage of impervious cover exceeds 25%, most watersheds experience severe habitat and water quality impairment.

In 2005, the US Geological Survey (USGS), in cooperation with NHDES, released The Effects of Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03, a report that contains up-to-date information on impervious coverage for communities in the region. The report concludes that "one can begin to see degradation at sites[ii] with 14% impervious coverage in the watershed and generally showed changes in stream quality as measured by reductions in the combined water quality, habitat condition and biological condition score."[16]

While the study took into account a number of different factors along the watershed, which included impervious coverage and urban land use buffers widths[iii], generally speaking, there was a range between 7 and 14% impervious coverage where one could begin to see degradation within the watershed.

In 2011, New Hampshire GRANIT completed a study titled, "Impervious Surfaces in Coastal New Hampshire and Southern York County, Maine 2010." The development of this data was funded by a grant from the Piscataqua Region Estuaries Partnership (PREP), as authorized by the EPA's National Estuary Program.

This study evaluated impervious surface acreage estimates for the 59 municipalities in coastal NH and southern York County, Maine within the PREP project area. Data was developed using a combination of subpixel and traditional image classification techniques applied to Landsat 5 Thematic Mapper (TM) imagery. Additionally, centerline data from the NH and Maine Departments of Transportation were used to capture narrow, linear features where pavement exists.

The data extends previous impervious surface mapping efforts for New Hampshire and portions of coastal Maine from the years 1990, 2000, and 2005. This provides a time-series of impervious surface trends for the region throughout the 20 year period. It is important to note that the data was intended to be used at a regional scale to generate and evaluate watershed acreage summaries.

Currently, the estimated total impervious surface coverage in the region is 14.9%, which exceeds the critical threshold of 14% referenced in the USGS and NHDES report for the protection of surface water quality. While the region as a whole remains a safe distance from exceeding the 25% threshold, three communities (Dover, Rochester and

[ii] Referenced as the sub-watershed of the site measured upstream from the sampling location

[iii] Rather than explaining the buffer results, it can simply be stated that for some buffers, degradation could be seen at lower percentages of impervious coverage and urbanization

Somersworth) have surpassed this benchmark and are most likely to experience water quality impairments. As shown in the table below, impervious surface coverage for the region increased steadily from 1990 through 2010.

Table 4: Impervious Coverage for the Region [1990-2010]

Municipality	Total Acreage	1990 (Acres)	1990 (%)	2000 (Acres)	2000 (%)	2010 (Acres)	2010 (%)	Change in Acres 1990-2010	% Change 1990-2010
Barrington	12,592.7	873.9	6.9%	1,234.3	9.8%	1,636.7	13.0%	763	87.3%
Brookfield	6,021.8	173.2	2.9%	232.2	3.9%	278.9	4.6%	106	61.0%
Dover	7,523.9	1,694.3	22.5%	2,235.3	29.7%	2,807.1	37.3%	1,113	65.7%
Durham	6,415.2	749.2	11.7%	1,022.2	15.9%	1204	18.8%	455	60.7%
Farmington	9,566.7	683.2	7.1%	920.5	9.6%	1,151.2	12.0%	468	68.5%
Lee	5,231.5	527.3	10.1%	745.8	14.3%	936.8	17.9%	410	77.7%
Madbury	3,156.2	282.2	8.9%	396.5	12.6%	470.3	14.9%	188	66.7%
Middleton	4,792.7	234.5	4.9%	319.7	6.7%	434.2	9.1%	200	85.2%
Milton	8,877.1	655.2	7.4%	882.2	9.9%	1,103.8	12.4%	449	68.5%
New Durham	11,353	521.1	4.6%	703.4	6.2%	889.4	7.8%	368	70.7%
Newmarket	3,674.7	490.4	13.3%	658.6	17.9%	825.5	22.5%	335	68.3%
Northwood	7,833.4	487.8	6.2%	671.9	8.6%	843.3	10.8%	356	72.9%
Nottingham	12,543.9	531.5	4.2%	745.3	5.9%	1,027.4	8.2%	496	93.3%
Rochester	11,768.5	2,232.5	19.0%	2,953.4	25.1%	3,361.1	28.6%	1,129	50.6%
Rollinsford	1,959.8	283.2	14.5%	378.2	19.3%	449	22.9%	166	58.5%
Somersworth	2,589.3	676.6	26.1%	861.7	33.3%	1,083.3	41.8%	407	60.1%
Strafford	13,265.1	517.2	3.9%	710.7	5.4%	932.1	7.0%	415	80.2%
Wakefield	11,621.4	1,016.8	8.7%	1,364.2	11.7%	1,566.1	13.5%	549	54.0%
Total	140,786.9	12,630.1	9.0%	17,036.1	12.1%	21,000.2	14.9%	8,370	66.3%

[Source: New Hampshire GRANIT. 2010]

Table 4 displays the acres and percentages of impervious surface coverage by municipality from 1990-2010. It similarly provides the amount of acreage change over the years as well as the percent change for each municipality. For the past two decades, the City of Rochester has held the highest amount of impervious surface coverage in the region. The City has also had the largest impervious acreage change from 1990-2010 gaining 1,129 acres. While impervious surface cover in the Town of Brookfield increased by a comparatively small amount during this time (106 acres), this represents a 61% increase in impervious surface cover in the town. Within the region, Nottingham (93%) and Barrington (87%) experienced the greatest increase in impervious surface cover during the period of 1990-2010, however, impervious cover accounted for 8.2% and 13%, respectively, of total land area within these communities in 2010. During this time Nottingham's population also increased by nearly 30%.

Table 4 shows that the City of Somersworth has the densest impervious coverage at 41%, indicating that nearly half of the City is unable to absorb water from precipitation, thus resulting in stormwater runoff. The density of impervious surfaces in Somersworth is a reflection of the high population density coupled with the small acreage of the city.

This table shows that impervious surface coverage is linked to the area of a municipality and also to population size. Cities with higher population and small area such as Somersworth have a high percent of impervious surface coverage. This differs from more rural towns such as Brookfield and Nottingham which are large in area and small in population, but show a high percent change over time.

TOWN OF NEWMARKET

Drinking Water Ordinances for the Protection of Surface Water Supply Areas and Sources

The Town of Newmarket adopted an Aquifer Protection District and Wellhead Protection District ordinance to protect groundwater resources. The Aquifer Protection District for Groundwater Protection includes all stratified-drift aquifer areas and contains the following innovative groundwater zoning protections:

- Compliance with Env-Wq 401 Best Management Practices rules for preventing groundwater pollution
- Incentives for open space and low-impact development
- Prohibiting high-risk land uses
- Requiring environmental performance standards
- Increased minimum lot size and reduced density where septic systems are used
- Limits on impervious surface coverage
- Limiting on-site hazardous materials.

The ordinance includes: a ban on new commercial excavation and underground storage tanks containing petroleum products within the wellhead protection area; and the requirement for a build-out analysis and a hydrogeological study for large developments.[17]

CITY OF SOMERWORTH

Low Impact Development (LID) Stormwater Regulations

The City of Somersworth adopted Low Impact Development (LID) Stormwater Regulations in order to promote development that minimizes land disturbance and preserves natural areas. The new regulations contain stormwater management practices that mimic natural processes including: decentralization, infiltration, and reuse. More specifically, these regulations require:

- Groundwater recharge
- The best available treatment with the least impact
- Careful analysis of the onsite conditions
- Practices that maintain/improve water quality
- Operation and Maintenance Plan with an annual reporting requirement

This ordinance is intended to support and compliment additional protection measures implemented throughout the City, such as riparian and wetland buffers, groundwater protection districts, preservation and conservation of land, as well other efforts that encourage long term economic and environmental health.

TOWN OF YORK

Lawns to Lobsters

The Town of York, Maine created a public education effort focused on environmentally sound lawn care practices focused on having a beautiful lawn without harming the rivers or the ocean from increased nutrients or pesticides. The program has spread throughout the coast of Maine and is now being adopted by the Town of New Castle as well. The program has 10 tips every homeowner can practice. Visit www.lawns2lobsters.org to learn more.

GREEN INFRASTRUCTURE INITIATIVE

NH Coastal Communities

Researchers and staff from the University of New Hampshire Stormwater Center, Geosyntec, Southeast Watershed Alliance, Rockingham Planning Commission, Antioch University and Great Bay NERR created a framework of technical and educational resources to build resilience and municipal capacity in coastal watershed communities. The project demonstrates the economic benefits of incorporating Green Infrastructure into existing methods, practices and plans.

The primary goals of the Green Infrastructure project include:

1. Complete installations and adopt Green Infrastructure practices and policies in NH coastal communities
2. Build understanding of economic and environmental benefits through direct community engagement
3. Increase municipal capacity to implement and manage GI and LID practices
4. Identify shared interests and collaborative partnerships
5. Target outreach and training workshops on technical and regulatory approaches

The project team – guided by an Advisory Board – provides essential technical tools and skills training that build community resilience and capacity for managing stormwater and water resources and their related services. Tools and training continue to be delivered through collaboration among many stakeholders including Low Impact Development (LID) experts, regional and municipal planners, municipal staff and elected officials, local watershed groups, engineering and design firms, and landscape nurseries and professionals. Participation at any level is optional and may vary depending upon community needs.

Erosion and Sedimentation

The development process involves the removal of vegetation, the alteration of topography, and the covering of previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. These changes to the landscape may result in the erosion of soil and the sedimentation of water bodies as soil travels to streams, rivers, and lakes in water runoff during storms at an increased velocity due to the lack of vegetative cover. The removal of vegetative cover and its roots system compromise the ability of vegetation to stabilize soil, reduce the velocity of runoff, shield the soil surface from rain, and maintain the soil's ability to absorb water.

Specific erosion and sedimentation impacts related to the loss of vegetation, pollution of the water supply, and alteration of topography are:

- Stream bank erosion caused by an increase in stormwater runoff. Eroded material may affect aquatic habitats and alter aquatic species' life cycle events by increasing turbidity, changing the water temperature, and changing the depth of water bodies.
- Alteration of existing drainage patterns. This may affect abutting properties and roads, as well as water bodies.
- Destabilization of steep slopes. Removal of trees and other vegetation may lead to erosion of soil on steep slopes.
- Reduced potential for groundwater recharge due to coverage by impervious surfaces or drainage control methods that take stormwater off-site.
- Runoff of chemicals into water supplies. Petroleum and other chemicals on construction sites may be included in non-point pollution that drains to water supplies during storm events.
- Runoff of nutrients into water supplies. Nitrogen and phosphorus concentrations in surface water bodies can be dramatically increased by stormwater runoff resulting in accelerated eutrophication and the proliferation of non-native aquatic plant species.

There are several structural and non-structural methods and management and planning techniques that may be used to control erosion and sedimentation during the site development process. Methods used during construction are meant to manage the increased amount of erosion and sedimentation that occurs as a result of grading and other land disturbance short-term activities during construction, and are not designed to be permanently in place.

When properly installed, these methods can be effective in preventing the erosion and sedimentation that may occur during construction, especially during storm events.

These methods include:

- Developing work zones by consulting with a building contractor during design.
- Within the work zones, establishing the phases of construction.
- Within the phases, developing the sequence of construction and methods to be used.
- Preparing a schedule for earth moving and building construction activities.
- Requiring a narrative of daily activities.
- When all of the above has been completed, creating an erosion and sediment control plan utilizing practices that will support the daily schedule of construction activities while preventing erosion and controlling sediment movement to water bodies.

Erosion and sedimentation control methods used on a development site can include one or more of the following techniques: compost filter sock and mulching; vegetated buffer strips; grassed swales; detention ponds; constructed wetlands; stabilization of steep slopes; infiltration structures and practices; silt fence and hay bale barriers; stone check dams; and proper phasing of land alteration and clearing.[18]

Road Salt and Maintenance

New Hampshire winters demand an effective and affordable means of de-icing roadways by using chemicals to lower the freezing point of water. The primary agent used for this purpose is sodium chloride (road salt). Chloride in the form of salt is imported to local watersheds from several major sources: roadway deicing, snow removal, food waste, water softeners, atmospheric deposition, and roadway salt pile runoff. Chloride is most commonly transported within a watershed through stormwater runoff and groundwater flow to surface waters. Year to year variations in chloride contribution is primarily due to differences in the severity of winter in a given year.[19]

Dramatic and rising concentrations of chloride from road salt have been identified in New Hampshire waters and mirror a trend that is being seen by other states in the US and Canada due to the application of de-icing chemicals. In 2008 New Hampshire listed 19 chloride impaired water bodies under the Clean Water Act. In 2010 that number increased to 40. Chloride can lead to a reduction in the diversity of aquatic species, decreased dissolved oxygen and increased nutrient loading, which promotes eutrophication in lakes.

Currently, the only way to prevent chloride from reaching surface and ground water is to reduce the amount applied to our roadways and parking lots without compromising safety. When road salt dissolves in water, the chloride molecule is not retained by the soil and easily moves with water flow. Chloride is not significantly removed by chemical reactions or evaporation. Therefore, nearly all of the chloride applied to the land surface as road salt will eventually end up in the nearby surface waters or groundwater.[20]

Chloride can infiltrate onto vegetation and into the soil, groundwater, storm drains, and surface waters posing a significant threat for both humans and the environment. Risks include:

- <u>Water quality impacts</u> - Water contaminated with sodium chloride creates a higher water density and will settle at the deepest part of the water body where current velocities are low such as in ponds and lakes. This can lead to a chemical stratification which can impede turnover and mixing, preventing the dissolved oxygen within the upper layers of the water from reaching the bottom layers while preventing nutrients within the bottom layers from reaching the top layers. As a result, the bottom layer of the water body becomes void of oxygen and is unable to support aquatic life.
- <u>Human health impacts</u> - Sodium in drinking water is a health concern for individuals restricted to low-sodium diets due to hypertension (high blood pressure).
- <u>Pet impacts</u> - According to the ASPCA's Animal Poison Control Center, ingestion of road salt by eating salt directly, licking salty paws, and by drinking snow melt and runoff "can potentially produce effects such as drooling, vomiting, diarrhea, loss of appetite, vocalizing/crying, excessive thirst, depression, weakness, low blood pressure, disorientation, decreased muscle function and in severe cases, cardiac abnormalities, seizure, coma, and even death".
- <u>Wildlife impacts</u> - Road salt can cause a decline among populations of salt sensitive species reducing natural diversity. Damage to vegetation can have significant impact on wildlife habitat by destroying food resources, shelter and breeding and nesting sites, and by creating a favorable environment for non-native invasive species.
- <u>Aquatic life impacts</u> - Chloride in surface waters can be toxic to many forms of aquatic life. Aquatic species of concern include fish, macroinvertebrates, insects, and amphibians.
- <u>Vegetation impacts</u> - The most visible impact of road salt on our environment is in the grass, shrubs, and foliage along the roadside. Not only does salt effect the terrestrial roadside vegetation it also has an impact on emergent and submerged aquatic plants.
- <u>Soil Impacts</u> - Salt influences the chemistry of the soil in which it infiltrates. Because it can inhibit soil bacteria, salt compromises soil structure and inhibits erosion control mechanisms, increasing sediment in runoff.
- <u>Infrastructure impacts</u> - Chloride ions increase the conductivity of water and accelerate corrosion. Chloride can penetrate and deteriorate concrete on bridge decking and parking garage structures and damage

reinforcing rods, thus compromising structural integrity. Chloride damages vehicle parts such as brake linings, frames, bumpers, and other areas of an auto body by corrosion.[21]

In New Hampshire, municipalities are not required to report their salt usage to the Department of Environmental Services, so it is difficult to measure how much chloride is being leached from our transportation systems into the region's watersheds. However, as part of the salt reduction efforts in the I-93 corridor, DES does receive annual reporting of salt use from Derry, Londonderry, Salem, and Windham. These reports are applied to a weather severity index[iv] to normalize the data and analyze trends over time. This work was a result of chloride impairments within four watersheds, including parts of Salem, Windham, Derry, Londonderry, Auburn, and Chester. These watersheds failed to meet water quality standards for chlorides in particular segments during various times of the year. These impairments triggered a total maximum daily load (TMLD)[v] study for chlorides, which resulted in the development of additional requirements to reduce salt in the corridor where NHDOT is undertaking highway expansion.

While we do not have any road salt data for the region, we do have information from nearby communities as shown below.

Table 5: Municipal Salt Use

Red = assumed value

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Units
Auburn													Tons/yr
Chester													Tons/yr
Derry	4,910	3,347	5,486	3,503	4,465	5,158	2,051	5,750	4,407	3,770	3,300	1,900	Tons/yr
Londonderry	5,818	2,915.75	5,610	3,019	5,736	3,208	2,533	5,541	3,918	2,563	2,690	1,669	Tons/yr
Salem	**6,597**	**6,597**	**6,597**	6,122	7,714	8,305	3,492	7,450	8,025	5,071	6,521	3,205	Tons/yr
Windham	885	706.17	1,198.26	929	1,138	902	860	900	684	642	800	422	Tons/yr

[Source: Southern I-93 Corridor Chloride Impairment Study]

In the region, the UNH Technology Transfer Center is working with the Town of Durham and UNH Facility Services to develop salt reduction plans for the impaired College and Reservoir Brook watersheds.

In 2010, the UNH Technology Transfer (T^2) Center implemented a new salt applicator certification program called "Green SnowPro", to address private sector salt loading (which is more than 50% of the load in some urbanized watersheds). The UNH T^2 Center offers half day Green SnowPro Certification courses focused on efficient and environmentally friendly winter maintenance practices. The course covers the basics of salt reduction including:

- Equipment calibration
- Anti-icing
- Brine making
- Pre-wetting with brine and other liquids
- Efficient application rate changes with pavement temperature
- Effective plowing
- Emerging technologies
- Salt accounting
- Environmental impacts

[iv] The index is algorithm used to normalize the severity of winter weather so that road salt loading can be compared from year to year; more salt use would be expected in winters with more severe weather

[v] The term "total maximum daily load," or TMLD refers to the calculation of the maximum amount of a pollutant that a waterbody can receive and attain or maintain water quality standards for its designated use

The course is approximately 3 hours of classroom instruction and 1 hour of field demonstration of calibration and brine making techniques. Following demonstration and classroom time students take a 30 minute exam to qualify for certification. Currently, there are 265 certified winter maintenance professionals in New Hampshire.

The UNH T² Center has also developed best management practices (BMPs) as a result of a multi-year survey of the best and most applicable technology for New Hampshire snow and ice management professionals. They following fact sheets can be found on the NHDES website:

- Calibration – hydraulic spreader
- Calibration – pony motors
- How salt works
- Pre-wetting
- Brine making
- Anti-icing
- Good housekeeping

In 2013, the legislature passed a voluntary salt applicator certification law that provides liability protection for private salt applicators and landowners who use certified salt applications for winter maintenance. The intent of the new law is to avoid the over-use of road salt by addressing the concerns of property owners and contractors with respect to the possibility of being sued for injuries such as slips and falls. The Salt Applicator Certification Option, RSA 489-C, was passed into law as part of House Bill 2, and was effective on September 26, 2013.

Proposed Brining Facility

NH DOT has recently proposed a maintenance facility located at Exit 16 along the Spaulding Turnpike Connector in Rochester. The project includes seven structures:

- Maintenance facility building
- Secondary storage building
- Salt shed, brine building
- Hazardous material storage building
- Spreader hanger building
- Fueling facility.

The project site is served by public water and sewer and will be paved and have a closed stormwater collection system with a detention basin. NH DOT and consulting firm Stantec submitted initial proposed maintenance facility plans to the City of Rochester for review in December 2013. Because there is potential contamination of high quality wetlands and underlying aquifers, best management practices for wastewater discharges from vehicle washing, brine storage and management, and aquifer protection are recommended.

Best Management Practice

College & Reservoir Brook Watershed Management Plan Development Phase I: Salt Reduction Demonstration Project

Type of Non-Point Sources and Water Quality Threat
Concentrations of chloride in excess of federal standards were present in both College and Reservoir Brooks in Durham, NH. Road salt was identified as the primary source of contamination. Preliminary data suggested that sidewalk, parking lot, and road deicing by UNH and the Town was the largest source of chloride loading. Additional potential sources included a small stretch of Route 4 and Route 155 as well as several private parking lots.

Project Description
The Technology Transfer Center (T^2) worked in partnership with the Town, UNH and NHDOT to develop a watershed-based plan and to demonstrate selected BMPs for use primarily on the over 24 miles of sidewalks and parking lots. Demonstration BMPs will include equipment upgrades, operator and supervisor education and hands on training, quantification of existing application rates and demonstration of salt accounting practices to document usage and reductions. The watershed-based plan will quantify annual reduction goals and proposed BMPs to achieve those goals (e.g. equipment calibration, use of anti-icing, pre-wetting, ground speed oriented spreaders, and recommended temperature calibrated application rates). Success shall be verified during the project period by documenting salt reduction achieved by demonstration BMPs, and in the long-term through adoption of BMPs recommended in the watershed-based plan by UNH and the Town of Durham.

Desired Environmental Outcome
It is anticipated that there will be 10-30% reduction in chloride imports from the demonstration BMPs. Additional reductions are possible but cannot be guaranteed, as the reduction through use of BMPs is highly dependent on current practices and the ability to achieve greater material efficiencies through the use of BMPs. This project is the planning and demonstration phase of a multi-year approach which should ultimately result in meeting of predicted TMDL requirements and in reducing the contaminant loading to an acceptable level in both watersheds.

Aboveground Storage Tanks

Aboveground storages tanks (ASTs) are defined as containers that hold petroleum products. Petroleum ASTs are regulated by both the Department of Environmental Services (DES) and the New Hampshire Fire Marshal's Office. The Aboveground Storage Tank Program, which is a division within DES, is designed to prevent releases of oil from these tanks throughout New Hampshire. DES established rules for petroleum ASTs in April 1997. The rules entitled *Control of Aboveground Petroleum Storage Facilities* (Env-Wm 1402) with revision effective May 28, 2005. These rules apply to:

- Facilities with a single AST system having a capacity greater than 660 gallons, or
- Facilities with two or more ASTs that have a total storage capacity greater than 1,320 gallons.[22]

Note: ASTs with a combined capacity of 1,320 gallons or less storing fuel oil (not used oil or waste oil) used **only** to heat an **on-premise** structure are exempt. This includes home heating oil tanks.[23]

According to the Aboveground Storage Tank Program at the New Hampshire Department of Environmental Services:

- All regulated ASTs in New Hampshire **shall** be registered with DES.
- New regulated ASTs having a capacity greater than 660 gallons must be approved by DES before they can be installed. Approval is obtained by submitting the following:
    - an engineered site plan showing where the proposed tank will be located
    - a completed application form
    - cut sheets containing information on the tank, high level alarms, gauges, pumps, and any other appurtenance that will be installed on the tank system
- Plans shall be prepared and certified by a New Hampshire licensed professional engineer.
- All regulated AST facilities shall have the following:
    - overfill protection in the form of a gauge and an independent audible and visible high level alarm
    - a Spill Prevention Control & Countermeasure Plan (SPCC)[vi]
    - tank markings

The table below identifies the number of aboveground storage tanks (total and currently in use) in the region. Results are based on data extracted from the NHDES OneStop Web Geographic Information System, which was last updated on April 14, 2014.

Table 6: Aboveground Storage Tanks in the Region

Municipality	Facility Type(s)	Total Number of Tanks	Number of Tanks Currently in Use
Barrington	Gas Station; Industrial	16	8
Dover	Commercial; Trucking/Transport; Local Government; Recycling Center; Petroleum Distributor; Oil Change Facility; Utilities; Industrial; Residential; Hospital; Other	106	68
Durham	Recycling Center; Commercial; Industrial; School; Utilities; College/University; Local Government	75	56
Farmington	Contractor; Petroleum Distributor; Asphalt Batching; Gas Station; Recycling Center; Local Government	53	39
Lee	Gas Station; Recycling Center; Trucking/Transport; Commercial	10	4
Madbury	Industrial; Asphalt Batching; Farms and Isolated Sites	22	10
Middleton	Auto Dealership; Commercial; Local Government	17	16
Milton	Trucking/Transport; Recycling Center; Utilities	5	4
New Durham	Commercial; Local Government	3	3
Newmarket	Recycling Center; Local Government; Utilities; Residential; Other	12	10
Northwood	School; Commercial; Recycling Center; Contractor; Petroleum Distributor; Utilities; Gas Station	39	21
Nottingham	Commercial; Recycling Center	12	12
Rochester	Asphalt Batching; Commercial; Industrial; Petroleum Distributor; Oil Change Facility; Auto Salvage; Auto Dealership; Utilities; Recycling Center; Local Government; Contractor; Other	160	137
Rollinsford	Contractor; Utilities; Commercial; Local Government; Petroleum Distribution; Industrial; Other	100	67
Somersworth	Utilities; Petroleum Distributor; Commercial; Trucking/Transport; Industrial; Recycling Center; Auto Dealership	34	21
Strafford	Gas Station; Local Government	2	0
Wakefield	State Government; Utilities; Petroleum Distributor	10	6
TOTAL		**676**	**482**

[Source: New Hampshire Department of Environmental Services One-Stop Data and Information Site]

[vi] A SPCC Plan is a well-thought-out written document that describes the facility, its oil storage, the procedures for handling oil, the features used to control spillage, and the countermeasure that would be employed should a spill occur.

Above ground petroleum storage tanks (AST) are located in 17 of the 18 communities located in the Strafford region. Brookfield is the only municipality that does not host an AST as defined by the state. These tanks are located at a variety of different facilities. Utilities and local government facilities are two of the most common AST users in the region.

As of April 14, 2014 there were 676 aboveground storage tanks in the Strafford region. Only 482 of these tanks were actually in use. This means that 194 above ground tanks exist in the region, but are not currently active. The University of New Hampshire in Durham, with 47 total tanks and 39 tanks in use, has the most tanks in the region. Wentworth Greenhouses Inc. in Rollinsford and Waste Management of NH Inc. in Rochester also have a significant amount of tanks, with 25 and 28 active tanks respectively. The City of Rochester, with 160 tanks at 33 separate facilities, hosts the most tanks in the region.

Many of the older tanks associated with many older businesses have been removed. These tank removals represent a significant reduction in the threat of contamination from petroleum products since many of these former tanks were 30 to 40 years old, well beyond the typical design life of steel tanks.

Underground Storage Tanks

Underground Storage Tanks (USTs), according to RSA 146-D: Oil Discharge and Disposal Cleanup Fund, are defined as:

"a location consisting of a system of underground storage tanks, pipes, pumps, vaults, fixed containers and appurtenant structures, singly or in any combination, which are used or designated to be used for the storage, transmission, or dispensing of oil or petroleum liquids, and which are within the size, capacity and other specifications prescribed by rules adopted by the commissioner pursuant to Chapter 146-A: Oil Discharge or Spillage in Surface Water or Groundwater."

USTs are regulated by the Department of Environmental Services (DES). The Underground Storage Tank Program, which is a division within DES, was created to prevent and minimize contamination of the land and waters of the sate due to the storage and handling of:

- Heating oils,
- Hazardous substances,
- Lubricating oils,
- Motor fuels,
- Other petroleum and petroleum contaminated liquids.

NHDES established rules for registration; permitting; and standards for design, installation, operation, maintenance, and monitoring of UST facilities. These rules apply to:

- All underground storage tank systems that store motor fuels or a regulated substance other than heating oil having a total storage capacity of more than 110 gallons, and
- Non-residential tank systems that have a heating oil storage capacity of more than 1,100 gallons.

The owner of an underground storage facility must register the facility with DES by providing the information required in UST facility rules. Owners are required to submit in writing any change in facility status, such as, ownership and equipment within 10 days of the change. No person is allowed to operate a facility, which is not registered with the department.

The owner of a UST facility must provide an application and plans to DES before:

- Commencing construction,
- Installation of a new or replacement system, or
- A substantial modification of an existing underground storage system.

The plans must be prepared and stamped by a registered professional engineer, licensed to practice in the state of New Hampshire.[24]

The table below identifies and lists all the locations, names, types, and number of underground storage tanks in the region. Results are based on data extracted from the NHDES OneStop Web Geographic Information System, which was last updated on April 14, 2014.

Table 7: Underground Storage Tanks in the Region

Municipality	Facility Type(s)	Total Number of Tanks	Number of Active Tanks
Barrington	Local Government: Gas Station; Commercial: Residential or Farm; Contractor	34	7
Brookfield	Local Government	1	0
Dover	Industrial; Commercial; Residential or Farm; Contractor; Gas Station; Petroleum Distributor; Local Government; School; State Government; Trucking/Transport; Auto Dealership; Utilities; Marina; Hospital; Federal - Non Military; Other	365	54
Durham	Gas Station; Local Government; Commercial; State Government; Federal - Non Military; Utilities; Church; Other	117	10
Farmington	Commercial; Industrial; Gas Station; Local Government; Petroleum Distributor; Residential or Farm; Utilities; Other	95	15
Lee	Commercial; Gas Station; Local Government; State Government; Residential or Farm;	51	11
Madbury	Industrial; Local Government; Residential or Farm; Commercial	8	0
Middleton	Commercial; Local Government; Residential or Farm	10	0
Milton	Gas Station; Industrial; Commercial; State Government; Local Government; Marina	39	9
New Durham	Residential or Farm; Commercial; Gas Station; Marina; Utilities; Local Government; State Government; Industrial	30	5
Newmarket	Gas Station; Residential or Farm; Commercial; Industrial; Utilities; Local Government; Federal - Non Military; Contractor; School	73	16
Northwood	Commercial; Gas Station; Local Government; Residential or Farm; Contractor; State Government; Utilities;	92	20
Nottingham	Gas Station; Commercial; Local Government; Residential or Farm	24	6
Rochester	Commercial; Industrial; Local Government; Utilities; Gas Station; Contractor; Residential or Farm; Federal - Non Military; Hospital; Church; School; Trucking/Transport; Auto Dealership; Petroleum Distributor; State Government; Federal - Military; Other	431	71
Rollinsford	Gas Station; Commercial; Industrial; Residential or Farm; Local Government; Federal - Non Military	35	5
Somersworth	Petroleum Distributor; Industrial; Auto Dealership; Gas Station; Utilities; Local Government; Commercial; Contractor; Church; State Government; Federal - Non Military; Other	175	39
Strafford	Gas Station; Residential or Farm; State Government; Local Government; Trucking/Transport	24	5
Wakefield	Marina; Gas Station; Contractor; Commercial; State Government; Local Government; Residential or Farm	86	17
TOTAL		**1690**	**290**

[Source: New Hampshire Department of Environmental Services One-Stop Data and Information Site]

According to the table, underground petroleum storage tanks are located in each municipality within the Strafford region. These underground tanks are located primarily at gas stations along with commercial, local government, and other facilities. There are 1,690 tanks in total, but only 290 are currently active. This difference of 1,400 tanks shows the significant decrease in the use of underground storage tanks in the region. This change is the result of the following:

- Higher standards for tanks, including newer standards that were effective September 1, 2013;
- The required closing of single wall tanks and piping by December 22, 2015. By that date, single wall tanks and piping will need to be permanently closed. Due to upgrades not being affordable for every owner, permanent closure is the route many are choosing (a full site upgrade with new tanks and piping can cost upwards of $200,000, if not more); and
- Switching over to more affordable fuel sources (especially with schools). Many are converting over to natural gas or biofuels and are closing their tanks.

The University of New Hampshire in Durham demonstrated the most significant change in usage: 18 tanks total, but none in current use. Dead River Company, a petroleum distributor in Somersworth, has nine of their 16 tanks in use which is the highest ratio in the region. The City of Rochester has the most tanks in the region hosting 431 tanks at 137 different locations, while only 71 tanks are currently in use.

Hazardous Waste Generators

For more than 20 years, hazardous waste management in New Hampshire has been regulated under RSA 147-A and rules adopted pursuant to that statute as part of a system designed to protect human health and the environment. This system is consistent with the federal Resource Conservation and Recovery Act (RCRA), that act strives to prevent the release of harmful chemicals into water, land and air.[25]

Small Quantity Generators

A New Hampshire small quantity generator is any "person" that owns or operates a facility and generates less than 220 pounds (100 kilograms or approximately 26 gallons of most liquids) of hazardous waste per month. A "person" is defined as any individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, state, municipality, commission, United States government or any agency thereof, political subdivision of the state, or any interstate body.

Despite the relatively small amount of hazardous waste generated by each individual small quantity generator (SQG), releases from SQGs have created about a third of the hazardous waste sites in New Hampshire. Over the years, many SQGs have been inspected by NH DES staff, but many more have never been inspected and continue to pose a threat to groundwater resources. With about 2,500 hazardous waste generators in the state, it became clear that DES could not just continue the typical inspection and enforcement model to assure the compliance of such a large universe of generators.

To address this inspection problem and improve compliance rates of SQGs, the New Hampshire Legislature amended RSA 147-A in 2003 to establish a SQG Self-Certification Program. The law, RSA 147-A:5, IV, requires SQGs to review their hazardous waste management procedures, conduct a self-inspection of their facility and certify compliance to DES.[26]

Small Quantity Self-Certification Program

This Program requires each SQG to review its hazardous waste management procedures, conduct a self-inspection of its facility and certify compliance to DES every three years. SQGs that are not in compliance must develop a Corrective Action Plan, specifying how they plan to come into compliance within 90 days from the date the declaration is due. Effective July 1, 2007, SQGs must also submit a fee of $90 per year, payable every three years at the time of certification. The renewal fee is $270 payable every three years, however, each SQG is responsible for payment beginning in the year that the SQG becomes an active hazardous waste generator. Political subdivisions of the state, typically municipalities and public schools, are exempt from the fee but not the certification requirement. State agencies are not considered political subdivisions and are required to pay the fee.[27]

Full Quantity Generators

According to Env-Hw 500, NHDES shall classify an entity as a full quantity generator if it any time accumulates or in a single month generates equal to or greater than: at any time the generator accumulates or in a single month:

- Greater than 1,000 kg (2,200 lbs) of hazardous waste at any time
- Equal to or greater than 1 kg (2.2 lbs) of an acutely hazardous waste at any time;
- Equal to or greater than 100 kg (220 lbs) of spill cleanup material contaminated with acutely hazardous waste

Full Quantity Generator Requirements

NH statute and administrative rules require each full quantity generator to have on staff, at the facility where the hazardous waste is generated, a hazardous waste coordinator certified by DES. The certified hazardous waste coordinator is responsible for ensuring that the generator is aware of and in compliance with applicable requirements relating to hazardous waste management, including but not limited to storage, transportation, and disposal. Certification shall not be transferable. Initial certification shall be valid for one year and may be renewed for subsequent one-year terms. The department may charge a reasonable fee to cover expenses for education and training programs that fulfill the initial certification and continuing education requirements. The commissioner may authorize alternative certified hazardous waste coordinator programs provided the program demonstrates equivalent on-site staffing, training, continuing education, and management organization to meet the responsibilities of this paragraph.

For more information, reference New Hampshire Code of Administrative rules chapter Env-HW 500 Requirements for Hazardous Waste Generators.

Table 8 shows the count, status, and size of hazardous waste generators in each municipality within the region. The regional average is 82 generators per municipality. Larger cities such as Dover and Rochester, hosting 346 and 362, have significantly more generators than the smaller surrounding towns. In contrast the Town of Brookfield has only three generators, none of which are active.

The region has a grand total of 1,473 hazardous waste generators, however only 18 percent of these generators are active. Overwhelmingly 70 percent of the generators in the region are inactive and 12 percent are declassified or non-notifier, which also do not actively collect hazardous waste. The majority of overall generators are small quantity (holding less than 220 lbs. (100 kg) a month). Rochester, with the most generators in the region, has 221 small quantity generators. Twenty seven generators are full quantity (holding 220 to 2,000 lbs. a month) and only ten are full quantity (holding more than 2,000 lbs. a month). One hundred and four of the generators in the city are listed as having a size of “None”. A listing of “None” refers to a hazardous waste generator which produces universal wastes (mercury containing devices, cathode ray tubes, and florescent lamps) and oil for recycle. The state of New Hampshire does not require an ID for these generators, however if waste from these generators is shipped out of state they require an identification. Therefore, DES lists them as “None” so that the generated waste can be shipped, however New Hampshire does not track the shipments.

Table 8: Hazardous Waste Generators in the Region

Municipality	Activity Status				
	Active	Inactive	Declassified	Non-Notifier	TOTAL
Barrington	**10**	**40**	**5**	**1**	**56**
	4 - Small Quantity Generator (< 220lbs)	2 - Full Quantity Generator (220-2,000lbs)	3 - Small Quantity Generator (< 220lbs)	1 - Full Quantity Generator (220-2,000lbs)	
	6 - None	30 - Small Quantity Generator (< 220lbs)	2 - None	-	
	-	8 - None	-	-	
Brookfield	0	3	0	0	3

Municipality	Activity Status				
	Active	**Inactive**	**Declassified**	**Non-Notifier**	**TOTAL**
	-	3 - Small Quantity Generator (< 220lbs)	-	-	
Dover	**51**	**238**	**57**	**2**	**348**
	13 - Full Quantity Generator (> 2,000lbs)	213 - Small Quantity Generator (< 220lbs)	-	2 - Small Quantity Generator (< 220lbs)	
	15 -Full Quantity Generator (220-2,000lbs)	25 - None	-	-	
	23 - None	-	57 - None	-	
Durham	**10**	**64**	**2**	**0**	**76**
	2 - Full Quantity Generator (> 2,000lbs)	2 - Full Quantity Generator (> 2,000lbs)	1 - Small Quantity Generator (< 220lbs)	-	
	6 - Small Quantity Generator (< 220lbs)	3 - Full Quantity Generator (220-2,000lbs)	1 - None	-	
	2 - None	42 - Small Quantity Generator (< 220lbs)	-	-	
	-	17 - None	-	-	
Farmington	**14**	**43**	**5**	**1**	**63**
	3 - Full Quantity Generator (220-2,000lbs)	1 - Full Quantity Generator (> 2,000lbs)	1 - Small Quantity Generator (< 220lbs)	1 - Small Quantity Generator (< 220lbs)	
	7 - Small Quantity Generator (< 220lbs)	34 - Small Quantity Generator (< 220lbs)	4 - None	-	
	4 - None	8 - None	-	-	
Lee	**7**	**36**	**5**	**0**	**48**
	3 - Small Quantity Generator (< 220lbs)	1 - Full Quantity Generator (> 2,000lbs)	1 - Small Quantity Generator (< 220lbs)	-	
	4 - None	1 - Full Quantity Generator (220-2,000lbs)	4 - None	-	
	-	30 - Small Quantity Generator (< 220lbs)	-	-	
	-	4 - None	-	-	
Madbury	**6**	**12**	**1**	**0**	**19**
	3 - Small Quantity Generator (< 220lbs)	1 - Full Quantity Generator (220-2,000lbs)	1 - Small Quantity Generator (< 220lbs)	-	
	3 - None	10 - Small Quantity Generator (< 220lbs)	-	-	
	-	1 - None	-	-	
Middleton	**4**	**4**	**1**	**0**	**9**
	2 - Small Quantity Generator (< 220lbs)	2 - Small Quantity Generator (< 220lbs)	1 - None	-	
	2 - None	2 - None	-	-	
Milton	**7**	**20**	**2**	**0**	**29**
	3 - Small Quantity Generator (< 220lbs)	2 - Full Quantity Generator (220-2,000lbs)	1 - Small Quantity Generator (< 220lbs)	-	
	4 - None	12 - Small Quantity Generator (< 220lbs)	1 - None	-	
	-	6 - None	-	-	
New Durham	**3**	**11**	**2**	**0**	**16**
	3 - None	1 - Full Quantity Generator (> 2,000lbs)	2 - None	-	
	-	9 - Small Quantity Generator (< 220lbs)	-	-	
	-	1 - None	-	-	
Newmarket	**12**	**55**	**7**	**1**	**75**

Municipality	Activity Status				
	Active	**Inactive**	**Declassified**	**Non-Notifier**	**TOTAL**
	8 - Small Quantity Generator (< 220lbs) 4- None -	3 - Full Quantity Generator (> 2,000lbs) 38 - Small Quantity Generator (< 220lbs) 14 - None	2 - Full Quantity Generator (220-2,000lbs) 1 - Small Quantity Generator (< 220lbs) 4 - None	1 - None - -	
Northwood	**8** 6 - Small Quantity Generator (< 220lbs) 2 - None - -	**51** 2 - Full Quantity Generator (> 2,000lbs) 2 - Full Quantity Generator (220-2,000lbs) 40 - Small Quantity Generator (< 220lbs) 7 - None	**8** 1 - Small Quantity Generator (< 220lbs) 7 - None - -	**1** 1 - Small Quantity Generator (< 220lbs) - - -	**68**
Nottingham	**6** 1 - Small Quantity Generator (< 220lbs) 5 - None -	**25** 3 - Full Quantity Generator (220-2,000lbs) 18 - Small Quantity Generator (< 220lbs) 4 - None	**1** 1 - None - -	**1** 1 - Small Quantity Generator (< 220lbs) - -	**33**
Rochester	**79** 48 - Small Quantity Generator (<220lbs) 23 - None 3 - Full Quantity Generator (>2,000lbs) 5 - Full Quantity Generator (220-2,000lbs)	**234** 164 - Small Quantity Generator (<220lbs) 49 - None 4 - Full Quantity Generator (>2,000lbs) 17 - Full Quantity Generator (220-2,000lbs)	**46** 8 - Small Quantity Generator (<220lbs) 32 - None 2 - Full Quantity Generator (>2,000lbs) 4 - Full Quantity Generator (220-2,000lbs)	**3** 1 - Small Quantity Generator (< 220lbs) 1- Full Quantity Generator (>2,000lbs) 1 - Full Quantity Generator (220-2,000lbs) -	**362**
Rollinsford	**6** 1 - Small Quantity Generator (< 220lbs) 3 - None 1 - Full Quantity Generator (220-2,000lbs)	**20** 13 - Small Quantity Generator (<220lbs) 5 - None 2 - Full Quantity Generator (220-2,000lbs)	**4** 1 - Small Quantity Generator (< 220lbs) 3 - None -	**0** - - -	**30**
Somersworth	**33** 17 - Small Quantity Generator (<220lbs) 9 - None 6 - Full Quantity Generator (220-2,000lbs) 1 - Full Quantity Generator (>2,000lbs)	**121** 79 - Small Quantity Generator (<220lbs) 31 - None 8 - Full Quantity Generator (220-2,000lbs) 3 - Full Quantity Generator (> 2,000lbs)	**18** 3 - Small Quantity Generator (< 220lbs) 14 - None 1 - Full Quantity Generator (>2,000lbs) -	**0** - - - -	**172**
Strafford	**1** 1 - Small Quantity Generator (< 220lbs) - -	**18** 12 - Small Quantity Generator (< 220lbs) 5 - None 1 - Full Quantity Generator (> 2,000lbs)	**1** 1 - Small Quantity Generator (< 220lbs) - -	**0** - - -	**20**
Wakefield	**3** 2 - Small Quantity Generator (< 220lbs) 1 - None -	**39** 23 - Small Quantity Generator (<220lbs) 13 - None 2 - Full Quantity Generator (220-2,000lbs)	**4** 4 - None - -	**0** - - -	**46**

Municipality	Activity Status				
	Active	Inactive	Declassified	Non-Notifier	TOTAL
	-	1 - Full Quantity Generator (> 2,000lbs)	-	-	
REGIONAL TOTAL	**260**	**1034**	**169**	**10**	**1473**

Active – an active EPA ID number to permit generation of hazardous waste

Inactive - the site at one time had an active EPA ID number and may or may not have generated hazardous waste, but is not currently. The operator has the option to reactivate the EPA ID number if needed in the future.

Declassified **-** the company moved out or shut down operations, no HW is being generated.

Non-Notifier – Hazardous waste was picked up at this site. They do not have an active EPA ID number. The waste was manifested by a hazardous waste transporter and provide copies of all shipments.

[Source: New Hampshire Department of Environmental Services One-Stop Data and Information Site]

Seventy percent of hazardous waste generators in the region are classified as inactive. This is partially due to the fact that the DES database covers recent as well as historical data. Older generators may have found alternatives to hazardous waste generation or have simply stopped generating waste. The high percentage also may result from the Small Quantity Generator Self-Certification program, which encouraged generators to use “green” alternatives to hazardous cleaning agents.

Some small businesses are unaware of hazardous waste disposal regulations. As a result, these businesses dispose of hazardous waste improperly by throwing it out or burning it on site. A challenge for DES is the identification of these businesses and the requirement to educate them of the hazardous waste disposal regulations. Small businesses recycling electronics, for example, may be unaware that they are creating hazardous waste by recycling products which contain silver, chromium, and lead. Identification of, and education for, these small businesses would help to reduce improper hazardous waste disposal in New Hampshire.

Funding is available for municipalities to help establish household hazardous waste collection and disposal events: Household Hazardous Waste Program.

Water Resource Protection Measures

The New Hampshire Legislature established the Water Protection Assistance Program in 1986 to encourage comprehensive surface and groundwater resources planning and protection. Throughout the region, municipalities have undertaken various protection measures including: completing water resource inventories; identifying threats to water quality from pollutants; recognizing the need for public/private water supplies; and understanding demands from competing water uses, such as recreation, wildlife habitat, hydropower production and fire protection. Clean water is a top priority for the communities in the region as demonstrated by their commitment in proposing new ordinances or amendments to existing regulations intended to protect water resources.

Local Ordinances, Overlay Districts, & Conservation Measures

Low Impact Development (LID) Ordinance/Regulations

Municipalities may have ordinances or regulations that require or promote Low Impact Development (LID) practices. This includes planning, management and control during development to reduce the negative effects of stormwater runoff.

LOCAL MODEL

The City of Somersworth requires LID stormwater regulations in its Site Plan Regulations. The regulations have requirements such as: drainage calculations (peak flow/soil cover etc.), comparisons of pre- and post-development flow rates, groundwater recharge requirements on site, stormwater control infrastructure (Best Management Practices), and erosion and sedimentation control requirements. All on site improvements are subject to inspection to assure completion and maintenance of these improvements.

Aquifer/Drinking Water Protection Zoning District

An Aquifer Protection District is to prevent the contamination of aquifers in municipalities in order to avoid pollution of the public drinking water. To minimize the effects of aquifer contamination the district follows specific regulations. These are rules such as: required minimum lot sizes, encouraged open space subdivisions, and septic system designs with higher standards within the wellhead protection areas.

Lots that reach a specified threshold of impervious surface coverage require the creation of a stormwater management plan to be reviewed by the planning board. Site drainage must meet stormwater best management practices. Minimal use of de-icing chemicals on roads and parking lots is allowed within the district. Prohibited uses within the district are permitted upon review and approval. However, if located in a wellhead protection area no expansion of prohibited uses is allowed. A hydrogeological study is required for developments that disturb over a certain amount of land within the Aquifer Protection District.

Districts with similar regulations include: Groundwater Protection Zones (Dover, Barrington, Milton, Somersworth), Aquifer Protection Districts (Durham, Farmington, Madbury, Middleton, Newmarket, New Durham, Rochester), Aquifer Conservation Districts (Lee, Nottingham, Wakefield), Water Protection Overlay (Strafford), and Wellhead and Well Site Protection Districts (Northwood, Rollinsford, Madbury).

See the Environment, Land Use, and Recreation Appendix for links to watershed management plans in the region.

LOCAL MODEL

The Town of Madbury has an Aquifer and Wellhead Protection Overlay District. This district not only regulates land located over stratified aquifers but also wellhead protection areas (400′ surrounding an identified public water supply wellhead). This district includes design and development requirements, performance standards, and procedures for conditional use permits. These requirements shield these critical resources from the negative effects of land use development.

LOCAL MODEL

The Town of Newmarket adopted an Aquifer Protection District and Wellhead Protection District ordinance to protect groundwater resources. The district includes all stratified-drift aquifer areas and contains innovative groundwater zoning protection: compliance with Env-Wq 401 Best Management Practices rules for preventing groundwater pollution; incentives for open space and low-impact development; prohibitions on high-risk land uses; requirements for environmental performance standards; increased minimum lot size and reduced density where septic systems are used; limits on impervious surface coverage; and limiting on-site hazardous materials. The ordinance includes a ban on new commercial excavation and underground storage tanks containing petroleum products within the wellhead protection area and requires a built-out analysis and hydrogeological study for large developments.[28]

LOCAL MODEL

The Town of Farmington adopted an Aquifer Protection Overlay District to protect, preserve and maintain existing and potential ground water supply and groundwater recharge areas within the known aquifer from adverse development or land use practice. Within the district, development conforms to NH DES's Best Management Practices as defined in NH DES Administrative Rules Env-Wq 401 and is in accordance with the Town of Farmington Health Ordinance for Wellhead and Groundwater Protection. The types of prohibited uses in this district include solid waste disposal, storage of petroleum or petroleum based products, junk and salvage yards, storage of toxic materials, and impervious lot coverage over 10% (or 60% if engineering designs and drainage calculations provide for sufficient treatment and recharge to render the post-development condition of the site to be the same as, or better than, the existing conditions of the site).

<u>Wetland Conservation/Protection Zoning District</u>

A wetland conservation overlay protects salt and fresh water wetlands in order to prevent unregulated land alteration. Development near a wetland can harmfully affect the land's ability to absorb floodwaters, provide a habitat for fish and wildlife, and treat stormwater and recharge groundwater supplies. Wetland districts also preserve the quality of surface and groundwater by shielding wetlands, which function to filter pollution, absorb chemicals, and trap sediment. Wetland conservation districts cover wetlands as defined by the NH DES wetland bureau: Prime wetlands, poorly drained soils, and associated buffers. Wetland buffers are measured 50 feet from the perimeter edge of the wetland.

Agriculture and forestry are only permitted in wetland conservation districts if carried out with Best Management Practices (BMPs). Surface water withdrawal is not allowed within the district. Development such as footbridges, catwalks, and docks allowed only when needed for access to neighboring surface water. Driveway and utility passages may be allowed in the district if the site is reviewed and approved by the planning board.

LOCAL MODEL

The Town of Strafford's Wetland Conservation District protects lands located inside the wetland buffers designated by the town. These buffers include buffer distances from wetlands to buildings/structures/non-residential parking areas and septic system leachfields. Wetlands with poorly drained soils must have a buffer of 50′ from buildings and 75′ from septic leachfields, very poorly drained soils and surface waters require 50′ from buildings and 100′ from leachfields, while vernal pools and designated rivers have 75′ and 100′ buffers. The district also has restricted uses and allows conditional use permits in order to protect the valuable wetlands in the town.

Shoreland Protection District

RSA 483-B (Comprehensive Shoreland Protection Act) is a New Hampshire State law, which applies to land areas within 250' of public waters. The Shoreland Protection Overlays cover these areas within 250' of the water in order to ensure the integrity of these water bodies by reducing pollution, protecting wildlife, and maintaining the scenic beauty of the areas.

General Requirements include: primary structure setbacks from the shore and accessory structure setbacks. Minimum standards apply to: junkyards, salt storage, maintenance of natural woodland buffers, impervious surfaces, water dependent structures, solid/hazardous waste facilities, erosion and siltation, fertilizer application, and chemical use.

Similar districts that adhere to the Comprehensive Shoreland Protection Act include: the Riverfront Residential Overlay District (Dover) and the Waterfront Protection Overlay District (Farmington).

LOCAL MODEL

The waterfront protection overlay district in Farmington has designated a Limited Development Zone, which comprises all areas that lie within one hundred (100) feet of any water body in the Town of Farmington, with the exception of those areas that lie within the Urban Residential District as defined herein, for which the Limited Development Zone shall comprise all areas that lie within fifty (50) feet of a water body.

Watershed Protection Overlay

The purpose of this overlay is to protect potential useable water resources in a municipality from pollution caused by land development. Providing additional regulations surrounding water bodies with higher watershed classifications provides further protection of water resources.

LOCAL MODEL

Class A Watershed Protection Overlay District in the Town of Newmarket. This district protects Class A surface waters by enforcing a minimum setback of 150' from these specific waters. Class A surface waters in Newmarket include the Piscassic River and Follett's Brook. Class A waters are higher quality waters which can potentially be used for water supply.

Water Resource Conservation Measures:

Water conservation is important in controlling water loss, waste, and use in order to preserve fresh water supplies. Water conservation measures include:[29]

- Water infrastructure enhancements and maintenance
- Education of water conservation techniques that results in altered behavior of water use in and around homes
- Setting up of water efficient hardware
- Improvements in water use management and accounting

Water conservation techniques for homeowners inside and outside of the home include: restricting lawn irrigation, low maintenance landscaping, fixing leaking pipes, and limiting of water use in the bathroom, kitchen, and laundry room. Homeowners can also perform a home water audit which can help determine what areas of water conservation that need attention in their homes. More information can be found at Home Water Efficiency: Home Water Audit.

NH DES and EPA WaterSense Program Partnership

NH DES has a formed partnership with the EPA WaterSense program to help promote water efficiency in the State. The program makes it easy for consumers to find and select water efficient products and services with a label backed by independent testing and certification. For more information see: http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/

NH DES Model Regulations

The EPA estimates that one-third of all residential water is for landscape irrigation. To assist municipalities in reducing landscape water use, NH DES developed a model regulation for landscape water efficiency. Recommendations include area limits for lawns, utilization of native plants, retention of mature trees, minimum loam requirements, and water efficiency provisions for in-ground irrigation systems. For more information see: http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/documents/mo-water-efficient-landscpg.pdf

Under RSA 38:26, municipal and privately-owned public water systems have had the authority to implement water use restrictions for water system customers. Municipalities also have the authority to restrict residential lawn watering for areas within their political boundaries if the state or federal government declares a drought condition for that region of the state. This authorizes a municipality to adopt regulations to restrict residential lawn watering during a drought for properties that obtain water from either public water systems or on-lot private domestic wells. NH DES developed model regulations. For more information see: http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/documents/mo-lawn-watering-rstrctn.pdf

Water use restrictions may provide public water suppliers with useful tools for the management of the public water supply in the case of drought or other emergency. NH DES prepared a model water use restriction regulation that a municipality or village district may adopt to restrict water use when there is a declared water supply shortage. For more information see: http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/documents/water_use_restrictions.pdf

NH DES Water Efficiency Practices

NH DES has a suite of factsheets for home, industrial, commercial, institutional, and agricultural water efficiency. Factsheets can be found at: http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm#efficiency

Drinking Water Protection

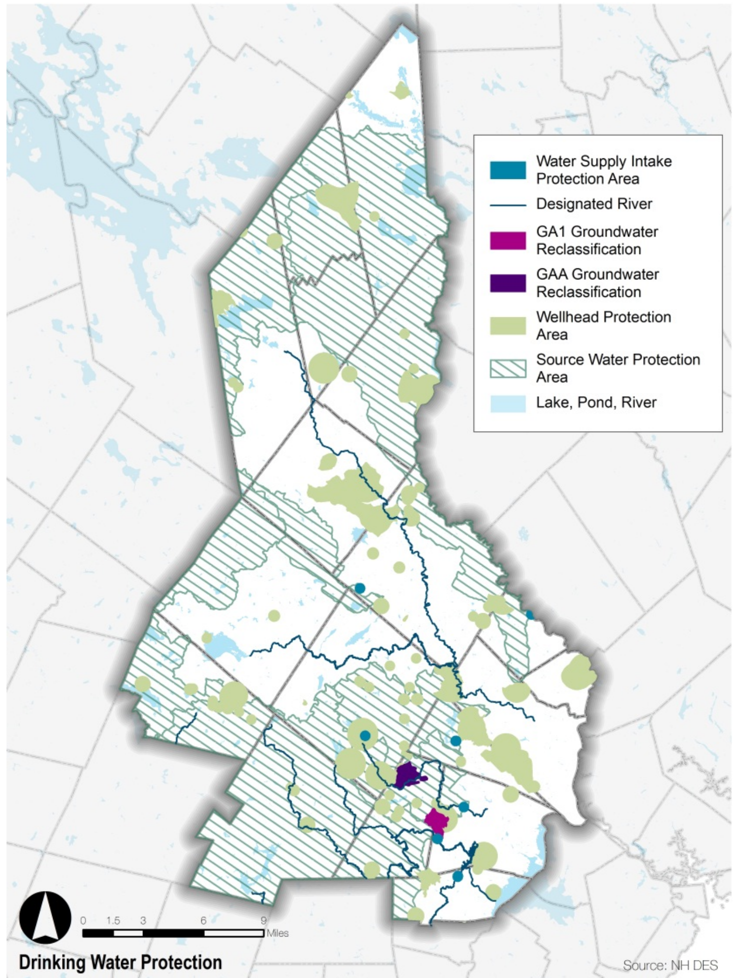
Eight communities (44%) in the region have incorporated a water resource management and protection plan into their municipal Master Plan (Table 9).[30] In addition to incorporating water resource protection into the community planning process, this can also put the municipality in a stronger legal position if any of their regulatory protection strategies are challenged in court.[31] Figure 2 displays designated surface and groundwater protection areas.

Groundwater Protection

NHDES established best management practices (BMPs) for potential contamination sources throughout the state under the Groundwater Protection Act. These BMPs consist of storage and handling guidance for non-residential activity that uses more than household quantities (5 gallons) of regulated substances. [32]

At the municipal level, groundwater protection ranges from conducting outreach and education or adopting a low-salt policy near a community well to creating a management program that enforces state BMPs. For example, a municipality may adopt a local health ordinance to require local compliance with ENV-421, BMPs, and establish a health agent's authority to enforce BMPs.[33] Local entities, including municipalities or water suppliers, also have the ability to apply to DES to reclassify wellhead protection areas or areas of high-value groundwater. Municipalities can adopt regulations that restrict land use development within wellhead and aquifer protection areas, such as an overlay district.[34] In addition, municipalities can use site plan review rules to protect groundwater resources.[35] Within the region, 11 communities (61%) have wellhead protection regulations and 16 (89%) have aquifer protection regulations (Table 9).[36] Eleven out of 18 communities (61%) have defined impervious surface limits in aquifer protection area. In communities that have defined surface limits, the average impervious surface limit in aquifer protection areas is 22% of lot coverage.[37] The Piscataqua Region Estuaries Partnership recommends that municipalities with impervious cover limits over 10%, or no defined limits for impervious cover above their aquifers, strengthen protections for these important areas which are often relied upon for drinking water and maintenance of stream base flows.[38]

Figure 2: Designated Drinking Water Protection Areas.



[Source: NHDES]

To assist communities with protecting groundwater resources, DES and OEP prepared a Model Groundwater Protection Ordinance that is designed for the protection of aquifers as well as other locally important groundwater, such as wellhead protection areas. The model provides an alternative to a strictly regulatory approach based solely on local use restrictions by including provision for inspections, measurable performance standards for best management practices and stormwater treatment, and protection of selected groundwater resources that serve as drinking water supplied to ensure the necessary resources can be focused in these areas.

At the state level, large groundwater withdrawals of 57,600 gallons or more during any 24-hour period from a well or wells installed after July 1998 at a single property or place of business require a permit from NH DES. NHDES has issued three Large Groundwater Withdrawal (LGW) permits in Strafford County and one LGW permit in Rockingham County.[39]

Municipalities have the ability to adopt local regulations that require local review and/or prohibit large withdrawals for export. Within the region, Farmington and Nottingham have adopted local regulations that prohibit large groundwater withdrawals for export purposes.[40]

Table 9: Drinking Water Protection Strategies of Municipalities in the Piscataqua Region Watershed

	Wellhead Protection Regulations?	Aquifer Protection Regulations?	Impervious Surface Limits in Aquifer Protection Area (% of lot coverage)	Source Water Protection District?	Prohibition on Large Ground Water Withdrawals & Export?	Water Resources Management Plan in Master or Community Plan?
Barrington	yes	yes	ND	no	no	no
Brookfield	no	no	ND	no	no	no
Dover	yes	yes	20	yes	no	no
Durham	no	yes	20	no	no	no
Farmington	yes	yes	10	no	yes	yes
Lee	no	yes	10	no	no	yes
Madbury	yes	yes	20	no	no	yes
Middleton	no	yes	20	no	no	no
Milton	yes	yes	ND	yes	no	yes
New Durham	yes	yes	15	yes	no	yes
Newmarket	yes	yes	ND	no	no	yes
Northwood	yes	yes	ND	no	no	yes
Nottingham	no	yes	10	no	yes	no
Rochester	no	yes	40	no	no	yes
Rollinsford	yes	yes	10	no	no	no
Somersworth	yes	yes	ND	no	no	no
Strafford	no	no	ND	no	no	no
Wakefield	yes	yes	50	no	no	no
Total in Region	11 yes 61%	16 yes 89%	11 61%	3 yes 17%	2 yes 11%	8 yes 44%

ND = not defined

[Source: Piscataqua Region Estuaries Partnership. Piscataqua Region Environmental Planning Assessment - 2010]

Groundwater Protection Act

New Hampshire's Groundwater Protection Act enables local entities to actively manage threats and potential contamination sources in order to protect valuable groundwater. Under the Act, all groundwater may be classified into one of four classes: GGA classification , which is the most protected class and includes groundwater contributing to public water supply wells (wellhead protection areas), prohibits six high risk land uses, and requires that local entities develop a management program that includes regular on-site inspections and distribution of educational material to potential contamination sources; GA1 classification that allows local entities to identify valuable groundwater resources they want to protect via management of potential contamination sources; GA2 classification that includes high-yield stratified drift aquifers mapped by the USGS that are potentially valuable sources of drinking water; GB classification that includes all groundwater not in another higher classification. Within areas reclassified to GGA or GA1, local health officers may enforce best management practices within state administrative rule Env-Wq 401 that apply to regulated substances. Reclassification allows protection to be applied across multiple communities according to the resource's boundaries. Durham and Madbury have GGA and GA1 classification areas (see Figure 2). For more information see:
http://des.nh.gov/organization/divisions/water/dwgb/dwspp/reclassification/permit_gw_reclassification.htm

Source Water Protection

NH DES established a Drinking Water Source Assessment Program (DWSAP) as part of the Drinking Water Source Protection Program to help improve protection of public water supply sources. The DWSAP improved public water supply source protection by providing information about the vulnerability of each of the approximately 2,950 public water supply sources in the state. This information was provided in the form of assessment reports (one for each public water supply source) to public water suppliers and the general public between 2000 and 2003. While DES was required by the Federal Safe Drinking Water Act Amendments of 1996 to have this program, it did have some discretion as to how the information was gathered to prepare the assessment reports. DES's approach, described in detail in its DWSAP Plan, was approved by the EPA in May 1999.

NH DES Model Drinking Water Ordinance for Protection of Surface Water Supply Areas and Sources

Pursuant to the local authority to adopt health regulations, a model ordinance restricting activities on surface water was created. The purpose of the ordinance is to preserve, maintain, and protect from contamination existing and potential drinking water supply areas and sources, and surface water bodies that are hierologically connected to them in the interest of public health, safety, and general welfare. The ordinance regulates land uses and activities within a primary and secondary buffer to protect existing or potential surface water supply areas and sources from the effects of point source and non-point sources pollution and sedimentation.

Adopting a source water protection district or overlay that protects natural surface source water areas buffers –such as a 300-400 foot wide zone of natural vegetation along a reservoir-- is one strategy a municipality can use to protect drinking water supplies.[41] Three communities (17%) in the region have source water protection districts (Table 9).

State Rules and Regulations

Wastewater Treatment Facilities:

- Env-Wq 304 Regulations Relating to the Certification of Wastewater Treatment Plant Operators (formerly Env-Ws 901)
- Env-Wq 500 Clean Water State Revolving Loan Fund
- Env-Wq 700 Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities
- Env-Wq 800 Sludge Management

Watershed Management:

- Env-Ws 451-455 Water Quality Certification Regulations (401 Water Quality Certificate)
- Env-Ws 1300 Exotic Aquatic Weed Control
- Env-Ws 1700 Surface Water Quality Regulations
- Env-Ws 1900 Rules for the Protection of Instream Flow on Designated Rivers
- Env-Wq 1800 Rivers Management and Protection Program
- RSA 483: Rivers Management and Protection Program
- RSA 483-A: Lakes Management and Protection Program
- RSA 487: Control of Marine Pollution and Aquatic Growth and the New Hampshire Clean Lakes Program

Sub-Surface Systems:

- Env-Wq 1000 Subdivision and Individual Sewage Disposal System Design Rules
- RSA 485-A Water Pollution and Waste Disposal

Drinking Water/Groundwater:

- Env-Dw 300 Sources of Water
- Env-Dw 500 Operation & Maintenance
- Env-Dw 600 Capacity Assurance
- Env-Dw 700 Water Quality: Standards, Monitoring, Treatment, Compliance, and Reporting
- Env-Dw 900 Protection of Water Sources

Dams:

- Env-Wr 100-700 Dam Rules
- Env-Wr 900 Official List of Public Waters
- RSA Chapter 482: Dams, Mills and Flowage

Public Drinking Water

Overview

The NH DES Drinking Water and Groundwater Bureau (DWGB) administers the Federal Safe Drinking Water Act (SDWA) and state statues to ensure the reliable provision of safe drinking water in 2,400 public water systems throughout the state.

DWGB protects groundwater by permitting and regulating large groundwater withdrawals and discharges to groundwater, and works with municipalities and water systems to implement local groundwater protection programs. Additionally, the DWGB coordinates the efforts of other DES programs to protect drinking water sources, implement the state's Water Well Program, promote conservation and accurate water reporting, and evaluate certifying laboratories that test water.[42]

Safe Drinking Water Act
The Safe Drinking Water Act (SDWA) was first passed in 1974 and amended in 1986 and 1996 and is the main federal law that ensure the quality of Americans' drinking water. SDWA authorizes the EPA to set national health-based standards for drinking water and oversees the states, localities, and water suppliers who implement those standards. Most states, including New Hampshire, have applied for and received "primacy," or the authority to implement SDWA within their jurisdiction because they will adopt standards that are at least as stringent as EPA's.
[Source: EPA Safe Drinking Water Act]

Water systems must be able to meet the highest anticipated demand with existing source water as well as plan for the continued growth of the service area. The quantity of water from a surface water source must be adequate to meet the maximum projected water demand of the service area as shown by calculations based on a one in fifty year drought or extreme drought of record and should include consideration of multiple year droughts. The quantity of groundwater obtained though wells should be adequate to meet the maximum demand from the system under the provision that the sources are also able to meeting the average daily demand from the system with the largest water supply well out-of service. Water supply wells must be tested to demonstrate sustainable well capacity and yield evaluation under a projected condition of constant water production during a six-month drought. Additionally, potential impacts associated with water withdrawal from wells on nearby water users and water-related natural resources must be mitigated through reducing the quantity of water produced or other measures.[43]

Water use data can help local and county officials, planners, water supply managers, and citizens understand the quantity of water used in a given year, the distribution of the population on household wells and using on-site disposal systems, and water withdrawal estimates by watershed.[44] Per capita water use may vary considerably depending on factors such as demographics, fixture efficiency, and landscape irrigation. The average per capita water use in the region is 75 gallons per capita per day (gpcd), ranging from 63 gpcd in the winter to 92 gpcd in the summer.[45] While improvements in efficiency have resulted in a downward trend in indoor water use, outdoor summer water uses has trended upwards.[46] Projected increases in temperature and summer drought in the region will likely result in an increase in peak demand during summer.

Access to basic needs such as clean, adequate supplies of drinking water is crucial to health and well-being of residents in the region. Protection and stewardship are important to maintaining clean sources of drinking water.

Drinking Water Sources

In New Hampshire, surface water-only systems, groundwater-only systems, and combined surface and groundwater sources supply public water systems (Table 10). Approximately 40% of New Hampshire residents are served by private wells.[47] Within the region, approximately 35% of the population had household wells as of 2005 (Table 11). Approximately 11.7 mgd were withdrawn from groundwater (36%) and surface water (64%) for community water systems. Domestic wells withdrew 3.83 mgd of groundwater in 2005 (Table 11).

Table 10: Statewide Community Drinking Water System Source Profile (2012)

Community Systems	# Systems	Population Served
Groundwater Sources (only)	623	292,106 (22% of CWS population)
Surface Water Sources (only)	20	216,073 (16% of CWS population)
Combined Sources (Surface and Ground)	17	277,200
Purchased Sources (only)	25	39,346
Purchased Sources with Groundwater Sources	15	43,949

[Source: NH DES Annual Compliance Report on Public Water System Violations - 2013]

Table 11: Strafford Region Public and Private Withdrawal by Source (2005)

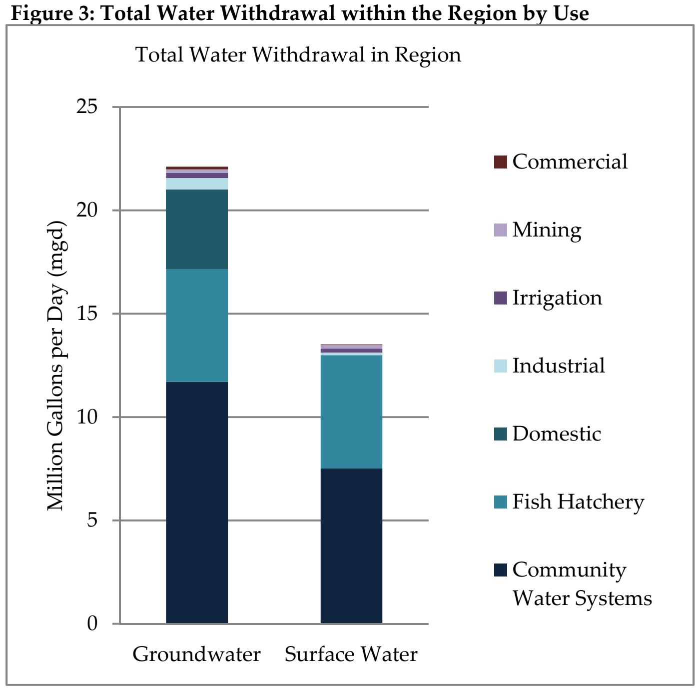
	2005 Withdrawal (mgd)
Population	144,075
Household wells (#)	51,007
Community water systems (#)	93,086
Withdrawal (million gallons/day)	
Total withdrawal	22.12
Groundwater	8.61
Surface water	13.51
Domestic[1] (groundwater)	3.83
Community System Withdrawal	11.7
Groundwater	4.19
Surface water	7.51

[1]Estimated, [2]Estimated and reported. [Source: USGS - 2005]

Household water use accounts for the majority of water withdrawal in the region (Figure 3). Community water system and domestic well groundwater withdrawals account for approximately 70% of total groundwater withdrawal in the region. Community water system surface water withdrawals account for approximately 56% of total surface water withdrawal in the region.[48]

Water rates in New Hampshire range from about $250 - $1,000 per year for a typical year-round customer.[49]

Figure 3: Total Water Withdrawal within the Region by Use



[Source: USGS – 2005]

Surface Water Sources

There are approximately 60 surface water supplies used as sources of public water supply in New Hampshire.[50] Surface water sources provide approximately 64% of the 11.7 mgd used by community water systems.[51] Surface water sources within the region include Berry River, the Bellemy Reservoir, Follet's Brook, the Lamprey River, Oyster River Reservoir, and the Piscassic River Salmon Falls (see Table 12).

Surface water is susceptible to contamination from sources such as stormwater runoff, pesticide application, sedimentation and erosion, failed septic systems, hazardous materials spills, injection wells, leaking chemical storage tanks, and wildlife.[52] Because there is risk of contamination from bacteria and disease-causing organisms, NHDES recommends that individual private homes not use surface waters not be used as the sources of drinking.[53]

Piscassic River, Newmarket

Photo credit: Newmarket Historical Society

Table 12: Sources of Surface Water and Population Served in the Region

Name	Municipality	Source	Population
Newmarket Water Works	Newmarket	Follet's Brook (Raw) Piscassic River/Raw Lamprey River/Raw	3,750
Portsmouth Water Works	Portsmouth	Bellamy Reservoir	33,000
Rochester Water Department	Rochester	Berry River/Raw	17,000
Somersworth Water Works	Somersworth	Salmon Falls/Raw	9,500
UNH/Durham Water System	Durham	Oyster River Reservoir (Raw) Lamprey River/Raw	12,600

[Source: NHDES – 2013]

Groundwater Sources

Groundwater withdrawn from fractured bedrock provides approximately 25% of the total drinking water and 85% of the water for private domestic wells in the State. Groundwater from bedrock also accounts for 8% of the drinking water supplied by public systems and 5 percent of the water used for commercial, industrial, and agricultural purposes.[54] Demand for groundwater from the bedrock aquifer has increased with the increasing cost of surface water treatment.[55]

There are approximately 805,500 acres (14% of total land area) of mapped stratified-drift aquifers in New Hampshire (see Figure 4).[56] These aquifers are scarce, scattered, under protected, and often not located near population growth areas in the state (Table 13). Stratified drift aquifers generally have a higher yield than bedrock wells because they have a higher transmissivity rate. The regional ground-water-flow system in the Seacoast Region is characterized by relatively thin and discontinuous surficial aquifers underlain by a fractured crystalline-bedrock aquifer. Average recharge is estimated at 1.6 feet per year.[57]

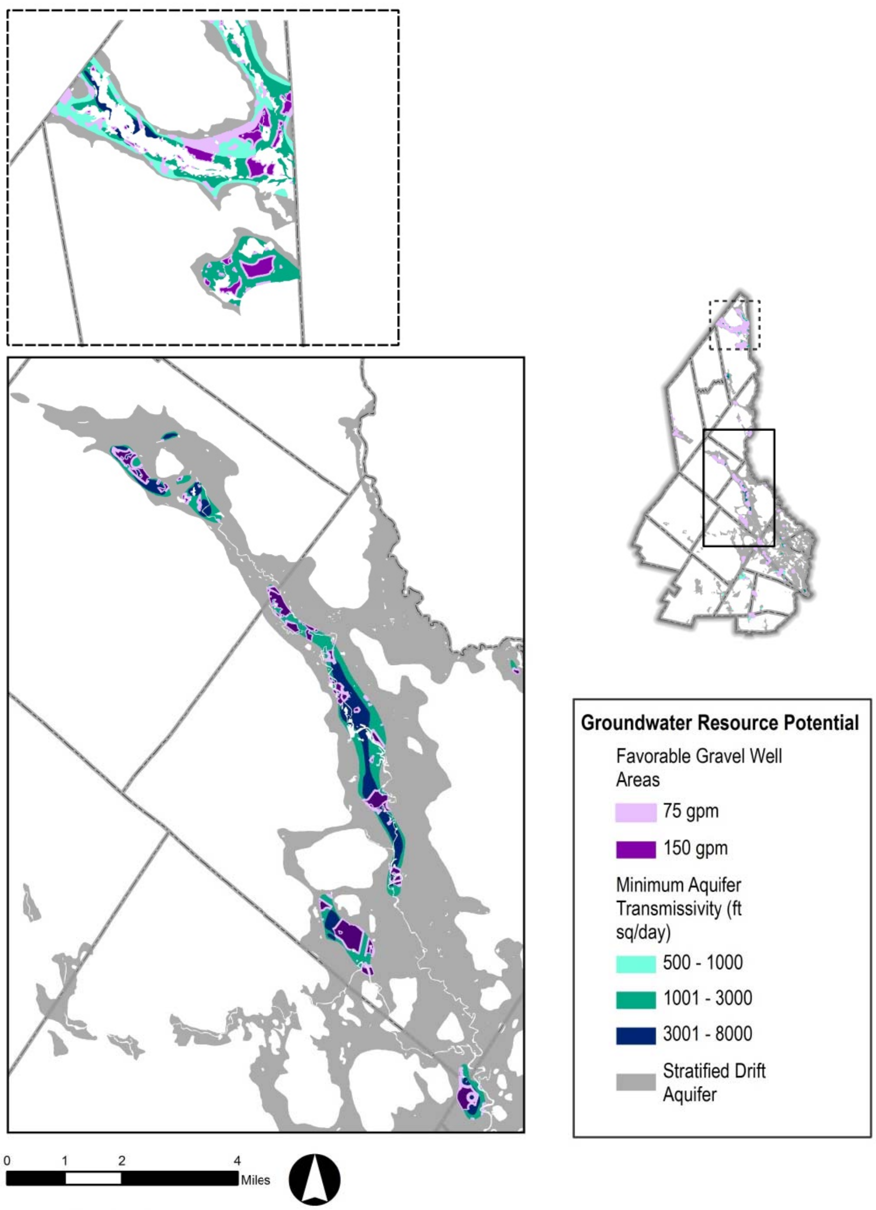
Groundwater drawn from high-yielding sand and gravel aquifers and fractured bedrock aquifers is the source of drinking water for Community Water Systems and approximately 51,007 people that use household wells within the region.[58] Within the region, there are approximately 58,880 acres of stratified-drift aquifer and most occurs in the southeast part of the region. Areas with the highest transmissivity (3,000 or more square feet per day) include areas along the Cocheco River in Farmington and Rochester and along the Pine River and Copp Brook in Wakefield.[59]

Access to basic needs such as clean, adequate supplies of drinking water is crucial to health and well-being of residents in the region. Protection and stewardship are important to maintaining clean sources of drinking water.

Wells

Wells can draw groundwater from unconsolidated soil and rock deposits above the bedrock and from fractures within bedrock. Most wells in New Hampshire are bedrock wells (also called drilled or artisanal wells), which draw groundwater from bedrock fractures. An average of 4,350 bedrock wells – with a median depth of 365 feet and a median yield of 8 gallons/minute - were drilled annually in New Hampshire between 2000 and 2010. Radon gas and arsenic contamination is often high in bedrock wells. Dug wells, which capture water in the upper unconsolidated soil and rock deposits, account for fewer than 10% of wells in the State. Point wells, which are typically 2-3 inches capture water in loose soil deposits, account for less than 2% of wells in New Hampshire and are typically 2-3 inches in diameter.
[NH DES – Overview of Water Supply Sources. 2010]

Figure 4: Map of Groundwater Resource Potential with Stratified Drift Aquifer with Transmissivity.



[Source: GRANIT, NHDES]

Table 13: Statistics for Stratified-Drift Aquifers in the Region

			FGWA 300			FGWA 400		
			High-Yield Wells (>75 gpm)			Very High-Yield Wells (>150 gpm)		
Municipality	Total Acres SDA	Percent of Total Land Area	Total Acres Suitable	Total Acres Protected	Percent Protected	Total Acres Suitable	Total Acres Protected	Percent Protected
Barrington	5421	18.2	1598	169	10.5	25	0	1.5%
Brookfield	1070	7.3	338	43	12.8	0	0	
Dover	12965	75.9	3630	1101	30.3	84	54	63.8%
Durham	738	5.2	73	40	54.6	39	23	58.4%
Farmington	2560	11.0	603	12	2.0	71	12	17.1%
Lee	2752	21.7	79	5	5.9	12	0	0.0%
Madbury	2814	38.0	963	262	27.2	83	25	30.4%
Middleton	102	0.9	24	0	0.0	0	0	
Milton	2,268	10.8	553	275	49.6	51	12	24.5%
New Durham	3641	13.8	247	56	22.9	41	14	33.9%
Newmarket	671	8.3	38	3	7.5	4	0	0.0%
Northwood	260	1.4	0	-	-	0	-	-
Nottingham	2106	7.0	0	-	-	0	-	-
Rochester	11285	39.9	2551	220	8.6	220	43	19.5%
Rollinsford	3616	77.3	1337	248	18.5	0	0	
Somersworth	4216	67.8	856	34	3.9	5	3	54.5%
Strafford	1377	4.4	113	1	1.2	0	0	
Wakefield	5712	22.6	795	2	30.0	208	0	0.0%
TOTAL	**63574**		**13760**	**2471**	**18.0**	**843**	**186**	**22.1%**

[Source: Society for the Protection of Forests. A guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified-Drift Aquifers. June 2010.]

Groundwater Withdrawals

Large groundwater withdrawals require a permit from NH DES. There are four users with large groundwater withdrawal permits in the region (Table 14).

Table 14: Large Groundwater Withdrawal (LGW) Permits and Water Usage in 1,000 Gallons per day in 2013

User	Name	Municipality	Hydrologic Unit	Action	Source Type	Sub Type	Average Daily Use (1,000 gpd)	Adjusted Average Daily Use (1,000 gpd)	Total Annual Usage
City of Rochester, Rochester Water Works User ID 20011 Strafford County	Round Pond To Reservoir	Barrington	Cocheco River	Withdrawal - Delivery	Surface Water	Pond	937.729	2098.361	256000
	Berry River To Reservoir	Farmington	Cocheco River	Withdrawal - Delivery	Surface Water	River	1769.231	2278.302	483000
	Rochester Reservoir	Rochester	Cocheco River	Withdrawal Of Water From The Ground Or Surface Water Body	Surface Water	Reservoir	2029.817	2029.817	554140
	Rch-1C	Rochester		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Packed Well	83.81	126.409	22880

User	Name	Municipality	Hydrologic Unit	Action	Source Type	Sub Type	Average Daily Use (1,000 gpd)	Adjusted Average Daily Use (1,000 gpd)	Total Annual Usage
	Rch-2A1	Rochester		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Packed Well	0	0	0
	Berry River To Round Pond	Rochester	Cocheco River	Withdrawal - Delivery	Surface Water	River	794.872	1808.333	217000
Milton Water Precinct User ID 20492 Strafford County	Milton Gpw	Milton	Salmon Falls River	Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Well	36.095	36.095	13174.7
	Rocky Point Well Field	Milton		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Well Field	39.126	39.126	14281
Lake Winnipesaukee Golf Course User ID 20673 Strafford County	Perry Hollow Brook	New Durham	Lake Winnipesaukee	Withdrawal - Delivery	Surface Water	Brook	34.228	67.899	12493.347
	Iw 1	New Durham	Lake Winnipesaukee	Withdrawal - Delivery	Groundwater	Bedrock Well	0	0	0
	Iw 2	New Durham	Lake Winnipesaukee	Withdrawal - Delivery	Groundwater	Bedrock Well	0	0	0
	Iw 3	New Durham	Lake Winnipesaukee	Withdrawal - Delivery	Groundwater	Bedrock Well	0	0	0
	Main Irrigation Pond	New Durham		Withdrawal Of Water From The Ground Or Surface Water Body	Surface Water	Pond	122.55	209.022	44730.653
	Club House Well 1	New Durham	Lake Winnipesaukee	Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Bedrock Well	0.125	0.186	45.667
	Club House Well 2	New Durham		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Bedrock Well	0.049	0.073	17.815
	Maintenance Building Well	New Durham		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Bedrock Well	0.272	0.405	99.221
Ne wm arke	Folletts Brook	Newmarket	Lamprey River	Withdrawal - Delivery	Surface Water	Brook	0	0	0

User	Name	Municipality	Hydrologic Unit	Action	Source Type	Sub Type	Average Daily Use (1,000 gpd)	Adjusted Average Daily Use (1,000 gpd)	Total Annual Usage
	Bennett Well	Durham	Lamprey River	Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Well	158.852	158.852	57980.996
	Sewall Well	Newmarket	Lamprey River	Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Well	216.081	216.081	78869.388
	Picassic River	Newmarket	Lamprey River	Withdrawal - Delivery	Surface Water	River	0	0	0
	Lamprey River	Newmarket	Lamprey River	Withdrawal - Delivery	Surface Water	River	0	0	0
	Nge-2B	Newmarket		Withdrawal Of Water From The Ground Or Surface Water Body	Groundwater	Gravel Packed Well	0	0	0

Average Daily Use: Average daily use for a specific source/destination calculated from actual reported monthly values, including months with zero values, expressed in thousands of gallons per day. Note: It may be more appropriate to review the adjusted average daily use for seasonal water users as months with zero usage are excluded in that computation.
Adjusted Average Daily Use: Seasonally adjusted average daily use for a specific source/destination calculated from actual reported monthly values, excluding months with zero values, expressed in thousands of gallons per day.
[Source: New Hampshire Department of Environmental Services One-Stop Data and Information Site]

Municipal Drinking Water Supply Distribution Systems

Public Water Supply Systems

Public water systems serve approximately 60% of New Hampshire's population.[60] There are three types of Public Water Systems (PWSs): Community ("C") systems, such as municipalities; Non-Transient Non-Community ("P") systems, such as schools or factories; and Transient Non-Community ("N") systems, such as restaurants and campgrounds systems.[61]

> Public Water System
> New Hampshire defines a public water system (PWS) as a system that provides water via piping or other constructed conveyances for human consumption to at least 15 service connections or designed to serve an average of at least 25 people for at least 60 days each year.

As of the 2012 PWS inventory the State had 2,474 active systems including 695 "C" systems servicing 858,671 people, 435 "P" systems, and 1,297 "N" systems. Most "C" systems are small systems that serve less than 500 people. Within the region, there are 174 "C" systems, 44 "P" systems, and 155 "N" systems.[62] The size and type of public water systems in Strafford, Rockingham, and Carroll Counties is displayed in Table 15. Figure 5 shows C, P and N systems within the region.

Table 15: Active Public Water Systems in Strafford, Rockingham, and Carroll Counties (7/12012-6/30/2013)

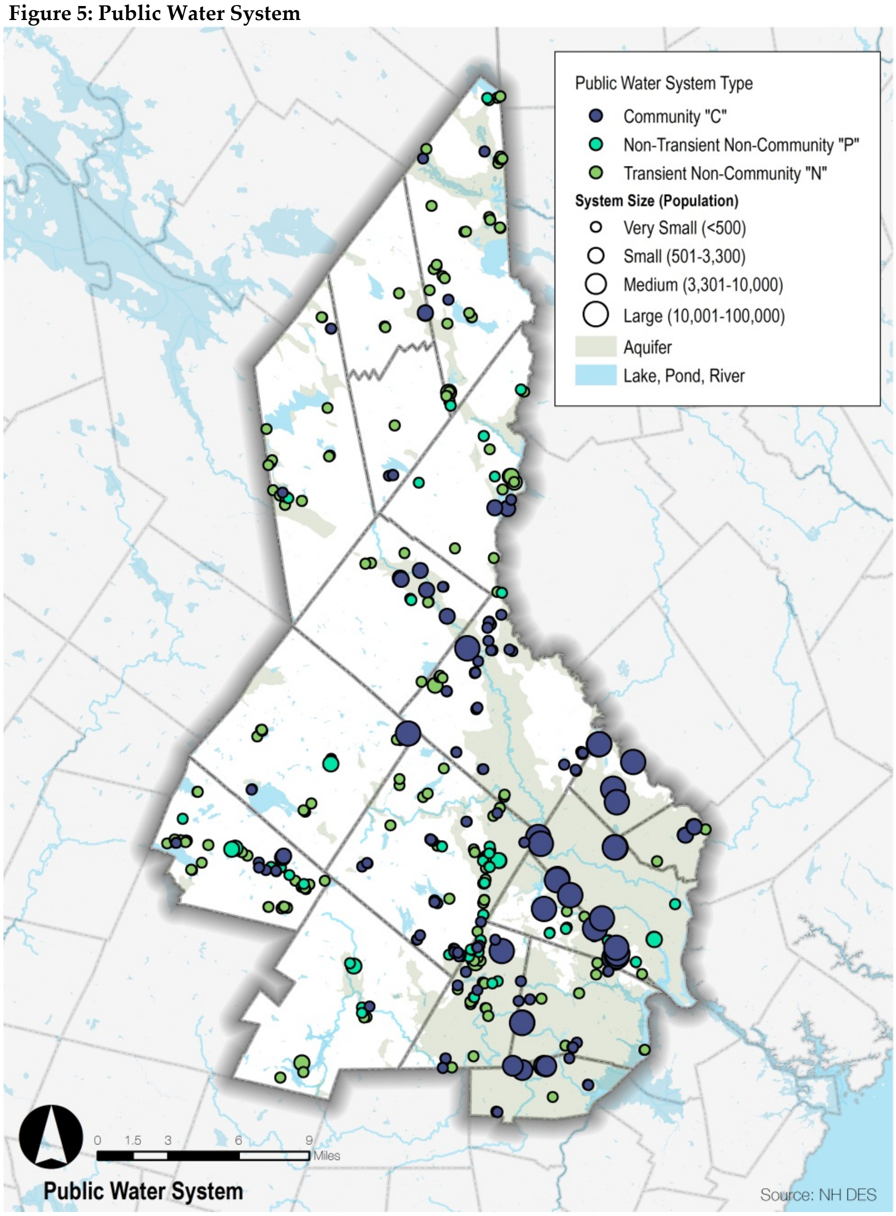
Strafford County					
Type of Water System	**Very Small <500**	**Small 501-3,300**	**Medium 3,301-10,000**	**Large 10,001-100,000**	**Grand Total**
Community Water System	40	3	-	4	47
	4,538	5,488	-	76,000	86,026
Non-Transient Non-Community Water System	21	2	-	-	23
	2,862	1,151	-	-	4,013
Transient Non-Community Water System	64	4	-	-	68
	7,518	2,650	-	-	10,168
Total Systems	125	9	-	4	138
Total Population	14,918	9,289	-	76,000	100,207

Rockingham County					
Type of Water System	**Very Small <500**	**Small 501-3,3000**	**Medium 3,301-10,000**	**Large 10,001-100,000**	**Grand Total**
Community Water System	173	13	3	6	195
	19,900	17,273	13,840	114,145	165,158
Non-Transient Non-Community Water System	120	21	-	-	141
	13,419	20,143	-	-	33,562
Transient Non-Community Water System	230	8	-	-	238
	32,247	5,820	-	-	38,067
Total Systems	523	42	3	6	574
Total Population	65,566	43,236	13,840	114,145	236,787

Carroll County					
Type of Water System	**Very Small <500**	**Small 501-3,3000**	**Medium 3,301-10,000**	**Large 10,001-100,000**	**Grand Total**
Community Water System	97 12,088	9 10,682	3 14,447	- -	109 37,217
Non-Transient Non-Community Water System	29 3,554	2 1,800	- -	- -	31 5,354
Transient Non-Community Water System	220 28,842	8 6,090	- -	- -	228 34,932
Total Systems	346	19	3	-	368
Total Population	44,484	18,572	14,447	-	77,503

[Source: EPA SCWISFED Drinking Water Data)

Figure 5: Public Water System



[Source: NHDES]

Public Utility Commission

The large majority of the State's residents are served by a municipal utility, a condominium or homeowners association, or by private wells. Approximately 10% of New Hampshire's residents are served by 16 water utilities in the state that own approximately 100 separate systems ranging in size from 26 customers to about 25,000. The Public Utilities Commission regulates water utilities that serve over 48,000 service connections in 60 cities and towns. [New Hampshire Public Utilities Commission – Biennial Report. 2013.)

There are five large water treatment plants (see below).

Table 16: Large Water Treatment Plants

Municipality	Water System	Population	Capacity	Plant/Treatment Processes
Dover	City of Dover	28,000	1.0 mgd 1.0 mgd	Groundwater Fe/ Mn Removal Lowell Road: Sodium hydroxide, potassium permanganate, pressure sand filter, waste to sewer. Groundwater: VOC, Fe/Mn: PHR Plant: Sodium hydroxide, potassium permanganate, pressure sand filter, aeration, waste to infiltration lagoon
Durham	UNH Durham Water System	16,000	1.5 mgd	Surface Water: Conventional Plant Poly aluminum chloride (PCH 180), rapid mix, potassium permanganate, sedimentation, Ciba (magnafloc LT 225), gravity multimedia filtration, sodium hypochlorite, sodium fluoride, sodium hydroxide, waste to lagoon with recycle
Newmarket	Newmarket Water Department	5,000	1.0 mgd	Surface Water: Conventional Plant Alum, sodium aluminate, powdered activated carbon, potassium permanganate, (aluminum chlorhydrate seasonally), upflow clarifier, polymer filter aid, gravity multimedia filtration, sodium hypochlorite, waste to sewer.
Rochester	City of Rochester Water Department	20,000	5.0 mgd	Surface Water: Conventional Plant Alum, sodium hydroxide, rapid mix, flog/coag sedimentation, sodium hypochlorite, ABW gravity filtration, ABW activation carbon adsorption, sodium hypochlorite, hydrofluorosilicic acid, sodium hydroxide, waste to pressure sewer
Somersworth	Somersworth Water Department	12,000	3.0 mgd	Surface Water: Microfloc Plant Potassium permanganate, Nalco 8105-cation charge, alum seasonally, powdered activated carbon, polydyne pw3 poly8-cation charge, upflow clarifer, multimedia, gravity filtration, sodium hypochlorite, sodium hydroxide, waste to recycle and sewer

[Source: NH DES – Large Surface Water Treatment Plants in New Hampshire. 2012]

City of Dover

The City of Dover water system consists of eight gravel-packed wells that provide access to four aquifers, approximately 150 miles of water main, 1090 hydrants, three water treatment plants and a 4 million gallon concrete storage tank on Garrison Hill (Table 17). Municipal water service is available to almost 68% of the City's land area and provides water to over 85% of the City's households and businesses. The system currently provides for 8,100 customers.[63] Surface water withdrawals from the Bellamy and Isinglass Rivers during certain times of the year supplement the recharge of two aquifer areas. A Groundwater Protection Ordinance protects the quantity and quality of the ground water around the city's wells by regulating land use within a specified protection zone.[64]

Table 17: City of Dover Well Source and Yield

Well	Source	Yield
Griffin Well	Pudding Hill Aquifer near the Bellamy River	500 gpm
Ireland Well	Pudding Hill Aquifer between Mast Road and Knox Marsh Road south of the Bellamy River	600 gpm
Calderwood Well	Hoppers Aquifer off Glen Hill Road near the Barrington line	500 gpm sustained yield and up to 700 gpm
Campbell Well	Hoppers Aquifer near the Calderwood Well	400 gpm sustained yield and up to 600 gpm with recharge from the Isinglass River
Smith & Cummings Well	Located 100 feet apart in the Willand Pond Aquifer between Glenwood Avenue, Central Avenue, the Spauding Turnpike, and Indian Brook Drive	535 yield
Hughes Well	Barbados Aquifer located off Old Stage Road near Barbados Pond	300 gpm
Bouchard Well	Located off French Cross Road near the Bellamy Reservoir	700 gpm

[Source: City of Dover, NH Master Plan]

UNH Durham Water System (UDWS)

UDWS supplied water for the University of New Hampshire and the Town of Durham. UDWS has three registered water sources: the Lee Well, the Oyster River, and the direct withdrawal from the Lamprey Designated River in Durham. The pumping station and intake on the Lamprey River are located in the reservoir approximately 2,700 feet upstream of Wiswall Dam. One raw water main transfers water withdrawn at the pump station and discharges it diretly to the Oyster River approximately one mile upstream from UNH's Arthur Rollins Water Treatment Plant (ARWTP) in Durham. A second raw water main was constructed in 2002 allow water withdrawn from the reservoir to be pumped directly to the ARWTP and thereby avoids losses of the transferred water within the Oyster River and riparian wetlands. Between 1970 and 2009, withdrawals from the Lamprey River were sporadic due to complexities and system deficiencies and supply needs were usually met with withdrawals from the Oyster River and the Lee Well. Starting in 2009, the Lamprey River became the principal source of water for the UDWS when flow on the Lamprey River exceeds 45 cfs. Annual water used from the Lamprey River between 1993 and 2008 ranged from 0 to 121 million gallons/year due to experimentation as the Lamprey River withdrawal was transitioned from a direct discharge to the Oyster River Reservoir to a direct connection with the ARWTP.[65]

Capacity of the UDWS pumps at the withdrawal from the Lamprey Designated River is 1.8 mgd. The Oyster River reservoir has an estimated storage volume ranging from 9 to 14.7 million gallons. Water supply from the Oyster River and Lamprey River is limited by the maximum capacity of the Arthur Rollins treatment plant, which is 1.55 mgd. The Lee Well has an estimated sustainable yield of 0.54 mgd.[66]

Newmarket Water Department

Newmarket's public water system serves approximately 5,000 of the town's residents and has approximately 2,000 water service connections. The water system currently withdraws water from two groundwater sources: the Bennett and Sewell Wells. These wells are located in the Newmarket Plains Aquifer, a sand and gravel aquifer off Route 152, west of the downtown. The water distribution system consists of a 750,000-gallon water tank, approximately 22 mile of water lines, over two hundred hydrants, and a booster station located on Folsom Drive. By 2030, the average daily demand for water is expected to exceed 550,150 gpd. The town has identified four projects for implementation that would increase the supply and storage capacity and make improvement to the water distribution system necessary to meet projected demand.[67]

City of Rochester Water Department

The primary source of water for the City of Rochester Water Department water system is the Rochester Reservoir. Water diverted from the Berrys River watershed is stored in the reservoir and Round Pond. Drinking water is also produced from the recently constructed Cocheco Well Treatment Facility, which supplied approximately 13.6 million gallons of groundwater in 2012. The distribution system consists of approximately 120 miles of water main, three water storage tanks, five water booster stations, and approximately 8,000 service connections. Annual consumption of drinking water was 736.9 million gallons in 2012.[68] The capacity of the system is 5.5 mgd.

Rollinsford Water and Sewer District

Two bedrock wells and one gravel pack well provide water to the Rollinsford public water supply. The public water system serves about 1688 residents and supplies approximately 72,000 gpd. The system has 639 service connections.

Somersworth Water Department

The Somersworth water treatment facility water source is the Salmon Falls River. The facility provides water to over 12,000 residents and many commercial and industrial users including Velcro USA, General Electric, and several medical centers. Averaged daily finished water production at the facility is 2.5 mgd with a 6 mgd capacity (9 mgd max capacity).[69]

Additional Withdrawal from Region

The City of Portsmouth Water Department owns rights to the Bellamy Reservoir and has drawn water from the reservoir since the early 1960s.[70] Madbury's water treatment plan has a 4.5 mgd capacity and a 2.5 mgd safe yield. Just under one mgd of water is drawn from Portsmouth's four wells in the Johnson Creek aquifer.[71]

The Bunker Lane Mobile Home Park and one private dwelling in Madbury receive water from the Portsmouth Water Treatment Facility. Residents of Madbury and Dover account for 8% (142 people) and 1% (5 people) of the people served by the Portsmouth Water Treatment Facility.

Drinking Water Quality

The Public Water System Supervision (PWSS), established by EPA under the SDWA, sets national limits known as Maximum Contaminant Levels (MCLs) and Maximum Residual Disinfectant Levels (MRDLs) on contaminant levels in drinking water to ensure safety for human consumption. All PWSs are required to comply with drinking water standards, water quality monitoring and reporting requirements, public notification requirements, and operational and construction standards. New Hampshire submits data, including PWS inventory information, the incidence MCL exceedances, MRDLs, monitoring and reporting (M/R) and treatment technique (TT) violations, and information on enforcement activity related to violations, to the Safe Drinking Water Information System (SDWIS) each quarter. In 2012, the majority of PWS violations in New Hampshire were the due to failure to monitor and most violations occurred at PWSs serving populations less than 500.[72] However, New Hampshire generally tends to have a higher number of MCL occurrences than other states.[73] Table 18 displays violations in PWS in Strafford, Rockingham, and Carroll Counties by violation type and contaminant.

Table 18: Violations in Public Water Systems in Strafford, Rockingham, and Carroll Counties (7/1/2012 – 6/30/12)

		Strafford County				**Rockingham County**				**Carroll County**			
		Violation Type				Violation Type				Violation Type			
Contaminant Type		MCL	MR	Other	TT	MCL	MR	Other	TT	MCL	MR	Other	TT
Total Coliform Rule	Violations	7	21	-	-	54	63	-	-	17	38	-	-
	Sys. in Violation	6	18	-	-	37	52	-	-	16	34	-	-
	Pop. in Violation	20,523	2,157	-	-	5,526	5,397	-	-	7,717	6,485	-	-
Stage 1 Disinfectants By-Product Rule	Violations	4	-	-	-	-	3	-	-	-	-	-	-
	Sys. in Violation	1	-	-	-	-	2	-	-	-	-	-	-
	Pop. in Violation	150	-	-	-	-	232	-	-	-	-	-	-
Groundwater Rule	Violations	-	3	-	4	-	10	-	19	-	8	-	16
	Sys. in Violation	-	3	-	4	-	9	-	19	-	8	-	16
	Pop. in Violation	-	145	-	506	-	782	-	2,404	-	1,825	-	1,958
Arsenic	Violations	2	1	-	-	22	2	-	-	1	-	-	-

Contaminant Type		Strafford County				Rockingham County				Carroll County			
		Violation Type				Violation Type				Violation Type			
		MCL	MR	Other	TT	MCL	MR	Other	TT	MCL	MR	Other	TT
	Sys. in Violation	2	1	-	-	12	1	-	-	1	-	-	-
	Pop. in Violation	100	25	-	-	4,402	88	-	-	431	-	-	-
Nitrates	Violations	-	1	-	-	2	6	-	-	-	3	-	-
	Sys. in Violation	-	1	-	-	2	6	-	-	-	3	-	-
	Pop. in Violation	-	300	-	-	142	927	-	-	-	505	-	-
Other Inorganic Chemicals	Violations	-	-	-	-	-	-	-	-	-	2	-	-
	Sys. in Violation	-	-	-	-	-	-	-	-	-	2	-	-
	Pop. in Violation	-	-	-	-	-	-	-	-	-	838	-	-
Other Volatile Organic Chemicals	Violations	-	42	-	-	-	84	-	-	-	63	-	-
	Sys. in Violation	-	2	-	-	-	4	-	-	-	3	-	-
	Pop. in Violation	-	208	-	-	-	203	-	-	-	573	-	-
Synthetic Organic Chemicals	Violations	2	-	-	-	-	76	-	-	-	1	-	-
	Sys. in Violation	1	-	-	-	-	4	-	-	-	1	-	-
	Pop. in Violation	45	-	-	-	-	294	-	-	-	43	-	-
Radionuclides	Violations	-	-	-	-	4	3	-	-	3	4	-	-
	Sys. in Violation	-	-	-	-	1	1	-	-	2	2	-	-
	Pop. in Violation	-	-	-	-	35	42	-	-	55	118	-	-
Lead and Copper Rule	Violations	-	7	-	-	-	36	-	9	-	8	-	4
	Sys. in Violation	-	7	-	-	-	33	-	7	-	7	-	3
	Pop. in Violation	-	711	-	-	-	10,392	-	2,211	-	2,961	-	223
Consumer Confidence Report Rule	Violations	-	-	6	-	-	-	34	-	-	-	12	-
	Sys. in Violation	-	-	6	-	-	-	27	-	-	-	11	-
	Pop. in Violation	-	-	435	-	-	-	3,930	-	-	-	7,450	-
Public Notification Rule	Violations	-	-	105	-	-	-	152	-	-	-	260	-
	Sys. in Violation	-	-	15	-	-	-	58	-	-	-	31	-
	Pop. in Violation	-	-	1,830	-	-	-	9,622	-	-	-	8,166	-
MCL: Health-Based: Maximum Contaminant Level						MR: Monitoring or reporting violation							
Other: Other violation, including public notice violation						TT: Health-Based: Treatment Technique							

[Source: EPA SDWISFED Drinking Water Data]

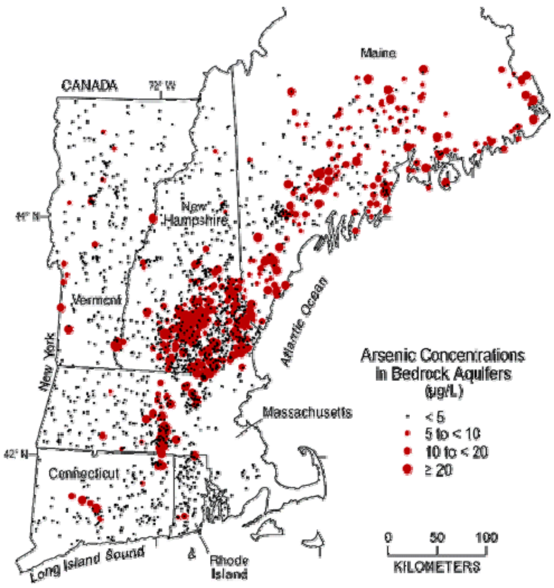
NH DES conducted assessments of the vulnerability of public water supply sources between 1999 and 2003. Summary assessment reports were generated by municipality as well as by source and are available through NH DES (see:http://des.nh.gov/organization/divisions/water/dwgb/dwspp/dwsap.htm). Table 19, below, shows the average rankings of all sources.

Table 19: Average Ranking of all Sources for which Assessments were Completed as of January 2003

System Type	Average Number of Susceptibility Rankings		
	Highs	Mediums	Lows
Community “C”	1.9	2	7.8
Community Surface Sources	1.3	2.5	7.8
Non-Transient, Non-Community “P”	2.8	2.5	6.7
Transient “N”	1.8	-	7.2

[Source: NH DES – All Sources of Public Drinking Water. January 3, 2003]

Figure 6: Location of Wells and Concentrations of Arsenic in Water from Bedrock Aquifer Wells.



[Source: USGS. 2013.]

Private Water Supply Systems

New Hampshire is ranked third in the nation for the number of households on private wells.[74] Approximately 40% of residents in New Hampshire use private, household drilled or dug wells.[75] About 35% of the total population in the region is served by household wells.

High levels of natural contaminants are common in private wells. NH DES estimates that 95% of private wells would exceed the proposed federal MCL PWS standard of 300 pCi/L for radon and 20% of private wells would exceed the federal MCL PWS standard of 10 ug/L for arsenic.[76, 77] Arsenic levels are higher in Southeast New Hampshire than other regions of the State and New England (Figure 6).

While there are no state requirements relative to water quality or quantity for private home wells, some municipalities have local requirements for private water wells. NH DES encourages well testing and education about the importance of well testing. Municipalities can require testing, and compliance with MCLs, and facilitate community-wide voluntary testing events. One strategy would be to require testing of a minimum number of test wells when subdivisions are approved.[78]

Future Municipal Drinking Water Supplies

Projections of future water demand account for factors including population per housing unit, median value of owner-occupied single family homes, median year of housing construction, population density, housing unit density, and proportion of housing units that are in urban areas. Using a Travel Demand Model and applying current domestic and non-domestic coefficients, water demand in the Seacoast Region was projected for 2017 and 2025 using the housing and employee projections for those years. In 2003 water demand was estimated at 26.3 million gallons per day. Domestic demand accounted for 72% or 19.0 mgd. From 2003 to 2025, domestic water demand is projected to increase by 54% to 28.7 mgal/day based on future population growth in the region.[79] More current projections that reflect observed and projected demographic shifts would likely vary from this projected domestic water demand from 2003.

A cost effective alternative to the expansion of water production facilities to meet potential increase future demand is a conservation water plan. A conservation plan maximizes system efficiency through water loss control measures and attempts to reduce customer demand through rate structures and social marketing programs.[80]

Groundwater Source Investigations

The Society for the Protection of Forest conducted a Favorable Gravel Well Analysis and found that, after accounting for a groundwater quality-based buffers including roads and highways, hydrological features, known and potential contamination sites, and urban features around wells, only about one-quarter to one-third of all the sand and gravel aquifer land area statewide remains.[81] Only a portion of the area remaining is suitable for large municipal well development on the basis of high yield. In addition, between 2002 and 2010, over 30 square miles of aquifer land area was lost to development.[82]

Well testing is important for ensuring safe drinking water and protecting health.

Within the region, there are a total of 63,574 acres of stratified-drift aquifer (SDA). A total of 18% of the remaining 13,760 total acres suitable for high-yield wells are protected. There are only 843 acres suitable for very-high yield wells of which 22.1% are protected (Table 15).[83]

Aquifers in Madbury, for example, are currently operating at maximum sustained yield. There is limited potential of future water sources, however, Freshet Creek Aquifer and an expansive area primarily in Barrington have been considered as potential aquifers. There may be a significant fault at the border between the Eliot and Berwick formations where water may be present but bedrock wells are vulnerable to overuse and will not offer an infinite supply of water.[84]

Recharge Projects

Both precipitation and induced flow from surface water can recharge groundwater. One study of groundwater recharge in the region assessed the opportunity to increase well water withdrawal by increasing the capacity of water storage in the aquifer. Emery & Garrett Groundwater Investigations, Inc. (EGGI) investigated the potential to artificially recharge the Newmarket Plains Aquifer to enhance withdrawals from the Town's two Production Wells by increasing groundwater storage in the aquifer. EGGI installed borings and monitoring wells, conducted percolation tests, and assessed geochemical testing carried out to determine the effectiveness of natural filtration of surface water through the local subsurface sand and gravel deposits. Modeling of the aquifer indicated that artificial recharge can increase productivity of the Town of Newmarket Production Wells by 70%. The State granted Newmarket an Artificial Recharge Permit and promulgated new regulations and guidelines regarding recharge as a result of the very favorable findings of this investigation.[85]

NH DES created guidance for artificially recharging aquifers as well as discharging treated wastewater to land surfaces for infiltration or irrigation purposes to ensure that artificial recharge projects are driven by quality concerns.

Artificial Recharge Examples in the Region

The Town of Newmarket completed a permitting process that will enable the town to discharge raw river water on the land surface to recharge the Newmarket Plains aquifer.

The City of Dover has used an artificial recharge system to supplement its water supply for 20years. Between November and May when river water levels are at their highest, water is pumped to a gravel pit and the water then infiltrates into the aquifer, increasing the available storage for use in the high demand summer months.

Interconnectivity Study

In 2006, Woodward and Curran conducted a Seacoast NH Emergency Interconnection Study to examine mutual aid between water utilities.[86] The evaluation assessed the potential for 10 water utilities — including the City of Dover, Newmarket Water District, City of Rochester Water Department, City of Somersworth Water Department, and UNH/Durham Water Works within the Strafford region — to provide water transfers to each other during periods of emergency. The evaluation looked at a number of existing and potential interconnecting points between various systems, assessed the potential for successfully transferring water between utilities for various durations of under six months, and considered the potential for hydraulic and capacity problems to interfere with water transfer through a particular interconnection. Water quality and public health concerns that could result from the interconnections were also assessed.

Benefits of a mutual aid approach:
- Greater redundancy
- Provision of water supply options during an emergency
- Enhanced service reliability
- Greater ability to provide uninterrupted service to customers

There are 5 surface water supplies and 50 groundwater supplies within the 10 Seacoast water utility systems that serve approximately 145,000 people over a 250 square mile area. There are currently only two interconnections between the 10 utilities (between Portsmouth and Rye and between Aquarion and Seabrook) that have been used during emergencies.

The study examined 15 potential interconnections between the water utilities using WaterCAD hydraulic modeling software at a selected flowrate. The initial flowrate was chosen based on considerations including how much excess capacity the donor utility had, the anticipated amount of aid that the receiving utility might need during an emergency, and the duration of transfer among others. Short, medium, and longer term transfers ranging from one day to up to six months were evaluated to simulate transfers needed due to situations such as fire demand or emergency repairs, reduced water levels or equipment failures, and supply contamination or loss of river crossings.

The study examined infrastructure requirements, hydraulic limitations, water quality issues to be aware of, procedures for mitigating potential water quality issues, and an order of magnitude cost for implementing the necessary improvements. In some instances, adjacent water systems with similar water quality may be able to blend waters from both systems with minimal impact, while other interconnections may pose a greater risk to the receiving systems in terms of water quality. Transfers between surface water supply and groundwater supply may present more complications. Table 20 displays critical system parameters including treatment, pH, system storage, etc. that were included in the study.

Table 20: Critical Parameters Associated with each Treatment System

Characteristic	Aquarion (Hampton)	Dover	Durham	Newmarket	Portsmouth	Rochester	Rollinsford	Rye	Seabrook	Somersworth
Source	GW	GS/SW	SW/GW	GW/SW	SW/GW	SW	GW	GW	GW	SW
Treatment			Conven.		Conven.	Conven.			Fe/Mn	UC/RS
Primary Disinfectant	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	None	Chlorine	Chlorine
Secondary Disinfectant	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	Chlorine	None	Chlorine	Chlorine
pH of Finished Water	7.9-8.5	7.3-7.7	9.0-9.5	8.0-8.5	7.5-8.5	7.6	8	7.4	7.0-7.6	7.3-7.5
Flouridation	N	Y	N	N	Y	Y	N	None	N	N
System Storage (MG (# of Tanks))	2.05 (4)	4.0 (1)	4.6 (3)	0.75(1)	9.84 (6)	4.35 (4)	0.75 (1)	2.35 (3)	1.72 (2)	2 (2)
HGL (ft nominal)	249/171	305	272/211	257	242/171/142	495/435/395	229	252/171	207	298

[Source: Woodward & Curran. 2006]

When combined, the 10 utilities have an average of 4.2 mgd of excess capacity (12% of the 33.6 mgd total current production capacity) that could be shared with neighboring utilities (Table 21). Approximately 16.8 mgd of excess capacity is available if average daily demand versus total supply is compared. Dover (2.6 mgd), Portsmouth (1.8 mgd), and Somersworth (1.5 mgd) provide a combined 5.9 mgd or 80% of the excess water available. Newmarket, Rochester, and Rollinsford had little excess water to share because their maximum daily demand equaled their total overall supply and could be recipients of mutual aid but not donors.

Newmarket, Rochester, and Rollinsford had little excess water to share because their maximum daily demand equaled their total overall supply and could be recipients of mutual aid but not donors.

Communities that have interconnected water treatment facilities are able to transfer water to each other during periods of emergency. Interconnectivity increases communities' capacity to respond to and cope with projected increases in precipitation and extreme weather events.

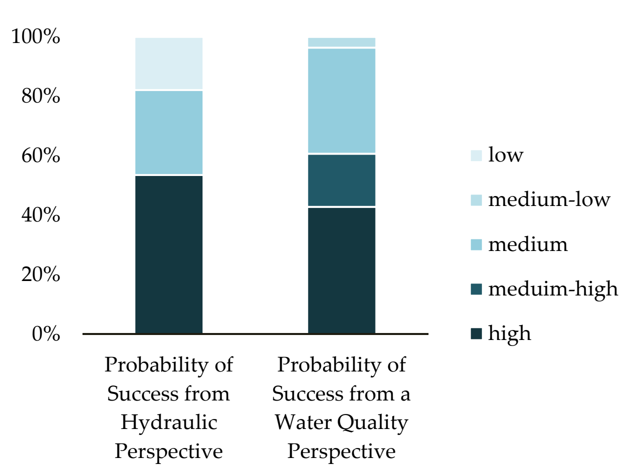
Table 21: Current Water Supply and Demand

		Aquarion (Hampton)	Dover	Durham	Newmarket	Portsmouth	Rochester	Rollinsford	Rye	Seabrook	Somersworth	Total
Current Supply (mgd)	Wells	5.1	4.2	0.5	0.6	5.1	0	0.2	1.2	3.32	1	21.2
	Surface Water	0	0	1.6	0	4	3.8	0	0	0	3	12.4
	Total	5.1	4.2	2.1	0.6	9.1	3.8	0.2	1.2	3.3	4	33.6
Current Year Demand (mgd)	Avg. Daily	2.4	2.8	0.8	0.45	5.2	2.1	0.14	0.4	1.4	1.8	17.5
	Max. Daily	4.9	3.8	1.7	0.55	10	3.2	0.15	0.8	2.2	2.2	29.5
	Excess Capacity on Average Day (mgd)	2.7	2	1.3	0.15	3.9	1.7	0.06	0.8	1.9	2.3	16.8
	Excess Capacity on Max Day (mgd)	0.2	0.6	0.4	0.05	0	0.6	0.05	0.5	0.3	1.5	4.2
Winter Demand (mgd)	Avg. Daily	2	1.9	1.2	0.45	5.2	1.4	0.14	0.32	1.1	1.4	15.1
	Max. Daily	2.2	2.6	1.7	0.55	10	2	0.15	0.32	1.8	2	23.3
Summer Demand (mgd)	Avg. daily	3	2.8	0.7	0.5	5.2	2.8	0.14	0.8	1.5	1.8	19.2
	Max. Daily	4.9	3.8	1	0.55	10	3.2	0.15	0.8	2.2	2.2	28.8
2020 Demand (mgd)	Avg. Daily	2.8	2.7	3.3	0.64	7.4	2.9	0.2	0.5	2.3	3.5	26.2
	Max Daily	6.3	4.3	6.3	1.1	12.9	5.4	0.2	0.8	5	5	47.3

[Source: Woodward & Curran. 2006]

The total combined distribution system storage of the ten utilities is 32.7 mg or about two days' supply at the combined average usage. Durham is the only utility that has a lower demand for water in the summer months and could potentially share 400,000-500,000 gallons/day with neighboring utilities. Because maximum daily demand — projected at 47 mgd by 2020 — exceeds the current available supply by over 10 mgd, additional sources will continue to be needed.

Figure 7: Probability of Interconnection Success



[Source: Woodward & Curran. 2006]

The study concluded that over 80% of the interconnections evaluated had a medium or high probability of success from a hydraulic perspective and over 95% had a medium or high probability of success from a water quality perspective (Figure 7).

The capital investment for the interconnections is estimated at $41,106,250 (in 2005 dollars), with an average cost of $2,569,141 and a range of $235,000 to $6,268,750.[87]

Durham is the only utility that has a lower demand for water in the summer months and could potentially share 400,000-500,000 gallons/day with neighboring utilities.

For more information on population projections in the region, see the FHEA Appendix.

Projections of Demand

The New Hampshire Water Sustainability Commission reports that some parts of the state are more likely than others to push the limits of the available future water resources. Water supply systems in some locations may be inadequate to meet future demand. Although water use on a per-person basis is declining, projected population growth in the state – approximately 200,000 people over the next 20 years—will result in greater water demand.[88] In the Seacoast region, domestic water demand is expected to grow by 54% between 2003 and 2025, and non-domestic water demand by 62 percent.[89]

USGS prepared water use and projected demand in 2005 and 2020 for both New Hampshire and Vermont. Table 22 displays the total projected water demand in 2030 and percent change from 2005 to 2030 for the 18 communities within the region. Total CWS and domestic groundwater withdrawal is projected to increase by just over 7% by 2030 from 2005 to 2030, with withdrawals from groundwater increasing approximately twice as much as withdrawals from surface water.[90]

Table 22: Water Use Estimates in the Region in 2030

	2030	Percent Change 2005 - 2030
Population	160,477	11.38
Household wells (#)	58,896	15.47
Community water systems (#)	101,581	9.13
On-Site Disposal Systems (#)	87,310	13.70
Wastewater Treatment Systems (sewers) (#)	73,176	8.74
Withdrawal (million gallons/day)		
Total withdrawal	23.73	7.28
Groundwater	9.52	10.57
Surface water	14.21	5.18
Domestic[1] (groundwater)	4.42	15.40
Community System Withdrawal	12.71	8.63
Groundwater	4.5	7.40
Surface water	8.21	9.32
Return Flow (million gallons/day)		
On-Site Disposal Systems	87,310	13.70
Wastewater Treatment Systems (sewers)	73,176	8.74
Total Return Flow	24.93	8.06
Groundwater	5.66	13.65
Surface water	19.27	6.52
Domestic (groundwater)	5.5	13.64
Community Water System (surface water)	1.52	5.85
Community Wastewater System	12.42	9.72
Groundwater	0	-
Surface water	12.42	9.72

[1]Estimated, [2]Estimated and reported

[Source: DES, USGS. 2009]

Future Variables

Variables that impact future water demand projections include: economic conditions and economic development trends, population, demographics, land development, climate and water efficiency.[91]

Temperature and precipitation trends affect the rate of evapotranspiration and have a significant impact on the amount of water used in the summer and fall for irrigation of lawns, crops or golf courses. Temperature has already increased in the region and is projected to continue to increase as the concentration of carbon dioxide in the atmosphere increases. As a result, the quantity of water required to offset increased evapotranspiration to maintain irrigated landscapes will increase. Climate change is also projected to have a lengthening effect on the growing season, which will further increase water use. The increase in extreme precipitation events associated with climate change may reduce the potential for rain to infiltrate into the ground, reducing water availability.[92] Finally, increased runoff, flooding, and sea level rise may also threaten the quality of surface and ground water supplies. Heavy downpours can increase the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies, making them unusable, unsafe, or in need of water treatment.[93]

Maintenance and replacement of aging infrastructure and future improvements and implementation of water efficiency measures also impact future water use. Detecting leaks and minimizing water loss play a fundamental role in the efficient operation of community water systems. Upgrading aging and inefficient infrastructure reduces the unnecessary stress to water sources, system infrastructure, and the environment and can reduce revenue loss.[94] At the regional and local level, water conservation plans for water systems and large groundwater withdrawal permits, model landscape regulations to minimize residential lawn watering, water supply and wastewater energy efficiency initiative, and financial incentives can reduce water use.[95] Management techniques for reduction of homeowner water use include water use and conservation audits, water fixture retrofitting, irrigation scheduling, and xeriscape.[96]

Understanding and taking into account the impact of land development activities driven by economic and population growth on water quality and water availability is a challenge to projecting and managing future water resources.[97] The New Hampshire Water Sustainability Commission, which was created by Executive Order in April, 2011, prepared a final report with recommendations to ensure that the quality and quantity of New Hampshire's water is as good as or is better in 20 years than it is today. One component of the final report is a set of guiding principles for sustainable decision-making about water. These principles are listed in the box below.

NH Water Sustainability Commission's
Guiding Principles for Sustainable Decision-Making about Water

Residents, businesses and other institutions understand the value of and work together to conserve water and use it efficiently.

Public policies, program, laws and practices are based upon the knowledge that New Hampshire's environment is the sources of abundant, clean water that supports human and ecological life, and, in turn, the state's economy. Access to enough clean water is a key element of our state's quality of life.

Decisions concerning water reflect how water moves and interacts with the landscape, are coordinated within a watershed system, are science-based and collaborative, and engage individuals and local, state, and federal officials, as needed.

Recognizing that there is often uncertainty as well as opportunities for innovation, we make decisions that protect the ability of our water systems to support our natural environment and human communities over the long term.

Asset Management

NH DES Drinking Water and Groundwater Bureau offers asset management capacity development and technical assistance. Asset management is a decision making tool to help determine how and where to allocate funding. Most community water systems are already using many elements of an asset management plan but could benefit from packaging the elements in a way that facilitates informed decision making and communication. NH DES suggests that entities:

- Create/update an asset inventory with new information from recent projects
- Create/update maps and drawings to include location of assets
- Review/track current and future expenses and develop a plan to replace assets
- Review current rates/user fees to see if they are adequate to fund future replacements, and if not, increase rates by small increments each year until they are.

Elements of an Asset Management Plan:

- maps
- equipment inventory
- condition assessment
- preventative maintenance plans
- identification of critical infrastructure
- desired level of service
- capital budget based on replacement costs and life expectancy
- schedule
- rate design that covers life cycle cost

The NH DES Asset Management Planning Grant program assists community water systems in developing an asset management plan. The goals of the program include:

- To initiate an asset management program at community water systems that don't currently have a program
- To assist systems in developing an asset inventory with condition assessment
- To review the current rates and determine if the existing structure supports future investment needs
- To communicate these planning efforts to customers and decision makers.

Drinking Water Systems and Climate Change

Climate change will affect some systems more than others based on parameters such as proximity to the coast and Great Bay, location in relation to fresh water bodies, elevation of system components, size of contributing watershed to surface water sources, and geologic settings of groundwater resources.[98] Many systems have already experienced impacts over the past 5-10 years including damage to infrastructure, water quality concerns, and water availability concerns.

Drinking water treatment facilities will increasingly need to adopt BMPs to reduce greenhouse gas emissions and adapt to extreme precipitation events, flooding, and sea level rise associated with climate change. NH DES recommends that facilities identify adaptation strategies that focus on energy efficiency and renewable energy, which will lower costs and free up funds to invest in improvements while strengthening the facility's resiliency. NH DES will collaborate with partners to provide information and technical assistance to communities and organizations that are seeking to incorporate adaptation measures into their projects and plans. Integrating drinking water system planning, operational, and infrastructure improvements into emergency preparedness and all hazards plans is one strategy communities can use to adapt to future changes in precipitation and runoff.

Asset management facilitates time- and resource- efficient investments in community infrastructure. Asset management plans provide an opportunity to integrate climate adaptation planning and should incorporate best available precipitation, floodplain, and sea level rise data.

Best Management Practice

City of Somersworth WWTF

The Somersworth Water Treatment Plant, which is located on the bank of the Salmon Falls River, was significantly damaged by floods in May 2006 and April 2007. Both floods exceeded the 500-year flood. During the May 2006 flood, the system was down and the Town was able to interconnect with the City of Dover. The plant was reopened within four days. The April 2007 flood resulted in even higher floodwaters at the plant. At this time, the plant was undergoing construction in response to the 2006 flood. There were open construction pits, the garage door had been removed, and there was debris and materials on site and throughout the entire facility. Pumps, blowers, a programmable logic controller, a generator and the HVAC equipment were lost. The Town was forced to undertake major repairs to the plant. As part of the project, major steps were taken to reduce the impacts of future flooding, including:

- Switched to liquid petroleum gas for building heat (eliminated need for larger oil tank);
- Installed a new, self-contained generator. The generator was elevated approximately 5 feet. The fuel storage tank was raised;
- Installed protection for storm windows & doors to prevent water flow into building;
- Relocated or sealed HVAC systems, louvers, and pipework; and
- Strapped propane tanks to a concrete pad to resist buoyancy.

The cost to implement this project was approximately $7,000,000. Funding sources were: FEMA mitigation grants, insurance pay-outs and Town budget for upgrades. There have been no flood damages since these upgrades were made. (Note that floods experienced since 2007 have not been as severe.) Somersworth lists its "lessons learned" as:

- Review Emergency Response Plan yearly or after any process changes;
- Develop protocols for notification, defense & when to abandon;
- Maintain customer confidence;
- Foster and cultivate cooperation with neighbors & vendors; and
- Simple solutions can solve big problems.[99]

Photo credit: City of Somersworth

Wastewater Infrastructure

Existing Wastewater infrastructure

Wastewater Treatment Plants

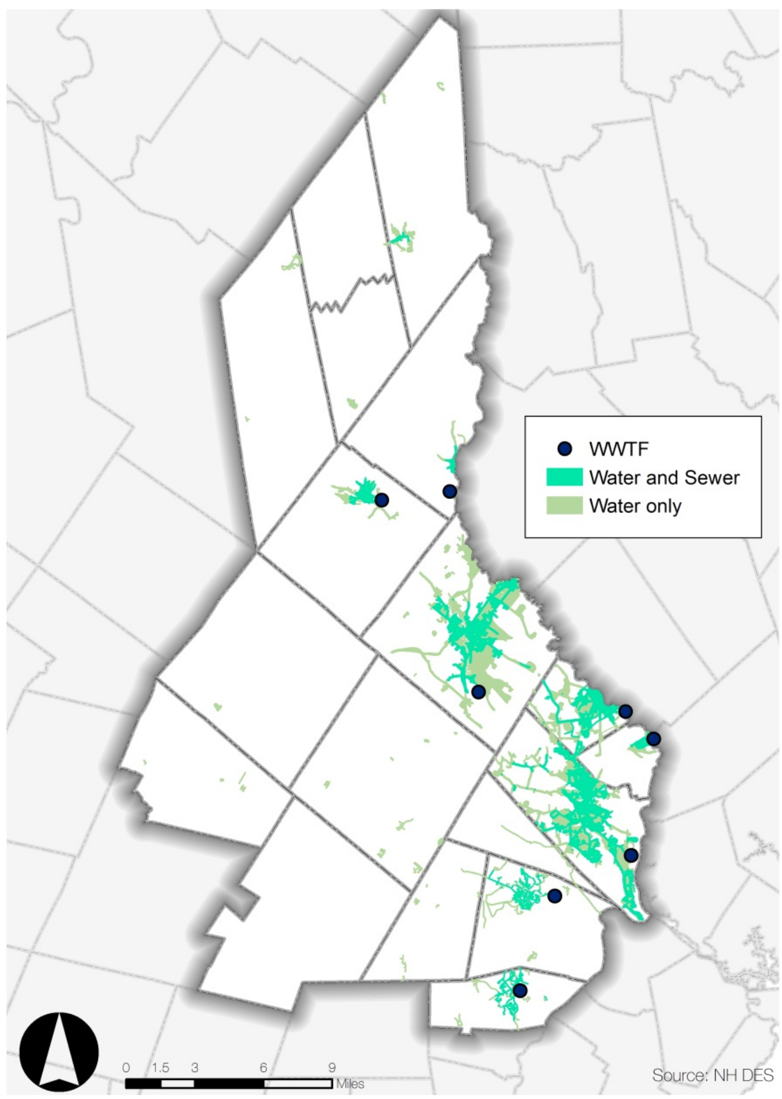
As defined by RSA 485 A:2, XVI-a, a wastewater treatment plant is the treatment facility or group of treatment devices which treats domestic or combined domestic and industrial wastewater through alteration, alone or in combination, of the physical, chemical, or bacteriological quality of the wastewater and which dewaters and handles sludge removed from such wastewater.

RSA 147:8 requires that occupied buildings located within 100 feet of a public sewer must connect to public sewers unless the municipality grants a connection waiver for an adequate, alternative, and approved sewage disposal system. Communities have the authority to enact and enforce more stringent local sanitation ordinances than the statutory requirements. For example, the City of Rochester requires sewer connections of all buildings located within 200 feet of a public sewer.

Approximately one-third of homes in the state are served by centralized wastewater treatment facilities, many of which are small, old, and approaching their design capacities. Most WWTFs discharge treated wastewater to rivers or streams. However, some discharge "onsite" to groundwater.[100] Centralized waste water treatment facilities (WWTF) and large, complex onsite systems require regulatory oversight. Statewide, there are 91 publicly owned treatment works (POTWs) and 30 private WWTFs that fall into this category. Seventy-four facilities in the state require a NPDES permit.[101]

There are eight WWTF in the region (Figure 8). These facilities serve approximately 84,700 people as well as a transient population of approximately 22,000 people in Durham, and have a combined long term average flow of 9.87 million gallons per day (mgd). The total flow capacity available for growth at these facilities is 6.38 mgd (Table 23). The Dover, Durham, Farmington, Newmarket, and Somersworth WWTFs have NPDES permits (see Table 30 in section below).

Figure 8: Wastewater Treatment Facilities and Extent of Town Sewer and Water Systems in the Region



[Source: NHDES]

Treatment and Disinfection

Wastewater undergoes multiple treatments to remove pollutants. Primary treatment removes larger particles and solids through the use of physical and chemical processes that coagulate and settle particles from wastewater to create a sludge that is disposed of separately. Secondary treatment is currently the minimum treatment required for all WWTFs in the State. Secondary treatment addresses oxygen-demanding pollutants and suspended solids and involves the use of microorganisms that digest organic matter in sewage to create less environmentally harmful byproducts. Some facilities use aerated wastewater lagoons that allow algae and bacteria to use sunlight and oxygen to break down pollutants, while other use activated sludge treatment in which aeration tanks mix and inject oxygen into wastewater to support a population of microorganisms that treat water.[102]

Tertiary treatment removes additional organic matter, nitrogen, phosphorus, and toxins. This treatment level is important to minimizing the impact of effluent on aquatic life in receiving waters.[103] Following secondary treatment, or following tertiary treatment if applicable, municipal and regional WWTFs disinfect wastewater through a process that eliminates or deactivates the microorganisms and pathogens that have the potential to cause human disease. Chlorine and ultraviolet radiation are used in disinfection. This step protects public health where people engage in water-contact recreation or where shellfish are harvested.[104] Table 24 summarizes the treatment processes and disposal methods in each of the WWTFs in the region.

Management options for the disposal of post-treatment residual material or biosolids from treatment plant will be discussed in a subsequent section.

Table 23: Flow, Capacity, and Population Served by WWTF in the Region

Facility	Average Daily Design Flow (mgd)	Long Term Average WWTF Flow (mgd)	WWTF Flow Capacity Used, % (11/1/13)	WWTF Flow Capacity Available for Growth (mgd)	Population Served by WWTF	Towns Served by WWTF or Collection System
Dover Wastewater	4.7	2.8	59.6	1.9	29,997	Dover
Durham Wastewater	2.5	0.9	36.0	1.6	13,200 plus 22,000 transient population	Durham, UNH
Farmington Wastewater	0.5	0.29	58.0	0.21	2,500	Farmington
Milton Wastewater	0.1	0.09	90.0	0.01	700	Milford, Wilton
Newmarket Wastewater	0.85	0.6	70.6	0.25	9500	Newmarket
Rochester Wastewater	5.03	3.4	67.6	1.63	17,000	Rochester
Rollinsford Wastewater	0.167	0.088	52.7	0.079	1168	Rollinsford
Somersworth Wastewater	2.4	1.7	70.8	0.7	10,705	Somersworth

[Source: NH DES: WWTF Process Data – Populated for RPCs. 2013.]

Table 24 Treatment and Disposal of Wastewater in the Region

	Primary and Secondary Treatment Processes				Advanced Treatment Processes	Disinfection and Effluent Disposal		
Facility	Primary Treatment Process	Advanced Primary or Pre-Secondary Process	Secondary Treatment Process	Secondary Clarification/ Sedimentation Process	Nutrient Removal	Disinfection Process	Post-aeration/pH Treatment	Surface Water Discharge Receiving Water
Dover Wastewater	Primary Clarifier - round	None	Activated Sludge - Conventional Plug Flow	Secondary Clarifiers - round	None	Ultraviolet	Post Aeration - Steps	Piscataqua River
Durham Wastewater	Primary Clarifier - rectangular	None	Activated Sludge - Conventional Complete Mix	Secondary Clarifiers - round	Activated Sludge with Anoxic Zone	Chlorination w/ Dechlorination	Chemical Addition for pH adjustment	Oyster River
Farmington Wastewater	Flow Equalization	None	Sequencing Batch Reactor	None	• Activated Sludge with Anaerobic, Aerobic, Anoxic and Aerobic Zones • Chemical Addition - Ferric Chloride	None	None	No surface water discharge
Milton Wastewater	None	Chemical Addition - Alum	Aerated Lagoons	None	None	Chlorination - Sodium Hypochlorite	None	Salmon Falls River
Newmarket Wastewater	Primary Clarifier - round	None	Trickling Filters w/ Rock Media	Secondary Clarifiers - round	None	Chlorination w/ Dechlorination	None	Lamprey River
Rochester Wastewater	None	None	Activated Sludge - Extended Aeration	Secondary Clarifiers - round	Filtration - Cloth Media Filter	Ultraviolet	Both pH adjustment and post-aeration	Cocheco River
Rollinsford Wastewater	None	None	Activated Sludge - Extended Aeration - Oxidation Ditch	Secondary Clarifiers - round	• Activated Sludge with Anaerobic Zone • Chemical Addition - Sodium Aluminate	Chlorination w/ Dechlorination	None	Salmon Falls River
Somersworth Wastewater	None	None	Activated Sludge - Conventional Plug Flow	Secondary Clarifiers - round	• Activated Sludge with Anaerobic and Anoxic Zones • Chemical Addition - Sodium Aluminate • Filtration - Cloth Media Filter	Chlorination w/ Dechlorination	Post Aeration	Salmon Falls River

[Source: NH DES: WWTF Process Data – Populated for RPCs. 2013.]

Collection Systems

Wastewater is typically conveyed through a sewer system by gravity along a downward-sloping pipe gradient. These sewers are known as conventional gravity sewers are designed to maintain flow towards the discharge point without surcharging manholes or pressurizing the pipe. Depending on the slope, conventional gravity sewers can require sewage pumping or lift stations to pump sewage to a WWTF. Pump stations substantially increase the cost of the collection system.[105] Both inflow and infiltration can result in increased wastewater volume, size of pipes and pump or lift stations, and cost. Table 25, below, displays information about the collection systems for the eight treatment facilities in the region. The extent of sewer and water pipes in five population centers is shown in Figure 9.

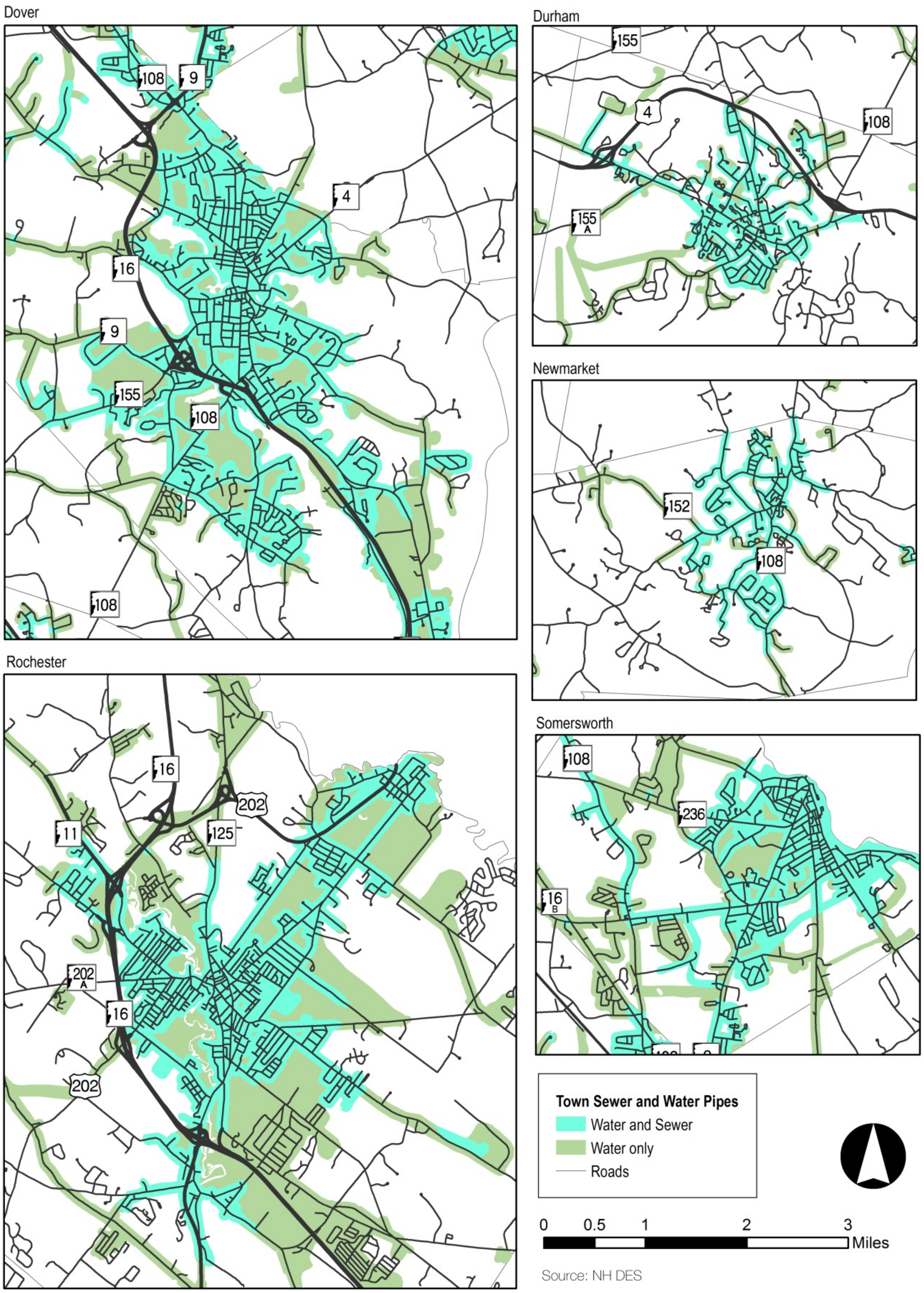
Table 25: Characteristics of WWTF Collection Systems in the Region

Facility	Number of Pump Stations owned by municipality	Number of Pump Stations privately owned	Miles of Gravity Sewer - Municipally Owned	Miles of Gravity Sewer - Privately Owned	Miles of Force Main - Municipally Owned	Miles of Force Main - Privately Owned	Number of Manholes	Number of Siphons	Number of air relief valves
Dover Wastewater	21	25	108		14		2968	2	20
Durham Wastewater	3	5	32		1		788	0	1
Farmington Wastewater	0	1	10	0.5	0	0.1	130	0	0
Milton Wastewater	1	0	3	0	0.1	0	50	0	0
Newmarket Wastewater	6	4	27		1.8		900	0	0
Rochester Wastewater	26		90				1600	4	12
Rollinsford Wastewater	1	1			0.2		103	0	0
Somersworth Wastewater	3	3	38						

Note: Blank indicates that data is not known at the time of database release.

[Source: NH DES: WWTF Process Data – Populated for RPCs. 2013.]

Figure 9: Population Centers Served by Town Sewer and Water



[Source: NHDES - 2014]

Management and Maintenance

Each WWTF has its own maintenance, upgrade, repair, and replacement schedule. Table 4 provides an overview of plans and programs each WWTF has prepared. Within the region, Dover has a completed WWTF Asset Management Plan and Durham, Newmarket, and Somersworth have partial plans or plans that are in progress. An overview of plant information and upgrades as well as a summary of storm impacts from each facility follows (Table 26).

Asset Management

Asset management is a planning process that ensures the most value from each asset and ensures there are financial resources available to rehabilitate and replace those assets when necessary. Key components of an asset management program include:

1. *Inventory of Assets*
2. *Prioritization of Assets*
3. *Development of an Asset Management Program*
4. *Implementation of the Asset Management Program*

Table 26: WWTF Management and Planning

Facility	WWTF Asset Management Plan	Capacity, Management, Operations and Maintenance (CMOM) Plan	Fats, Oils & Grease (FOG) Program	Infiltration/Inflow Study or Sewer System Evaluation Study Available	Collection System Map Available	Collection Map Type	Collection System Asset Management Plan
Dover Wastewater	Yes	Yes	Combined w/ pretreatment program	Yes	Yes	GIS	Yes
Durham Wastewater	Partial	In the works	Yes	In the works	Yes	GIS	In the works
Farmington Wastewater	No	No	No	Yes	Yes	GIS	No
Milton Wastewater	No	No	No	No	Yes	Paper	No
Newmarket Wastewater	In progress	In the works	Yes	Yes	Yes	GIS	In the works
Rochester Wastewater	No	No	Yes	Yes			No
Rollinsford Wastewater	No	No	No	Yes	Yes	Paper	No
Somersworth Wastewater	Partial	No	Combined w/pretreatment program	Yes	Yes	GIS	In the works

[Source: NH DES: WWTF Process Data – Populated for RPCs. 2013.]

Reported Maintenance and Future plans from WWTFs

Dover Wastewater Treatment Facility	
Facility Information	The City of Dover has a 4.7 million gallons per day (MGD) secondary activated sludge wastewater facility. The facility first accepted flow on June 24, 1991 and treats an average daily flow of about 2.8 MGD
Upgrades and Improvements Since Initial Construction	• A new flat cover odor control system was installed. • Both primary clarifiers were retrofitted with a new chain and flight system. • A new blower building was constructed. • A new Trojan 3000 Plus UV system was installed. • The outfall diffuser was retrofitted with pinch valves. • New high speed turbo blowers were installed. • A new dewatering process was installed.

	• A facility study was completed to evaluate and prioritize phase replacement of aging process equipment.
Future Upgrades and Plans	The City is at 60% design for phase one of the facility study, which will include upgrading the aeration system to treat Total Nitrogen to an average of 8 mg/l. The projected cost of Phase one is around 8 million dollars and is slated to go out to bid at the end of the year.

Durham Wastewater Treatment Facility	
Facility Information	The Town of Durham has a 2.5 mgd secondary activated sludge treatment facility. The activated sludge plant was originally built in 1977 as part of the Clean Water Act. The plants' flow is an average of 1.1MGD when UNH is in session and 0.6 MGD when UNH is on break.
Upgrades and Improvements	• 1991; a new dewatering system, aeration tank upgrades, chemical feed upgrades. • 2003 secondary clarifier upgrades, new headworks building and upgrades, aeration tank upgrades. • 2006; upgrades to aeration tanks from conventional treatment to a MLE system for nitrogen removal. • 2010; installed new energy efficient turbo blowers. • 2011; a new Dover Rd. main pump station was installed. • 2013; a new west side pump station being built. • 2013; an aggressive flow study continues for the collection system. • 2014: new dewatering system to be installed, a pilot 4-stage bardenpho secondary treatment to be completed for lower nitrogen removal, a new main generator to be installed, and new chemical addition building to be built.
Future Upgrades and Plans	The Town of Durham has been very aggressive in its budgeting plan, following the facilities update plan carefully. A new facilities plan has been implemented with the Towns CIP for future budgeting plan and equipment upgrades and replacement. The Town has also been very proactive in its collection system by identifying and slip lining old water infiltrated sewage lines. Also, replacement of troublesome manholes and spot repairs are continuously being completed. The Town also has an aggressive sewer cleaning program.

Farmington Wastewater Treatment Facility	
Facility Information	The Town of Farmington operates a 0.5 MGD wastewater treatment facility. The WWTF was upgraded in 2010 to a sequential batch reactor (SBR) facility to increase its design flow and meet more stringent permit limits. Currently the average flow to the Farmington WWTF is approximately 0.3 MGD over a long-term average monthly basis. Farmington is continuing to remove infiltration and inflow from their collection system to reduce the flows to the WWTF.
Upgrades and Improvements	• The WWTF effluent disposal system was upgraded to a rapid infiltration basin system (RIB) in 2009-2010. • The WWTF was upgraded to an SBR system in 2010-2012 • The sewer repair and rehabilitation project was in 2010-2012
Future Upgrades and Plans	Additional WWTF upgrades will consist of effluent disposal system upgrades and sewer projects are continuing 2013-2015.

Milton Wastewater Treatment Facility	
Facility Information	The Town of Milton operates a Wastewater Treatment Plant designed for 0.10 mgd and historically the average flow has been around 0.055mgd. It is an aerated lagoon plant with effluent disposal to the Salmon Falls River.
Upgrades and Improvements	There are no current plans for any upgrades.
Future Upgrades and Plans	The Town has started adding alum to the influent for phosphorus removal around 10 years ago when the Town received a TP lbs/day limit of 2.0. This simple approach has worked very well. There are no known collection system I+I issues documented. There is a concern that there are numerous sump pumps connected illegally.

Newmarket Wastewater Treatment Facility	
Facility Information	The Town of Newmarket wastewater treatment facility is designed for an average flow of 0.85 mgd with a 2.4 mg design peak flow. The secondary treatment, trickling filters technology, was constructed in 1985. The facility treats an average of 0.6 MGD of wastewater. The Town in November of 2013 received a new discharge permit with a new 3.0 mg/L total nitrogen limit. The new nitrogen limit is the limit of technology. Newmarket's current facility does not have the capability of treating the wastewater to meet low level total nitrogen limits.
Upgrades and Improvements	The Town Negotiated an Administrative Order of Consent with the EPA. The order allows for the Town to have an 8.0 mg/L interim total nitrogen limit, if the Town meets the requirements in the order, including: Wastewater Facility • Begin construction of new treatment facility by March 2015. • Complete construction by March 2017. • Operating and meeting 8.0 mg/l total nitrogen limit within 12 months from substantial completion. Non-point and Point Source Nitrogen Plan • Begin tracking non-point source and point source total nitrogen • Create a non-point source and point source total nitrogen tracking system • Submit a non-point and point source total nitrogen control plan by September 30, 2017
Future Upgrades and Plans	The Town is currently in the process of designing a new treatment facility that will cost an estimated $14.1 million dollars. The Town is tracking total nitrogen and will be hiring a consultant to develop the total nitrogen tracking system and plan.

Rochester Wastewater Treatment Facility	
Facility Information	The City of Rochester has a 5.03 mgd tertiary activated sludge wastewater facility with one of the most stringent effluent permits in the State. The advanced facility took flow in August of 2000 (upgrade cost of 20 million dollars) and does an average daily flow of about 3.4 mgd (68% of design flow).
Upgrades and Improvements	• Major headwork's upgrade was completed to include new bar screen, wash press, controls, electrical and heating systems. • Instrumentation upgrades on our Trojan UV 4000 system were completed to improve efficiency. • New High efficiency main aeration Turblex Blowers were installed. • Solar powered circulators for the equalization basins were installed to replace mechanical aeration. • Pilot study is being conducted to reduce blower output (energy savings) and enhance nutrient

treatment (possible capital and chemical savings).

- A facility evaluation was completed for nutrient reduction treatment options.
- The City is working with the EPA and State to ensure that effluent permit limits are scientifically based, environmentally beneficial and rater payer affordable.

Rollinsford Wastewater Treatment Facility

Facility Information

The Town of Rollinsford has an average daily flow of 0.085 mgd, with a designated max daily flow of 0.150 mgd and a 700 mgd peak flow. Treatment processes include extended aeration and activated sludge utilizing oxidation ditches

Upgrades and Improvements

Recent major upgrades include:

- Installation of a new head works building, influent channel, step screen, flow meters, anaerobic selectors, clarifier, sludge holding tank, and backup generator in 1994.
- Installation of a new lift station on Foundry Street that handles approximately 60% of the flow delivered directly to the head works building in 2012.

Somersworth Wastewater Treatment Facility

Facility Information

The City of Somersworth has a 2.4 mg design Modified University of Capetown (MUCT) Biological Nutrient Removal (BNR) plant. It has a design peak flow of 5.94 mgd and is designed to meet a total phosphorus limit of 0.5 mg/L, BOD and TSS limit of 10 mg/L and Total Ammonia Nitrogen of 7 mg/L. The facility has been in operation since 1973 and underwent two minor upgrades in the eighties which included adding dechlorination and improved solids handling with a Belt Filter Press. The City completed a major upgrade in 2005 at a cost of 8.9 million dollars. The Wastewater Treatment Facility is currently operating at 71% capacity. It serves a population of approximately 11,754 and discharges final effluent to the Salmon Falls River. This facility is permitted by the U.S. Environmental Protection Agency and the NH Department of Environmental Services, Facility Identification Number NH0100277.

Upgrades and Improvements

- A new Headworks Building consisting of (2) 1/8" Fine Screens with Washing Compactor and bagging system, septage receiving with (2) 10,000 gallon tanks, grit removal with washer and bagging system.
- Revised biological treatment with anaerobic, anoxic and fine bubble diffused aeration.
- New Blower Building with (4) 50HP Positive Displacement Blowers.
- Improved sludge handling system with a 164 GPM Centrifuge and (3) sludge storage tanks with aeration for mixing.
- Existing Secondary Clarifiers have been upgraded to center feed, peripheral discharge units for improved settling performance and sludge removal.
- Effluent filtration with (2) Cloth Media Disc Filters for removing particulate solids to less than 10 mg/l.
- New Chlorine Contact Tanks (2).
- New Post Aeration Tanks with fine bubble diffusers (2).

Proper septic system maintenance is an important component of non-point source pollution management. Failing systems can cause water quality impairment and human health risks.

Inflow and Infiltration

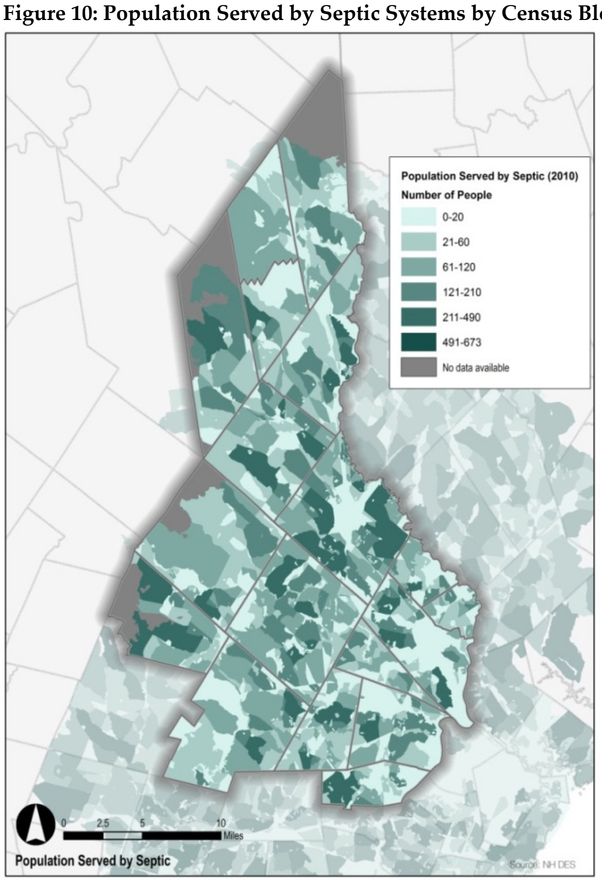
Groundwater and stormwater enter into dedicated wastewater or sanitary sewer systems through inflow and infiltration. Sources of inflow, or stormwater that enters into sanitary sewer systems at points of direct connection to the systems, may include drains from driveways or window wells, groundwater or basement sumps, or streams. Infiltration is groundwater that enters sanitary sewer systems through cracks and leaks in the sanitary sewer pipes. Both inflow and infiltration can increase the load on sanitary sewer systems that are designed to carry wastewater from toilets, dishwashers, sinks, or showers in homes or businesses, as well as reduce the ability of sanitary sewers and treatment facilities to transport and treat domestic and industrial wastewater. Infiltration and inflow can account for as much as 25% of the treated flows, which ties up much of the system capacity and can significantly increase the cost of treatment plant operations.

Onsite Wastewater Management – Septic Systems

Approximately two-thirds of New Hampshire homes and the majority of new homes are served by individual onsite wastewater treatment systems. These systems are typically septic tanks and absorption fields that serve single-family residences). NH DES has a comprehensive program to ensure the proper design, siting, and construction of new septic systems.[106] Figure 10 displays the population served by septic systems by Census block in the region.

Over the past several years, NH DES has approved many innovative technologies for the treatment and disposal of wastewater to subsurface systems. New Technologies, such as large-diameter gravel-less pipe and anaerobic treatment systems, enable development to take place on more difficult sites (such as sites with steep slopes or a high water table), with less site disturbance than conventional onsite technology.[107]

Figure 10: Population Served by Septic Systems by Census Block



[Source: NHDES - 2014]

SepticSmart

EPA's SepticSmart initiative is a nation-wide public education effort that aims to inform homeowners living on properties serviced by septic systems on the importance of properly maintaining their septic system and provides valuable resources to help homeowners make important decision regarding their wastewater management needs. The initiative also provides resources for outreach organizations and government leaders who seek to promote this message locally. For more information see: http://water.epa.gov/infrastructure/septic/septicsmart.cfm

When properly constructed and maintained, septic systems effectively treat wastewater and have the added benefit of returning water to the local hydrologic system as opposed to discharging from a wastewater treatment facility into a river or stream. A substantial but unknown number of existing onsite systems do not function properly because they were installed before current standards or because they are not properly designed, sited, constructed, or maintained. As properties change hands and buyers require evaluations and subsequent repair or replacement and as complaints by neighborhoods or local health official bring failed systems to NH DES's attention, these failing systems are gradually addressed. Septic systems that are located within 250 feet of a protected water body must be evaluated before a property changes hands per RSA 485-A Waterfront Site Assessment.[108]

Residuals Management and Biosolid Disposal

Management options for the disposal of residual material or biosolids from treatment plants include: application on land as fertilizer or soil amendment; disposal in landfills; or incineration. Biosolids are municipal sewage sludges that have been treated and tested and meet or exceed state and federal standards for use as fertilizers and soil amendments. When diverted from landfills and applied as recycled material on farms, biosolids are a cost saving beneficial use.[109] Because sludge disposal can account for as much as 40-50% of the cost of treating waste at WWTFs, land application of sludge may also be the most cost efficient disposal method.[110] In 2010, 114,500 wet tons of biosolids were generated in New Hampshire and disposed of through: land application (37%), landfilling (34%), incineration (City of Manchester only) (21%), out-of-state disposal (8%).[111]

Septage

Septage is material removed from septic tanks, cesspools, holding tanks, or other sewage treatment storage units such as septage lagoons, waste from portable toilets, and grease trap waste that has been co-mingled with wastewater.

Disposal of residuals, or septage, from private, on-site septic systems occurs locally or at regional WWTFs via land application, lagoons, and innovative and alternative waste treatment methods (see Table 27).[112] In 2011, nearly 95 million gallons of septage was generated in New Hampshire. Approximately 19% of septage generated within the state is disposed of at out-of-state WWTFs due to lack of capacity to treat septage in state. These out-of-state facilities receive approximately $1.5 million annually that could otherwise fund local facilities serving New Hampshire communities.[113]

Most communities in the region dispose of their septage at WWTFs (Table 28). Five communities dispose of septage at their own WWTF and 10 communities dispose septage at WWTF in other towns including South Berwick, ME. Northwood and Wakefield have their own lagoons. Brookfield is non-compliant.[114]

Table 27: Percent of New Hampshire Septage Disposed at in- and out-of-state Locations in 2011

Disposal Location	Percent of Total Septage
In-State WWTF	66
Land Application	7
Innovative or Alternative "Septage Only" Facilities	5
Septage Lagoons	3
Out-of-State WWTF	19

[Source: New Hampshire Municipal Association: New Hampshire's Water Assets Under Pressure: Municipal Wastewater Systems. May 2012.]

Table 28: Municipality Responsibility to Provide for Septage Disposal

In Compliance	City/Town	Written Agreement	Expiration Date	WWTF		Lagoon		Comments/ Solutions
				Own	Other Town	Own	Other Town	
Yes	Barrington	X	12/31/2010		X			Somersworth WWTF
Yes	Barrington	X	Resolution		X			Dover WWTF
No	Brookfield							Non-compliant
Yes	Dover			X				Dover WWTF
Yes	Durham			X				Durham WWTF
Yes	Farmington	X	12/31/2010		X			Somersworth WWTF
Yes	Lee	X	Resolution		X			Dover WWTF
Yes	Madbury	X	Resolution		X			Dover WWTF
Yes	Middleton	X	12/31/2010		X			Somersworth WWTF
Yes	Milton	X			X			South Berwick, ME
Yes	New Durham	X	12/31/2009		X			Pittsfield WWTP
Yes	Newmarket			X				Newmarket WWTP
Yes	Northwood					X		Northwood Septage Lagoon
Yes	Nottingham	X	12/31/2010		X			Somersworth WWTP
Yes	Rochester			X				Rochester WWTF
Yes	Rollinsford	X	12/31/2011		X			Somersworth WWTF
Yes	Somersworth			X				Somersworth WWTF
Yes	Strafford	X	12/31/2009		X			Pittsfield WWTF
Yes	Wakefield					X		Town Lagoon

[Source: NH DES – Town Responsibility to Provide for Septage Disposal RSA 485-A:5-b. September 1, 2009]

Best Management Practice
Biosolid Management Options - Merrimack, NH

Since 1994, Town of Merrimack's WWTF has used an enclosed in-vessel composting facility to process and dispose of biosolids. Compost generated at the facility is recognized for its superior quality and has been used to refurbish the great lawn at New York Central Park, for construction of the Boston Red Sox Teddy Ebersol ball fields, and in the landscaping of the Rose Kennedy Greenway over the Boston central artery. The WWTF received a first place award from the EPA in 2002 for it beneficial use program.

With the need to make significant upgrades to the existing facilities in 2008, the town initiated a study to help evaluate two biosolid options under consideration: continued composting vs. landfill disposal. The study analyzed energy consumption and greenhouse gas (GHG) emissions associate with biosolid management occurring after dewatering for each option. This included energy consumed and GHGs released from all activities associated with making, distributing, and using compost in comparison with transportation and landfill disposal of the wastewater solids. The analysis indicated that the current composting operation requires significantly more energy consumption than landfill disposal, but opting for landfill disposal results in greater GHG emissions due to the release of significantly more methane into the atmosphere (see table below). By upgrading the composting system as opposed to disposing via landfill, an estimated 2,660 Mg of carbon dioxide equivalent emissions – the equivalent of taking almost 500 passenger cars off the road - would be avoided each year.[115]

The town generated $103,000 in 2011 and has generated up to $140,000 in additional revenue annually by composting outside sources of sludge.[116]

Biosolid Management Options	kWh per dry ton of wastewater solids processed	Percent change from current operation	Carbon Dioxide	Percent change from current operation
Current composting	735 kWh		1,529 Mg CO_2	
Future composting with improved dewatering and continued composting	568 kWh	-23%	1,094 Mg CO_2	-28%
Landfill disposal	261 kWh	-64%	3,754 Mg CO_2	146%

Combined Wastewater Overflow (CSO)

Combined sewers collect municipal wastewater or sewage and stormwater runoff in a single pipe system. Stormwater runoff enters the combined sewer system through catch basins and from downspouts or roof leaders connected to the system. During dry weather and small wet weather events, combined sewers transport all flows to a municipal wastewater treatment facility where it is treated before being discharged to a nearby water body, such as a river or a stream. Combined Sewer Overflows (CSOs) occur during heavy rains when stormwater combined with sewage overwhelm the collection system causing an overflow into the nearest stream or river.[117] The term CSO refers to both the event and the place the overflow occurs.

CSOs can pollute water bodies when they discharge a combination of untreated domestic sewage, industrial wastewater, and storm water. CSO often include:

- Bacteria from human and animal fecal matter, which could cause illness.
- Oxygen demanding pollutants that may deplete the concentration of dissolved oxygen in the receiving water to levels that may be harmful to aquatic life.
- Suspended solids that may increase turbidity or damage benthic communities.
- Nutrients that may cause eutrophication.
- Toxics that may persist, bioaccumulate, or stress the aquatic environment.
- Floatable litter that may either harm aquatic wildlife or become a health and aesthetic nuisance to swimmers and boaters.[118]

Thirty-three CSOs have been identified in the State. There are no CSOs in the region.

Future Wastewater Infrastructure Challenges and Improvements

Upgrades to Aging Infrastructure

Much of NH's wastewater treatment infrastructure was constructed between 1972 and the mid-1980s, and the majority of these facilities are near or beyond the end of their design life expectancy of 20-30 years. During the 1970s, the federal government heavily subsidized the design and construction of the vast majority of WWTFs in New Hampshire to meet federally-mandated secondary treatment standards. Since the late 1980s, the low-interest loan programs known today as State Revolving Loan Funds (SRF), have replaced the Federal Construction Grants program, in which 95% of the funds necessary to meet federally-mandated secondary treatment standards were provide by the federal (75%) and state 20%) government.[119] In addition to SRF loans (which provide up to 100% of eligible costs), the state also supports municipal wastewater infrastructure projects through grants that cover up to 30% of eligible costs.

The decline in state and federal funds to finance capital improvements that municipalities have historically depended upon has resulted in a significant backlog of wastewater infrastructure maintenance and upgrades. New Hampshire documented needs totaling $1.982 billion in 2012.[120] Within the region, wastewater needs totaled $153 million (Table 29). The HB 1491 Commission final report's more recent estimate of WWTF upgrades to meet the needs of a growing population and increasingly stringent treatment standards was $1.2 billion, or an annual investment of $105 million for WWTF upgrades (between 2008-2018).[121,122] This does not include the estimated $300 million that will be required to address the nitrogen issue on the Seacoast.

Table 29: Clean Watershed Needs Survey Summary by Municipality and Wastewater Category

Municipality	Total Needs (Sum of all Categories)	Wastewater Treatment	Sewer Rehabilitation and Replacement	New Sewers	Combined Sewer Overflow Abatement	Stormwater
Barrington	$1,177,910					$1,177,910
Brookfield	$576,558					$576,558
Dover	$53,362,992	$45,285,487	$4,882,932			$3,194,573
Durham	$19,222,430	$15,005,692	$2,950,015			$1,266,723
Farmington	$2,615,673	$1,694,676				$920,997
Lee	$504,018					$504,018
Madbury	$617,662					$617,662
Middleton	$455,934					$455,934
Milton	$2,308,524	$1,804,039				$504,485
New Durham	$1,043,947					$1,043,947
Newmarket	$29,409,751	$19,485,675	$2,674,319	$6,577,595		$672,162
Northwood	$709,521					$709,521
Nottingham	$1,173,527					$1,173,527
Rochester	$31,742,474	$21,140,028	$9,411,300			$1,191,146
Rollinsford	$2,124,658	$1,559,673	$453,405			$111,580
Somersworth	$4,332,219	$2,175,086	$391,128			$1,766,005
Strafford	$1,235,285					$1,235,285
Wakefield	$566,551		$99,596			$466,955
Total	$153,179,634	$108,150,356	$20,862,695	$6,577,595	$0	$17,588,988

[Source: NHDES – 2013]

Facilities Approaching Design Capacity Due to Population Growth

The average flow capacity used at WWTF in the region is 63%, ranging from 36% in Durham to 90% in Milton. There are a total of 6.4 mgd of flow capacity available for growth at the eight facilities in the region (Table 23).[123] In the absence of adequate WWTF capacity, new development in urban fringes may instead rely on individual on-site systems and consequently shift to lower-density development.[124]

New Requirements for Centralized Wastewater Treatment Facilities

Wastewater treatment facilities, and any facility that discharges directly to surface water, are required to obtain a National Pollution Discharge Elimination System (NPDES) permit. See Table 30 for links to current permits. The EPA is moving toward including strict nitrogen and phosphorus limits for many New Hampshire discharge permits. Because the Great Bay estuary failed to meet the criterion for nitrogen concentration, the EPA issued three draft NPDES permits for Exeter, Newmarket, and Dover to require nitrogen removal to 3 milligrams per liter. The Newmarket WWTF permit issued in November 2012 limits nitrogen discharge levels to 3 mg/L. Dover was issued a draft permit in 2012 requiring nitrogen discharge limits of 3.0 mg/L.

EPA issues Public Owned Treatment Works General Permits (POTW GP) for the discharge of wastewater from publically owned treatment works plants in New Hampshire. This permit is effective on July 6, 2011, and will expire on July 6, 2016. This permit replaces the POTW GP that was issued in 2005 and expired on September 22, 2010. The POTW GP authorizes discharges of wastewater from major and minor POTWs and other treatment works treating domestic sewage. The POTW GP establishes Notice of Intent (NOI) requirements as well as effluent limitations, standards, and prohibitions for facilities that discharge to fresh and marine waters in New Hampshire.

WWTF Upgrades - Newmarket

After reviewing the permit issued by the EPA, the Town of Newmarket accepted the permit and entered into an Administrative Order on Consent. While the Town does not agree that EPA and DES addressed all the uncertainties about the health of Great Bay, it determined that it was in the best interest of the community to work with the EPA to protect Great Bay instead of entering into a lengthy and costly legal process. The Town has 15 years to achieve the 3.0 mg/L discharge level. In 2013, Newmarket voters approved a $14 million upgrade to the WWTF. The Town will reduce nitrogen discharge levels to 8 mg/L over the next five years and has 15 years to reduce discharge levels to 3mg/L.

Investigating alternatives to technical upgrades to WWTFs, The Great Bay Municipal Coalition prepared an Adaptive Management Plan to address Great Bay use impairments related to excessive nutrient contributions and habitat loss due to invasive species.

Table 30: Wastewater Treatment Facility Permits

City/Town (Watershed)	Facility Name and link	Permit Number	Date of Issuance
Dover (Piscataqua River)*	Dover, City of (PDF)	NH0101311	1/06/12*
Durham (Oyster River)	Durham POTW, Town of (PDF)	NH0100455	12/15/1999
Farmington (Cocheco River)	Farmington, Town of (PDF)	NH0100854	4/17/2007
Newmarket (Lamprey River)	Newmarket, Town of (PDF)	NH0100196	11/16/2012
Somersworth (Salmon Falls River)	Somersworth, City of (PDF)	NH0100277	4/20/2004

*draft

[Source: EPA – New Hampshire EPA New England Issued Permits]

Nutrient Loading

Today's domestic wastewater contains many pollutants that can negatively affect the environment and public health and safety. In addition to human pathogens, wastewater also contains high levels of nutrients such as nitrogen and phosphorus, which can trigger surface water algal blooms, lowered dissolved oxygen, and fish kills. Industrial wastes can also contribute toxic pollutants as byproducts of manufacturing.[125]

Nitrogen Pollution

Wastewater treatment facilities discharge treated wastewater through pipes into rivers that flow into the Great Bay estuary. In the Strafford Region there are eight wastewater treatment facilities which release treated wastewater into nearby rivers. These treatment facilities are a major factor in nutrient loading in the Great Bay estuary which has led to decreased water quality and habitat loss. Wastewater treatment facilities contribute 390 tons/year (32% of total nitrogen load) of nitrogen to Great Bay.[126]

The eight treatment facilities, located on 5 of the major rivers in the region, together loaded 295.73 tons of TN into these rivers from 2009-2011 (Table 31). The wastewater treatment facility on the Cocheco River in Rochester had a significantly higher result of TN loading than any of the other facilities. With an average load of 35.46 mg of nitrogen and average annual flow of 3.438 mgd of the Cocheco, the Rochester facility alone loaded 140.01 tons of total nitrogen into the Cocheco River from 2009-2011. This contributed to 47.34% of the regional total, followed by the facility in Dover which contributed 31.8% of the total. These numbers contrast with the smaller facility on the Salmon Falls River in Milton. This treatment facility (which serves fewer people) had the lowest totals with an average annual flow of .082 mgd and only delivered 1.47 tons of total nitrogen in the time period, 0.49% of the overall total.

Table 31: Estimated Total Nitrogen Loads from Wastewater Treatment Facilities in 2009-2011

WWTF	Discharge Location	Ave. Total Nitrogen Load (Mg.)	Annual Ave. Flow 2009-2011 (MGD)	Delivered Load in 2009-2011 (Tons/Yr.)
Dover	Upper Piscataqua River (tidal)	22.33	2.770	94.02
Durham	Oyster River (tidal)	10.28	.952	14.88
Farmington	Cocheco River	19.86	.297	3.75
Milton	Salmon Falls River	17.97	.082	1.47
Newmarket	Lamprey River (tidal)	30.10	.612	27.99
Rochester	Cocheco River	35.46	3.438	140.01
Rollinsford	Salmon Falls River	17.97	.085	2.30
Somersworth	Salmon Falls River	4.95	1.582	11.31

[Source: Piscataqua Region Estuaries Partnership: Environmental Data Report. December 2012.]

Together the facilities loaded 229.84 tons of DIN into the rivers in the region from 2009-2011 (Table 32). The facility in Rochester on the Cocheco River loaded 127.10 tons/yr., contributing to 55% of the DIN loaded in the region. The treatment plant on the Upper Piscataqua River in Dover yielded 28.04% of the total, the second highest amount of DIN in the region. This differs from the facility in Milton on the Salmon Falls River which had an average DIN of 14.10 mg. an annual average flow of .082 MGD delivering the lowest total of 1.16 tons a year from 2009-2011.

Table 32: Estimated Dissolved Inorganic Nitrogen Loads from Wastewater Treatment Facilities in 2009-2011

WWTF	Discharge Location	Ave. DIN Load (Mg.)	Annual Ave. Flow 2009-2011 (MGD)	Delivered Load in 2009-2011 (Tons/Yr.)
Dover	Upper Piscataqua River (tidal)	15.31	2.770	64.46
Durham	Oyster River (tidal)	8.95	.952	12.95
Farmington	Cocheco River	17.33	.297	3.27
Milton	Salmon Falls River	14.10	.082	1.16
Newmarket	Lamprey River (tidal)	19.56	.612	18.18
Rochester	Cocheco River	32.19	3.438	127.10
Rollinsford	Salmon Falls River	14.10	.085	1.80
Somersworth	Salmon Falls River	4.35	1.582	9.92

[Source: Piscataqua Region Estuaries Partnership: Environmental Data Report. December 2012.]

Both tables indicate that rivers with higher average flow rates deliver a higher percentage of their average loads yearly. This, along with high average nitrogen loads, contributes to the significantly higher yearly averages in Rochester and Dover over the facilities on smaller rivers. The tables furthermore indicate that wastewater treatment plants emit lower overall amounts of DIN than TN each year; however some municipalities load higher percentages of DIN than others. The treatment plant in Rochester, with 127.10(DIN) and 140.01(TN) overall delivered tons per year, dispenses nearly as much DIN as TN annually. This is in contrast with Dover, which has the second highest rates but a much larger gap between DIN and TN annual delivered loads, distributing 64.46(DIN) and 94.02(TN) tons per year. Overall amounts of delivered nitrogen into the Great Bay estuary depend on the river flow rate and amount of nitrogen discharged from the wastewater treatment facilities.

Septic and Nutrient Loading

Although required setback from property lines and water supply wells are designed to ensure adequate dilution to protect water supply wells, nitrate loading remains a concern where older systems have not been properly sited, designed, installed or maintained and where elevated levels of nitrogen reach freshwater or estuarine ecosystems. Phosphorus is not removed by conventional onsite systems, but rather is absorbed to varying degrees by the soils and plant roots through which the treated effluent passes on its way to surface waters.

The Great Bay Nitrogen Non-Point Source Study[7] conducted by NH DES found that septic systems account for 27% of nonpoint source nitrogen pollution in Great Bay and approximately 18% of the total nitrogen load in Great Bay.[127] This calculation was made based the local of sewer lines obtained from municipalities, the USGS water demand model for New Hampshire Towns, and population totals from 2010 census data and the assumption that the population not served by municipal sewer systems used septic systems.

Storm Impacts

New Hampshire has experienced increased frequency and intensity of flooding events in the last few decades, and this trend is projected to continue. One method to prepare for changes in precipitation is to assign a flood risk rating, which is a description of the overall threat posed by flooding over the next 25 years. This is an important component of a vulnerability assessment. Historical flooding events as well as the elevation of facilities should be considered when assigning a flood risk level to a WWTF.[128]

Flood Rating

High Flood Risk

There is a strong potential for a flood of major proportions during the next 25 years; or history suggests the occurrence of multiple floods of moderate proportions during the next 25 years. The threat is significant enough to warrant a major program effort to prepare for, respond to, recover from and mitigate against this flooding hazard. This flooding hazard should be a major focus of the municipality's emergency management training and planning program.

Medium Flood Risk

There is a moderate potential for a flood of less than major proportions during the next 25 years. The threat is great enough to warrant modest effort to prepare for, respond to, recover from and mitigate against this flooding hazard. This flooding hazard should be included in the municipality's emergency management training and planning program.

Low Flood Risk

There is little potential for a flood during the next 25 years. The threat warrants no special effort to prepare for, respond to, recover from and mitigate against this flooding hazard. This flooding hazard does not need to be specifically addressed in the municipality's emergency management training and planning program, except as generally dealt with during flood awareness training.

[7] Note: Draft report released May 2013.

Southeast New Hampshire experienced significant flooding during extreme precipitation events in 2006 and 2007. Facility managers were asked to provide a summary of the damage that occurred during these storms. Table 33 summarizes the impacts to WWTFs in the region.

Table 33: Facility Update on Impacts from Storm Events

Facility	2006 and 2007 Storm Impacts
Dover	While there wasn't any structural damage sustained to the facility during the severe storm events in 2006 and 2007, flows above the facility design were experienced. During the 2006 event, the facility was unable to handle the excessive flows and discharged through manholes on River Street. Since then the City has addressed inflow and infiltration issues, but extreme rainfall remains a concern.
Durham	As far as the 2006 and 2007 storms, the plant held its own with no equipment loss. There was an overflow from a manhole in the 2006 storm due to the main pump station reaching its pumping capacity. In the 2007 storm, both the plant and pump station operated without major problems.
Farmington	No information available.
Milton	No information available.
Newmarket	The Town did not experience any structural damage, but did receive some minor equipment damage during the floods of 2006 and 2007. Due to the high water, the power was shut off to the Cedar Street and Salmon Street pumping stations. The wastewater treatment facility flows peaked at over 4.0 mgd.
Rochester	While there wasn't any structural damage sustained to the facility during the severe storm events in 2006, 2007 and 2008, flows above the facility design were experienced. During the these events, the collection system was unable to handle the excessive flows and sanitary sewer overflows were reported from the siphon structure on Old Dover Road (Rte 16B) at Exit 11 off the Spaulding Turnpike. Since then the City has conducted a Siphon evaluation and performs scheduled cleaning operations. The City has also been active in sewer separation projects to reduce infiltration and inflow, but extreme rainfall remains a concern.
Rollinsford	No information available.
Somersworth	While there wasn't any structural damage sustained to the facility during the severe storm events during the storms of 2006 and 2007 we experienced flows in excess of facility design. However, we had no issues in terms of capacity with 100% of all influent being treated.

Climate Ready WWTFs

Flooding can impact a WWTF's capacity to manage floodwaters and lead to water quality degradation. Severe storms may result in loss of electricity other than the critical elements connected to generator power. It is critical for facilities to consider: critical elements that will be without power during outages; how long the facility can operate during high flow conditions and maintain adequate treatment to protect public health and the environment; and how to continue to operate the facility and collection system if critical infrastructure such as pump stations and outfalls are flooded.[129]

Six basic steps DES recommends WWTF take to can become Climate Ready include:

1. Climate Impact Awareness
2. Adaptation Strategies
3. Mitigation Strategies
4. Federal and State Policies and Program
5. Community Interest and Support
6. Partnerships Outside the Facility

Refer to the Climate Change Impacts and Adaptation Chapter for information about how WWTF in the region are adapting to climate change. Refer to the Energy Efficiency and Green Building Chapter to learn about measures WWTFs in the region are taking to reduce emissions and mitigate climate change.

Refer to the Climate Change Impacts and Adaptation Appendix for information about how WWTFs in the region are adapting to climate change. Refer to the Energy Efficiency Appendix to learn about how WWTFs are reducing emissions and mitigating climate change.

Projections of Demand

Population growth may result in exceeding capacity of individual WWTFs as well as increase the need to export residuals out of state. Shifts in population centers and development patterns will influence the percent of the population served by municipal sewer systems versus onsite systems. Between 2005 and 2020, the population served by on-site disposal systems is projected to increase by 5-29% across the region (Table 34).

Table 34: Population and Projected Population Served by on-site Disposal Systems and Sewers in 2005 and 2020

	2005 Population				2020 Population			2005-2020
Municipality	Total	On-Site Disposal Systems	Wastewater Treatment Systems (Sewers)	Percent Served by Municipal Sewers	Total	On-Site Disposal Systems	Wastewater Treatment Systems (Sewers)	Percent Increase in On-Site Disposal Systems
Barrington	8,163	8,163	0	0	9,440	9,440	0	16
Brookfield	663	670	0	0	854	863	0	29
Dover	28,734	5,982	22,752	79	30,446	6,339	24,107	6
Durham	13,429	5,537	7,892	59	15,072	6,217	8,855	12
Farmington	6,711	4,065	2,646	39	7,610	4,611	2,999	13
Lee	4,435	4,435	0	0	5,083	5,083	0	15
Madbury	1,748	1,748	0	0	1,950	1,950	0	12
Middleton	1,709	1,709	0	0	1,992	1,992	0	17
Milton	4,370	3,785	585	13	5,040	4,365	675	15
New Durham	2,484	2,484	0	0	3,177	3,177	0	28
Newmarket	9,307	2,848	6,459	69	10,058	3,085	6,973	8
Northwood	3,976	3,976	0	0	4,446	4,446	0	12
Nottingham	4,368	4,368	0	0	5,006	5,006	0	15
Rochester	30,672	14,401	16,271	53	34,284	16,103	18,181	12
Rollinsford	2,655	1,450	1,205	45	2,991	1,632	1,359	13
Somersworth	11,888	2,790	9,098	77	12,478	2,929	9,549	5
Strafford	3,992	3,992	0	0	4,617	4,617	0	16
Wakefield	4,771	4,385	386	8	5,933	5,455	478	24
Total	144,075	76,788	67,294	47	160,477	87,310	73,176	14

[Source: USGS – New Hampshire Water Use Data]

Future Wastewater Treatment Alternatives

Reducing the amount of nutrients that enter the Great Bay estuary will continue to be a significant wastewater management challenge.

The Great Bay Estuary Commission and NH DES are working to address the growing wastewater disposal concerns, help maintain compliance with stringent federal disposal standards, and achieve restoration of the Great Bay estuary habitat. A study is underway to determine how to dispose of treated wastewater and to handle, treat, and dispose of the growing volume of septage in the study area. Potential alternatives include:

- Upgrade to advanced treatment: Upgrade the existing plants to advanced wastewater treatment and continue to discharge treated effluent to the existing location.

- Discharge to the Atlantic Ocean: Continue with the same level of treatment, with discharge of treated effluent to the Atlantic Ocean. Three alternative discharge sites at different distances from the shore will be evaluated.
- Advanced treatment with land application of treated effluent: Upgrade the existing plants to advanced wastewater treatment and discharge treated effluent via land application (up to four sites will be evaluated).
- Build a new regional wastewater treatment facility: Replace the existing treatment plants with a new regional wastewater treatment facility with secondary treatment and a regional wastewater conveyance system. Treated effluent would be discharged to the Atlantic Ocean at one of three alternative sites at different distances from the shore. Septage receiving and treatment would occur at the regional wastewater facility.[130]

For the first three options, non-sewered communities with a need for a wastewater treatment facility would build a collection system and connect to one of the existing wastewater plants.

To initiate the planning process and begin identifying issues to be addressed in the feasibility study, SRPC interviewed approximately 30 experts, including municipal and government officials and consultants with expertise in areas such as wastewater treatment and disposal, planning, engineering, environmental protection, legal and regulatory compliance, and finance. SPRC addressed potential benefits and concerns associated with a regional treated effluent discharge system in its Planning Background Report (Table 35).

Table 35: Summary of Potential Benefits and Concerns of a Regional Effluent Discharge System

Regional Treated Effluent Discharge System	
Potential Benefits	Potential Concerns
• Long-term there may be savings for the communities through avoided costs, especially for the communities with existing wastewater treatment outfall in Great Bay and its tributary rivers. Planning ahead and solving this problem for not only today, but also the future, is sound economically, environmentally, and socially. • There would be significant water quality improvements in Great Bay and its tributary rivers. • Shellfish and other aquatic resources would be protected and their quality enhanced. • Potential for integrating and solving related septage waste disposal issues. • Ability to reduce wastewater treatment capacity constraints.	• The costs of a regional discharge system may outweigh the costs of upgrading individual plants; however, this may only be in the short term because of increases in EPA standards. • A regional discharge system with additional capacity may induce further development in the coastal zone. Currently low to medium density development patterns are recommended for the health of the region's ecosystem and for the resident's quality of life. • There are concerns that this type of system moves the treated effluent from one point to another without removing the metals and other pollutants, and thus creates environmental impacts at the new point of discharge.

[Source: SRPC – Planning Background Report: Toward Regional Treated Effluent Discharge Policies and Strategies. 2003]

NH DES prepared an Alternatives Comparison to compare environmental issues, non-monetary factors, and planning level construction costs associated with four alternatives for meeting more stringent federal requirements. [131] The planning level cost estimates for each alternative are displayed in the table below (Table 36).

Table 36: Alternative Treatment, Conveyance, and Disposal Planning Level Estimated Construction Cost Estimates

Alternative	Treatment Cost	Conveyance Cost	Disposal Cost	Total
Alternative 1 – No Action	$110,600,000			$110,600,000
Alternative 2 – Treatment at Existing WWTFs with a Regional Gulf of Maine Discharge	$73,800,000	$396,000,000	$119,300,000	$589,100,000
Alternative 3 – Decentralized Treatment and Continued Use of Existing WWTFs	$92,000,000		$119,500,000	$211,500,000
Alternative 4 – Treatment at Existing WWTFs with Land Application Discharge	$172,000,000	$113,900,000	$26,800,000	$312,700,000

[Source: New Hampshire Seacoast Region Wastewater Management Feasibility Study – Draft Alternatives Report. 2007]

Related Legislation:
Senate Bill 70
"AN ACT establishing a commission to study implementing recommendations of the New Hampshire Estuaries Project management plan."
Senate Bill 481
"AN ACT establishing a sewer and other water-related purposes district for Great Bay."
House Bill 1403
"AN ACT extending the reporting dates for certain study committees."
House Bill 199
"AN ACT relative to fish and game department expenditures for marine fisheries, and relative to the membership and reporting date of the commission to study recommendations of the New Hampshire estuaries project management plan."

Integrated Planning

Integrated municipal stormwater and wastewater planning is one method to help prioritize steps to achieving water quality objectives of the Clean Water Act (CWA) by identifying efficiencies in implementing competing requirements that arise from separate wastewater and stormwater projects, including capital investments and operation and maintenance requirements.[132] On June 5, 2012, EPA released the final Integrated Municipal Stormwater and Wastewater Planning Approach Framework (PDF) (9 pp, 396K). The framework was developed in conjunction with the October 27, 2011 memorandum to provide further guidance for EPA, States and local governments in developing and implementing effective integrated plans under the CWA. This framework was finalized after extensive public input including a series of workshops across the country.

Dams

History & Overview

Dams have been a fixture on New Hampshire's landscape for centuries, having first been constructed by the early settlers to power grist mills and lumber mills in the eighteenth century, then by large manufacturers to fuel the industrial revolution. Some of these dams, dating back to this period, are among the oldest and most massive engineering projects still in service in New Hampshire.

Lamprey River at Macallen Dam – Newmarket, NH

Photo Credit: Wunderground.com

Legislation governing dams dates back as far as these early dams, beginning in 1718 when the Provincial Government passed the Mill Dam Act. This Act encouraged industrial development through the construction of dams by providing a method of compensating land owners whose lands were flooded by the construction of a dam. In 1805, the New Hampshire Legislature passed a law empowering the selectmen of the town, in which a dam was located, to order it to be repaired if they determined that repairs were necessary.

The beginnings of the state's Dam Safety Program was first enacted in 1913, when the New Hampshire Legislature enacted a bill requiring that no dams greater than 25-feet-high be constructed until the plans and specifications were approved by the Public Service Commission. The statute also required that the commission appoint suitable persons to inspect the construction of the dam, and that the dam owner or contractor comply with orders issued by the commission to correct defects detected by the inspector.

The statute that provides the basis of New Hampshire's current Dam Safety Program, RSA Chapter 482, was first enacted in 1937, and has been amended over the years to reflect changes in public policy as well as changes in the principles and practices of dam safety.[133]

According to the New Hampshire Water Resources Primer, dams are an important feature of the New Hampshire environment, creating some of the best water-based recreational areas in the state, providing water supply and hydropower, and, in a few cases, flood control. Some historic dams are closely tied to people's sense of community character and aesthetics. During droughts dams can be important in retaining water for water supply and industrial use. On the other hand, dams can block fish migrations and adversely impact downstream water quality and streamflows. Also, dams that are not maintained in good operational order can fail and cause loss of life and economic damage.

Oyster River at Reservoir Dam – Durham, NH

Photo Credit: Oyster River Watershed Association

In New Hampshire the risks associated with many dams are increasing rapidly because of: 1) the encroachment of businesses and homes downstream from dams in areas that would be flooded if the dams were to fail; 2) increasingly frequent extreme rainfall events due to climate change; and 3) a lack of important maintenance on many privately owned and some publicly owned dams.

Definitions and Descriptions

In 2009, the New Hampshire Legislature changed the statutory definition (RSA 482:2, II) of a dam by increasing the minimum height criteria from four feet to six feet. In making this change, the Legislature determined that dams less than six feet in height were not likely to pose a threat to human life or downstream property if they were to fail. This change was also enacted to make New Hampshire's definition of a dam more consistent with the national standard. As a result of this change, over 700 structures were removed from New Hampshire's inventory of dams.

Revised Dam Definition (September 11, 2009)

(a) "Dam" means any artificial barrier, including appurtenant works, which impounds or diverts water, and which has a height of 6 feet or more, or is located at the outlet of a great pond. A roadway culvert shall not be considered a dam if its invert is at the natural bed of the water course, it has adequate discharge capacity, and it does not impound water under normal circumstances. Artificial barriers which create surface impoundments for liquid industrial or liquid commercial wastes, septage, or sewage, regardless of height or storage capacity, shall be considered dams.

(b) An artificial barrier at a storm water detention basin, which impounds 0.5 acre-foot or less of water during normal conditions, shall not be considered a dam unless its height is 10 feet or greater or its maximum storage is 6 acre-feet or greater.

Dam Classifications

There are currently 2,986 active dams in New Hampshire. Of the 2,986 dams, 827 of these dams are classified as hazardous dams. This classification is based solely on the extent of damage that would be imposed on developed areas downstream and within the potentially inundated area, and is not related to the condition of the dam.

Of these 827 hazardous dams, 107 are classified as high hazard dams because their failure would inundate houses or other occupied structures downstream and likely cause loss of life. One hundred and eighty-five dams are classified as significant hazard dams because their failure would cause major property damage downstream, and 535 are classified as low hazard dams because their failure would cause minor property damage downstream, such as damage to a town or city road. The remaining 2,159 active dams are classified as a Non-Menace structure.

NH Dam Classifications

High Hazard refers to a dam which has a great hazard potential because of the size and location of the structure. The failure or misoperation of high hazard dams will result in the probable loss of human life.

Significant Hazard means that a dam has potential to cause substantial danger if misoperated. Failure would not cause probable loss of life but major economic loss to structures and property, render roads impassable, and cause major public health and environmental issues.

Low Hazard refers to a structure, if it were to fail, would cause no loss of life, low economic and property loss, impassible roads, and result in reversible environmental losses.

A Non-Menace structure would cause no loss of life or property damage, providing the dam meets specific height and capacity measurements.

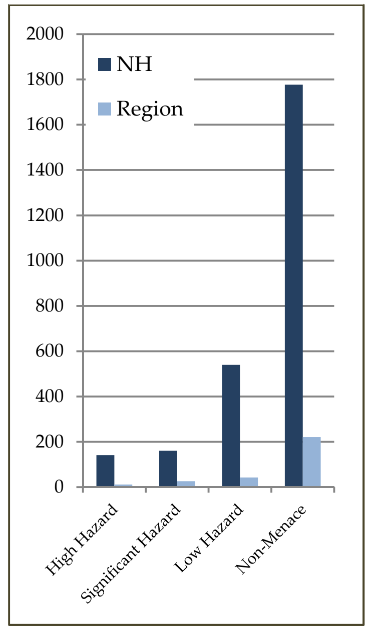
Table 37 shows the classification of dams in each municipality in the Strafford region. The regional totals are: 11 high hazard dams, 26 significant hazard dams, 41 low hazard dams, and 218 non-menace structure dams (Figure 11). Although the majority of the 296 active dams in the region are classified as a non-menace structure and low hazard, there are still 11 high hazard dams in the region which are potentially fatal if they were to fail or be breached. The Cities of Dover and Rochester both have the highest numbers of active dams with 31; this is followed closely by a total of 30 in Durham. New Durham, in contrast, has only 23 active dams total but hosts 3 high hazard dams which is the highest volume in the region.

Table 37: Classification of Active Dams by Municipality in the Strafford Region

Municipality	High Hazard	Significant Hazard	Low Hazard	Non-Menace Structure	TOTAL
Barrington	1	2	4	16	23
Brookfield	0	0	2	3	5
Dover	1	2	3	25	31
Durham	0	4	1	25	30
Farmington	0	0	1	11	12
Lee	0	0	0	11	11
Madbury	1	0	1	12	14
Middleton	1	0	2	2	5
Milton	0	2	3	14	19
New Durham	3	0	2	18	23
Newmarket	1	0	0	8	9
Northwood	0	1	5	11	17
Nottingham	1	3	4	6	14
Rochester	0	5	7	19	31
Rollinsford	0	2	0	8	10
Somersworth	0	1	1	7	9
Strafford	1	2	3	17	23
Wakefield	1	2	2	5	10
TOTAL	**11**	**26**	**41**	**218**	**296**

[Source: NHDES Dams - 2010]

Figure 11: Active Dams



[Source: NHDES Dams - 2010]

Table 38: Dam Status

Status	Dams
Active	296
Breached	18
Exempt	50
Not Built	46
Pending	4
Removed	7
Ruins	72
TOTAL	**493**

[Source: NHDES Dams - 2010]

Table 38 shows the status of the 493 dams in the region. The majority of the dams are classified as active, which indicates they are currently impounding water or have the ability to hold water during a specified storm event. There are 18 breached dams which no longer have the ability to impound water in the occurrence of a storm. Fifty exempt dams exist in the region, which once met the criteria of existing dams but no longer meet the DES standards of the definition of a dam. A status of not built describes a dam which has been permitted but was never constructed. There are 46 dams with this status. There are four pending dams which have been permitted but have not yet been confirmed as constructed. The seven removed dams have been intentionally extracted due to various causes. A status of ruins, the second largest category in the region with 72 dams, describes the remains of a dam which is no longer functional and is deteriorated to the point where the original configuration of the dam can no longer be determined.

Dam Ownership

Tables 39 and 40 display the classification of ownership of all active dams and all hazardous dams throughout the region and statewide. Hazardous dams include all dams which are low, significant, and high hazard. Twenty nine hazardous dams in the region are classified as having private ownership. This is followed by state and local dams which have totals of 27 and 22. This shows that the totals of hazardous dams are split fairly evenly among private, state, and local owners. There are no federally or public utility owned hazardous dams in the region.

Table 39: Regional Classification of Ownership

Owner	All Active Dams	All Hazardous Dams
Federal	0	0
Local	31	22
Private	226	29
State	38	27
Public Utility	1	0
TOTAL	296	78

[Source: NHDES Dams – 2010]

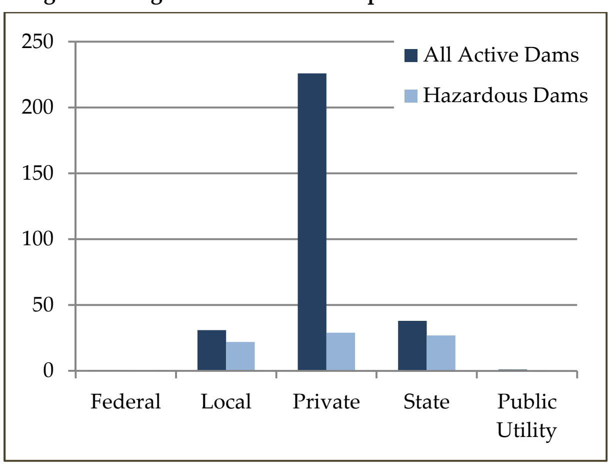
Table 40: Statewide Classification of Ownership

Owner	All Active Dams	All Hazardous Dams
Federal	40	21
Local	384	217
Private	2,290	399
State	260	181
Public Utility	12	9
TOTAL	2,986	827

[Source: NHDES Dams – 2010]

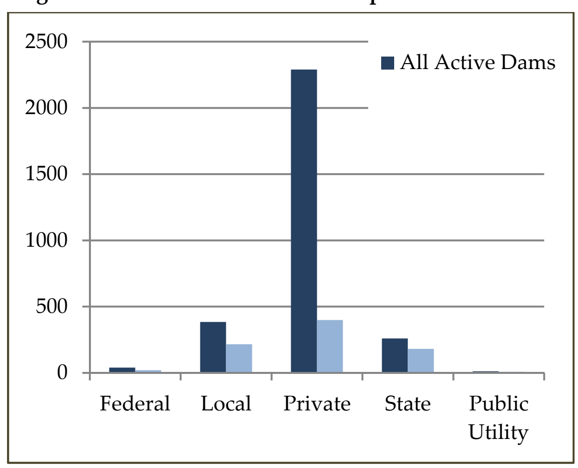
The graphs below (Figures 12-14) display the relationship between total and high hazard dams on the regional and state level. When comparing regional to statewide dam ownership, the trend is fairly similar. The majority of all dams are privately owned. Only 12.8% of the privately owned dams in the region are hazardous, this is compared to 70% and 71% of local and state owned dams. The high percentage of hazardous state and locally owned dams may be a result of state and local owners possessing larger dams than private owners. These larger dams impound high amounts of water resulting in inherently hazardous situations. This can be attributed to these dams being used by the state for purposes such as water supply and recreation, which may retain higher amounts of water than private uses. Relating the regional and state numbers, the state has 17% of hazardous privately owned dams whereas only 12% of the privately owned dams in the region are considered hazardous. The region does not host any of the 40 active federally owned dams in the state and only one of the 12 owned by a public utility. Overall, regional dam ownership stays true to the trends of dam ownership throughout the state.

Figure 12: Regional Dam Ownership



[Source: NHDES Dams 2010]

Figure 13: Statewide Dam Ownership

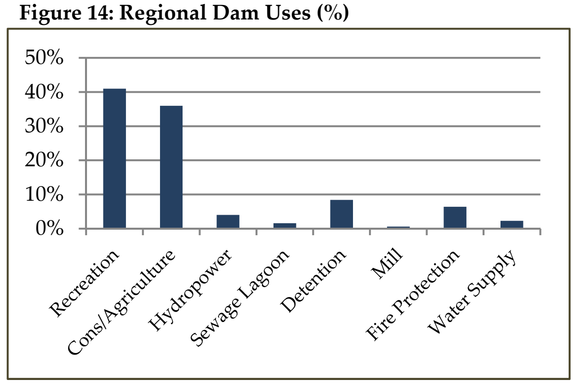


[Source: NHDES Dams 2010]

Dam Uses

Dams can be created for a variety of different purposes. The graph on the right shows the categories of dam uses in the Strafford region. Recreation is the most common use with 121 dams (41% of active dams), in the region. Dams built for conservation and farming purposes make up 36% of the dams in the region. These 105 active dams are used to collect water for farmland irrigation, to create small pools for wildlife, and other assorted purposes. These dams are beneficial to local regional farming as well as providing resources for animal species in the region. Local farming is supports the economy in the region. Additional uses for dams in the region are: waste water treatment sewage lagoons (1.6%), water detention (8.4%), fire protection (6.4%),

Figure 14: Regional Dam Uses (%)



[Source: NHDES Dams 2010]

hydropower (4%), and water supply (2.3%). The smallest category of dam use is mills, with only two in the region, making up a total of 0.6%. The two mill uses in the region are the Garborski Recreational Pond Dam on an unnamed brook in Strafford and the Drew River Mill on the Branch River in Wakefield. Both are privately owned, non-menacing, concrete dams.

Benefits and Public Usage

Dams have a variety of benefits to New Hampshire's businesses and communities, including recreation, water supply storage, hydropower generation, fire ponds, stormwater or sewage detention, mill process water, and farm ponds.

Economic Benefits

According to the New Hampshire Lake Association's Report on the Economic Value of New Hampshire's Surface Waters, New Hampshire's lakes provide up to $1.5 billion annually of economic benefit to the state, and waterfront property owners pay nearly a quarter billion dollars annually in property taxes. Since the majority of New Hampshire's surface waters are impounded by dams, the upkeep of these dams is important, not only to protect public safety and the environment, but also to maintain the significant economic benefits that they provide.

Bellamy Dam - Madbury, NH

Photo Credit: Wikipedia.org

Recreation

Dams that are used for recreation are created to enlarge certain water bodies for leisurely opportunities such as: hunting, boating, fishing, and swimming. These dams also broaden habitats for fish, waterfowl, and other aquatic species. Recreational opportunities are beneficial to the state's economy through annual waterfront property taxes and the appeal of New Hampshire lakes to tourists.

LOCAL EAMPLE

The Pawtuckaway Lake/Dolloff Dam is a high hazard dam in Nottingham, New Hampshire. The dam is currently owned by the New Hampshire Water Division. Pawtuckaway Lake was formed by the construction of two dams and two dikes (Dolloff Dam, Drowns Dam, Gove Dike and Drowns Dike), which allowed the flooding and merging of Pawtuckaway Pond and Dolloff Pond, both natural ponds greater than 10 acres in size. These dams are reported to have been built between 1839 and 1842 by the Newmarket Manufacturing Company to impound more industrial storage in Pawtuckaway Pond for use in their milling operations approximately 27 miles downstream. Ownership passed on to the Lamprey River Improvement Company, a subsidiary of New Hampshire Gas and Electric Company, sometime prior to 1917. Lamprey River Improvement Company utilized the impoundment primarily for upstream storage for generation of hydroelectricity for the region, with some recreational use. The New Hampshire Water Resources Board purchased the dams for one dollar ($1) in 1955, and since then the dams have been operated for recreation. Pawtuckaway Lake has various recreational opportunities. Pawtuckaway State Park, located on the lake, has a large family beach, hiking opportunities, camping opportunities, and boats available for rent. The dam, created for recreation, provides the landscape for the state park surrounding the lake. The state park charges entry fees as well as camping, and boat rental fees. The park provides an opportunity for tourism which generates revenue, benefiting the regional economy.

Dolloff Overflow Spillway –Pawtuckaway Lake

Photo Credit: Jack Hodgson (flickr photos)

See the Environment, Land Use, and Recreation Appendix for maps of impervious surface cover in the

Hydropower Dams

Hydroelectric power production is advantageous for communities in a variety of ways. Hydroelectricity is a renewable source of energy. It uses the energy of running water to produce electricity without reducing water quantity. The use of water as an energy supply provides stability of resources while emitting very small amounts of greenhouse gasses. Compared to fuel burning power plants, hydroelectric power produces minimal pollution and has low maintenance costs.[134]

Table 41 displays the 11 hydro-powered dams in the region. The City of Rochester, with three dams, has the most hydro-powered dams two on the Salmon Falls River and one on the Cocheco River. Overall seven of the 11 hydropower dams in the region are located on the Salmon Falls River. Three of the dams are on the Cocheco and one is on the Branch River in Wakefield. All these dams have a Federal Energy Regulatory Commission (FERC) license and are required to follow FERC standards and are inspected by the FERC as well as NHDES. The concentration of hydropower dams is due to the size and flow of the rivers. These three rivers, having the highest flows in the region, are suitable for generating hydroelectric power.

Table 41: Hydro Electric Dams in the Region

Dam Name	Municipality	Waterway	Owner	Authorized Capacity (KW)
Cocheco Falls Dam	Dover	Cocheco River	Cocheco Falls Associates	714
Watson Dam	Dover	Cocheco River	Watson Associates	265
South Milton Dam	Milton	Salmon Falls River	Algonquin Power Systems Inc.	1,500
Hatfield Dam	Rochester	Cocheco River	Woodsville Rochester Hydro Assoc.	266
Boston Felt Dam	Rochester	Salmon Falls River	Bacon Felt Company Inc.	157
Spaulding Pond Dam	Rochester	Salmon Falls River	Spaulding Ave. Industrial Complex, LLC	300
South Berwick Dam	Rollinsford	Salmon Falls River	Consolidated Hydro NH Inc.	1,200
Rollinsford Dam	Rollinsford	Salmon Falls River	Town of Rollinsford	1,500
Lower Great Falls Dam	Somersworth	Salmon Falls River	City of Somersworth	1,280
Great Falls Upper Dam	Somersworth	Salmon Falls River	General Electric Co.	2,220
*Union Village Dam	Wakefield	Branch River	The Sieman Company	N/a

***Was surrendered back in December 2005 (according to 11/06/2013 data)**
[Source: NHDES Dams 2010 & Federal Energy Regulatory Commission]

Hydropower Potential

Other dams in the region that have been identified as having a potential for hydropower development are displayed in the table below.

Table 42: Potential for Hydropower Development

Dam Name	Municipality	Waterway	Owner	Authorized Capacity (KW)
Wiswall Dam	Durham	Lamprey River	Town of Durham	360
Milton 3-Ponds Dam	Milton	Salmon Falls River	State of New Hampshire	210
Rowe Dam	Milton	Salmon Falls River	State of New Hampshire	59
Waumbec Dam	Milton	Salmon Falls River	State of New Hampshire	74
Macallen Dam	Newmarket	Lamprey River	Town of Newmarket	560
Gonic Sawmill Dam	Rochester	Cocheco River	Unknown	300

[Source: James W. Gallagher, Jr. P.E., Chief Engineer, NHDES]

While over the past 40 years, various parties have investigated the feasibility of hydropower at these sites, no sites have been developed to date due to various reasons including economic infeasibility, operational and environmental constraints, and the poor condition of some of the dams. However, in 2012, FERC issued a Preliminary Permit for the Milton 3-Ponds Dam and Waumbec Dam sites allowing the permit holder to study the feasibility of hydropower at the site, as well as its potential impacts.[135]

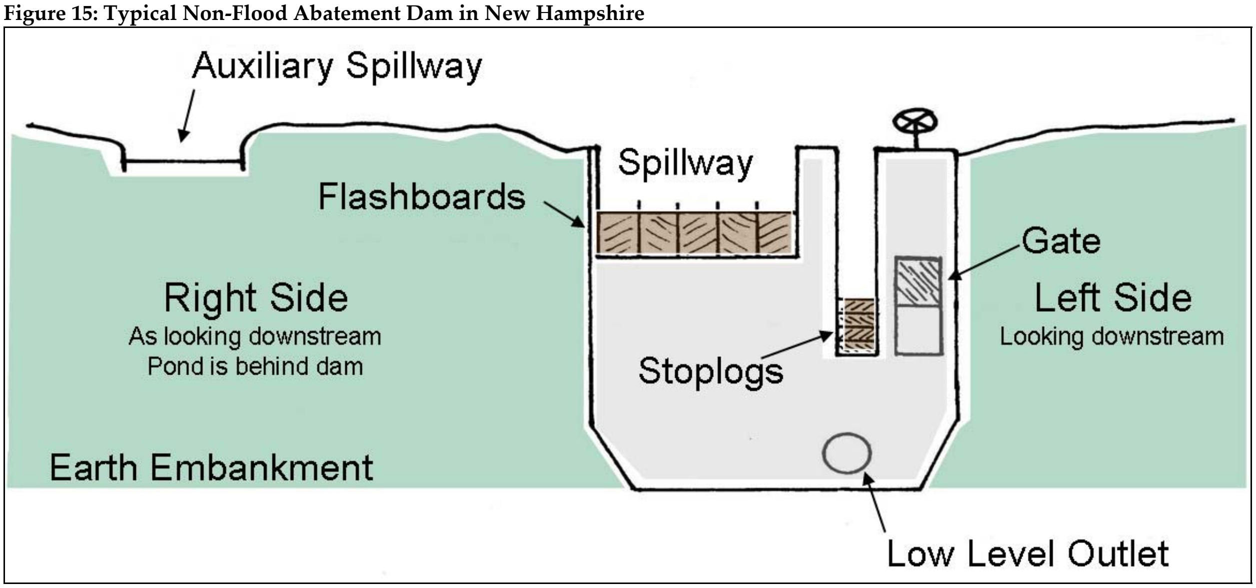
Flood Control

Numerous dams are built for reasons other than flood control, and can cause flooding because of water build-up above the dam. Particular dams, however, are built for the purpose of controlling flooding. An example of a dam built specifically for flood control is the Blackwater Dam in Webster, New Hampshire. The purpose of the dam is to protect the communities downstream from flooding during heavy precipitation and storming. The Blackwater Dam aids in preventing flooding in cities from Concord, Manchester, and Nashua to Massachusetts communities such as Lowell, Lawrence, and Haverhill. The dam is a dry-bed reservoir, the river flowing unhindered through the dam. The flood gates are only lowered to begin storing water in the reservoir when there is a risk of a flood.[136]

As shown in Figure 14, there are no flood control dams in the Strafford Region. Although 8.4% or 26 dams in the region are classified as detention ponds, these are typically very small and control stormwater from localized developments, a few acres in size, such as shopping centers or office parks. However, some limited flood control is provided, on a seasonal basis, by drawing the levels of certain lakes down in the fall, as described in the following section, to provide room to store some spring runoff. The amount of runoff that can be stored in these lakes depends on the depth of the drawdown, the size of the lake, and the size of the watershed that flows into the lake, but generally is limited to 2 to 5 inches of runoff.

Once these lakes are filled in the spring for the summer recreation season, the water level is maintained at the spillway crest, with no room for storage of flood waters. In addition, these dams typically have very limited discharge capacity through the low level outlets in the dams. As a result, the impoundments behind these dams cannot be drained very quickly to provide flood storage in advance of forecasted floods. Figure 15 shows the components of a typical non-flood abatement dam in New Hampshire.[137]

Figure 15: Typical Non-Flood Abatement Dam in New Hampshire



[Source: James W. Gallagher, Jr. P.E., Chief Engineer, NHDES]

Lake Drawdowns

A lake drawdown is the seasonal lowering of a lake in the winter. Lake drawdowns are performed for several reasons such as protection of shoreline, aquatic weed control, reducing ice damage, water storage, and flow regulations. Lowering water levels in the winter helps to reduce flooding from precipitation and snowmelt in the spring. Lake drawdowns can protect shoreline by preventing high water levels by providing vertical space for water to rise to normal levels in unusually high runoff conditions, thus reducing erosion. . Chances of shorefront properties experiencing flooding is significantly reduced in the case of a lake drawdown. The gradual draining of the water increases the efficiency of hydroelectric power production by allowing water flow in times of little precipitation. Drawdowns also have a negative effect on invasive plant species populations. The lowering of water levels in cold months may kill invasive plants by exposing sediments to freezing and drying conditions. Drawdowns are not always successful in curbing invasive plant species habitats. In circumstances of mild winters and heavy snow, plant populations may not be affected.

However, there are also disadvantages to lake drawdowns. Aquatic ecosystems can be negatively affected by lowering water levels. Fish and duck populations can potentially suffer from reduction of food sources as well as the lack of physical water space to inhabit. Vegetation, amphibians, and invertebrates may also be affected by the loss of the surrounding environment. If there is a dry spring, water levels may not return to normal levels, leaving the lake water unrestored.

Table 43 displays the ten lakes in the Strafford Region which experienced drawdowns in the fall of 2013. Four of the lakes are located in Wakefield, three in Nottingham, and one each in Brookfield, Middleton, and Barrington. Lake drawdowns are performed at two separate ponds on the Salmon Falls River in Wakefield. The drawdown levels shown are not from the current lake heights, but instead are the amounts to be withdrawn from the full water level. Pine River pond in Wakefield, with an 8′ drawdown level, has the highest drawdown amount in the region.

Table 43: Lake Drawdowns in the Region [Fall 2013]

Lake	River	Municipality	Depth (Ft.) From Full
Great East Lake	Salmon Falls River	Wakefield	3′
Horn Pond	Salmon Falls River	Wakefield	1.5′
Kingswood Lake	Churchill Brook	Brookfield	4′
Lovell Lake	Branch River	Wakefield	3′
Mendums Pond	Little River	Nottingham	7′
Nippo Pond	Nippo Brook	Barrington	2′
North River Pond	North River	Nottingham	1′
Pawtuckaway Lake	Pawtuckaway River	Nottingham	6.5′
Pine River Pond	Pine River	Wakefield	8′
Sunrise Lake	Dames Brook	Middleton	2′

[Source: NHDES Dam Bureau]

Best Management Practice

Lake Level Investigation: Pawtuckaway Lake, Nottingham

In May 2012, Department of Environmental Services Dam and Watershed Management Bureaus directed a primary investigation of environments in Pawtuckaway Lake in Nottingham. DES then initiated a Lake Level Investigation of the lake and Dolloff and Drowns Dam in Nottingham. The investigation reviewed wintertime operations, specifically drawdown levels. The analysis focused on a proposal to reduce the winter drawdown, to keep a water pulse to maintain stream levels during the winter. Through research of the dams' histories DES found that the drawdown levels were created for downstream power production and did not take into account water levels in the lake for habitat and recreational enjoyment. Through this investigation DES concluded that the most beneficial operations on Pawtuckaway Lake for all interests would be to reduce the winter drawdown. This change is put into effect over the course of four years, by decreasing the drawdown target more each year. In this case, high winter drawdown levels had a negative effect on wildlife habitat and the use of the lake for recreational enjoyment by community members. The reduction of annual winter drawdown levels will help to preserve the value of the natural resource.

Navigable Waters

Dams have never played a role in sustaining commercial navigation in New Hampshire and none of the state's dams are equipped with locks to pass vessels. Likewise, the impoundments formed by the dams in the state have insufficient capacity to continuously provide navigation flow in the state's rivers, without significantly impacting the uses for which the dams were built or are maintained. Commercial navigation in New Hampshire is limited to the state's coastal ports.[138]

Adverse Effects, Potential Risks & Emergency Planning

The upkeep of dams is important, not only to protect public safety and the environment, but also to maintain the large economic benefits that they provide.

Ecological Impacts

As stated in the New Hampshire Water Resource Primer, well-maintained dams can provide many benefits, but can also cause a number of environmental problems, including blockage of fish passage, interruption of sediment and nutrient transport, changes in temperature and chemical constituents, interference with the reproduction of aquatic life, and fragmentation of natural habitats. The effects can be felt significantly downstream and can modify, sometimes dramatically, the operation of a dam.

As water is detained behind larger dams, sediments tend to settle to the bottom behind the dam, building up in layers. This factor may actually improve the water quality in ponds downstream of a series of dams, but the riverine characteristics of habitat and fisheries are lost. Water temperatures are usually higher and oxygen levels lower because of a dam. Fish passage both up and downstream may be entirely lost. The sediment built up behind a dam may lead to increased oxygen consumption and create internal cycling of nutrients that can lead to algal blooms. Algal blooms can result in fish kills and threats to human health.

Downstream of the dam there can be significant negative effects. Flow may be significantly reduced, stranding aquatic life and cutting off usable habitat upstream. Anadromous fish that swim upstream may be prevented from migration, and most fish ladders, where they exist, are far from perfect.

Dam Failure

The failure of a dam can result in several negative consequences such as damage to property, and loss of life. Dam failures are possible in circumstances involving:

- water spilling over the top of the dam (overtopping);
- structural failure of dam building materials, cracking;
- insufficient upkeep of the dam, and;
- loss of internal soil material from seepage (known as "piping of soil" as evidenced by sink holes within the dam

The likeliness of dam failure increases with high stream flows. These rapid flows are caused by increasing developments and impervious surfaces intensifying the volume of precipitation runoff. Climate change is also a contributing factor by aggregating the concentration of high runoff. These factors result in high stream flows, which exceed the outlet capacities of the dams thus increasing the likelihood of the dam overtopping and eroding to the point of failure.[139]

Nottingham Lake Dam Failure – April 2007

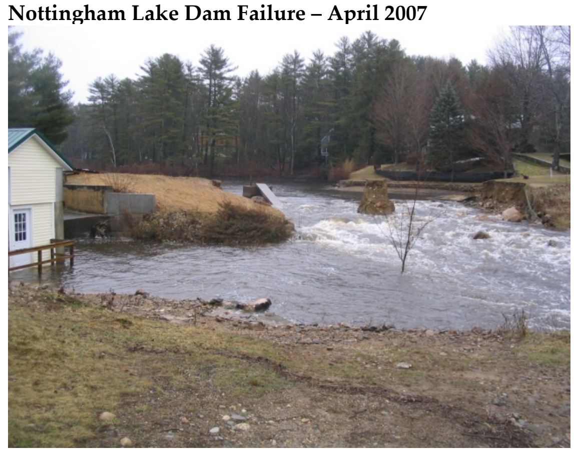


Photo Credit: Charles A. Brown – Nottingham, NH

The number of high hazard dams in is increasing in New Hampshire due to increased development downstream in the floodplains of large dams rather than the construction of new dams. There is increased encroachment of developments into areas which would be flooded in a circumstance of dam failure. The state does not have control over land use within flood areas downstream of dams; however, local regulation is possible through floodplain zoning.

To go along with increased development and landscape changes, the region has also experienced higher frequencies of extreme precipitation events, exceeding the outlet capacities of existing dams. The region is also facing continued increases in watershed imperviousness, escalating the percentage of precipitation that runs off the land, boosting the frequency and magnitude of high stream flows. Potential climate change is also predicted to increase the intensity and frequency of high runoff events, which will compound existing loads on dams.

Dams in Need of Repair

According to the New Hampshire Water Resource Primer, dams must be maintained to keep them safe. Occasional upgrade or rehabilitation is necessary due to deterioration, changing technical standards, improved construction techniques, better understanding of the area's precipitation conditions, increases in downstream populations, and changing land use. When a dam's hazard classification is changed to reflect an increased hazard potential, the dam may need to be upgraded to meet an increased need for safety.

The lack of funding for dam upgrades is a serious concern, especially within the private sector. Unfortunately, Operation, maintenance and rehabilitation of dams can range in cost from the low thousands to millions of dollars, and owners are responsible for these expenses. In New Hampshire more than three-quarters of the dams are privately owned and many owners cannot afford these costs.

The DES Dam Bureau regularly inspects, on a schedule based on hazard classification, the 827 hazardous dams. Following those inspections, DES issues reports to the dam owners identifying the deficiencies observed during the inspection and specifying a schedule to correct the deficiencies. Over the course of the last three years, there have been 24 dams identified with known deficiencies of some form. The most recent letters have been highlighted in Table 44.

Table 44: Deficient Dams and Correction Schedules in the Region

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
Barrington	Swains Lake Dam	1/20/2012	• Continuing basis: o Monitor seepage from the right embankment downstream retaining wall, which is located between 10ft and 25ft right of the spillway • May 1, 2012: o Complete and submit to the Dam Safety Office the Operation, Maintenance, and Response Form • December 21, 2012: o Remove all debris from the 15ft buffer zone of clearing, downstream from the dam embankment o Fill, seed, and mulch all areas of the dam's embankment that have bare or limited growth, and establish hearty growth of grass or provide approved erosion resistant sized stone to protect these areas o Fill, compact, seed, and mulch minor sinkholes of the dam's left embankment adjacent to the gate house and establish hearty growth of grass o Confirm the dam's right and left embankment crest are consistently level in elevation from end to end • December 31, 2013: o Update existing Emergency Action Plan. o Cut all trees, brush, and weedy growth from the footprint of the dam and 15ft beyond the footprint of the dam to prevent damage to the dam from root penetration, blow down of the trees and to create a buffer zone to monitor the dam for seepage and other maintenance concerns o Fill, seed, and mulch all areas of the dam that may be damaged from the tree cutting noted above
Dover	Sawyers Mill Upper Dam	1/3/2012	• January 1, 2013: o File a DES Wetlands Program application for the removal of the Sawyer Mill Upper Darn • January 1, 2014: o Complete all permitted work to remove the darn in accordance with a plan as approved by the DES Dam Safety Bureau
Dover	Sawyer Mill Lower Dam	1/3/2012	• January 1, 2013: o File a DES Wetlands Program application for the removal of the Sawyer Mill Lower Darn • January 1, 2014: o Complete all permitted work to remove the dam in accordance with a plan as approved by the DES Dam Safety Bureau
Dover	Redden Pond Dam	10/9/2012	• Since these items are considered minor in nature at the present time, and because they do not materially detract from the dam's structurally integrity or operability at this time, DES has established no schedule for you to address them nor does it intend to visit your dam again until the next scheduled inspection is to occur in 2018: o Remove brush and woody growth from the upstream slope of the dam to a distance of 25 feet from either side of the spillway structure; and o Add loam and seed, as necessary, to reestablish a growth of hearty grass cover on the bare areas of the crest
Farmington	Tufts Pond Dam/Berry Brook Res	4/18/2011	• Monitor: o The seepage found at the interface of the downstream side of the right embankment and right spillway abutment. It's not clear where the seepage is originating from. Monitor for changes in flow volume or movement of embankment material (fines). The monitoring procedure should be added to your Operation, Maintenance, and Response Form (OMR) • December 1, 2011: o Remove all trees and brush from the footprint of the dam (man-made portion/earthen embankment) and downstream and for a distance of l5 feet be) and the foot print of the dam and establish a hearty grass cover on any areas that are not protected by other erosion resistant materials. Notably the far right end of the dam's embankment and the dam's left side downstream slope. Stumps may remain if cut flush with the adjacent ground.

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
			o Remove all trees and brush from a 15ft area on all 4 sides of the dike. Stumps may remain if cut flush with the adjacent ground o Fill, seed, and mulch the dam's crest as necessary to promote a growth of heart grass cover. Notably the bare areas on far left embankment crest o Review/update as necessary the OMR dated February 14, 2008. If updates are required, please submit a copy to the Dam Bureau office.
Madbury	Bellamy Reservoir Dam	5/3/2011	• Continuing basis: o Review/update as necessary the OMR dated February 14, 2008. If updates are required, please submit a copy to the Dam Bureau office. The dam owner should also monitor the concrete deterioration and seepage on the dam surface as warranted. It is apparent that the historical efflorescence and seepage observed on the downstream face of the spillway monoliths and abutment walls is slowly continuing to cause deterioration to the concrete. The owner must be vigilant regarding this deterioration to assure the internal structural concrete is not weakened further. • August 1, 2011: o The EAP document is being updated by H.L. Turner. Review and incorporate attached edits to the plan and resubmit for DES review. The dam breach analysis should be updated and an updated inundation map prepared. Once the document has been prepared fully, submit to DES for review prior to distribution. Once approved, distribute and test the EAP as required o Assure the areas that have been disturbed on the left embankment are smoothed and stabilized with hearty vegetative cover o Remove the brush growth in the rip-rapped area at the downstream end of the left spillway abutment wall o The left end of the dam appears to still be too low relative to the remainder of the left embankment. Though the dam embankment crest may have more than the required one (1) foot of freeboard during the design event (x.5 x Ql00), DES recommends that the crest of the left embankment section be surveyed and repaired to return it to its design elevation;
Madbury	Gangwer Wildlife Pond Dam	2/10/2010	• July 1, 2010: o Complete the Operations, Maintenance, and Response (OMR) form o Remove all trees and brush growing along and within 15 feet of the footprint of the dam; to include the upstream, downstream, and crest portions of the embankment. Stabilize the area with a hearty vegetative cover, or with properly designed riprap stabilization. • July 1, 2011: o Repair the outlet structure so that the outlet operates properly and is free of debris, and the grate is connected to the outlet so that the structure is free-draining and self-cleaning. Additionally, maintain the area of the downtown outlet pipe so that it can be readily viewed and inspected o Replace or remove the access boards, as they appear to have deteriorated substantially and may be dangerous to personnel maintaining and inspecting the dam • Recommended items for Dike section: o Remove the trees and brush growing along and within 15 feet of the footprint of the dam; to include the upstream, downstream, and crest portions of the embankment. Stabilize the area with a hearty vegetative cover, or with properly designed riprap stabilization. o Re-grade and stabilize the damaged downstream embankment at the dike section
Milton	Milton Waste Water Lagoons		• July 2, 2012: o Remove all trees and brush from the footprint of the lagoon's man-made portion/earthen embankment and for-a distance of l5 feet beyond the foot print of the dam and establish a hearty grass cover on these same areas that are not protected by other erosion resistant materials. Stumps can remain if cut flush with the adjacent ground. It appears the man-made portions of the lagoon slopes are beyond the security fence and requiring maintenance. o Regrade all embankment crests, as necessary, to establish a consistent level grade around the complete circumference of each lagoon (return to original design elevation). New material shall consist of loam to produce a hearty growth of vegetation or an erosion resistant material such as well-compacted gravel. o Review the Operations, Maintenance and Response form (OMR) dated March 12, 2008, if updates are necessary, please return to the Dam Bureau.

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
New Durham	Downing Pond Dam	4/25/2011	• May 1, 2012: o Remove all trees and brush from the footprint of the dam and for a distance of 15 feet beyond the footprint of the dam. o Repair the erosion at the downstream left toe of the dam located to the left of the stoplog bays. o Prepare and submit an Operations, Maintenance, and Response Plan (OMR) form.
Newmarket	Macallen Dam	9/27/2010	• Continuing basis: o Monitor and repair seepage from downstream left side stone training wall o Monitor and repair concrete cracks • March 1, 2011: o Submit an Operations, Maintenance, and Response (OMR) plan to DES for review o Submit an updated EAP • September 1, 2011: o Fill, seed, and mulch the right side earthen embankment in order to provide a level, hearty grass surface consistent across the complete surface o Remove deteriorated portions to a sound substrate, clean and structurally patch areas o Investigate and report to DES the condition of the right side upstream training wall's base, assess for possible undermining and overall condition of the wall o Submit a permit application with appropriate plans and specifications to increase the discharge capacity of the dam to safely pass the design flow with one foot of freeboard with no operations and to address any other structural deficiency found as part of consultant's detailed evaluation • September 1, 2012: o Complete the reconstruction and/or repair of the dam to meet the requirements of the permit
Northwood	Gulch Mountain Pond Dam	1/18/2012	• On a continuing basis: o Monitor the seepage at the downstream toe of the dam to the right of the outlet and the wet area at the downstream toe of the embankment at the left end of the dam. • December 31.2012 o Remove all trees and brush from the footprint of the dam, man-made portion/earthen embankment and downstream and for a distance of 15 feet beyond the foot print of the dam and establish a hearty grass cover on any areas that are not protected by other erosion resistant materials. Stumps may remain if cut flush with the adjacent ground. o Review/update your EAP in accordance with Env-Wr 503, 507.01 and 501.02 and submit it to DES for review. The last submittal was made on March 6 2009 and the plan remains incomplete. The inundation map submitted is not in accordance with DES rules and requires updating. o Review/update as necessary the OMR dated March 5, 2009. If updates aren't required, please o submit a copy to the Dam Bureau office • February 1, 2013 o Conduct a test of the EAP in accordance with Env-WR 507.01
Northwood	Sauls Pond	4/23/2012	• On a continuing basis: o Monitor the 12" diameter drop inlet opening at the dike for debris removal. o Monitor the 14" wide stoplog bay at the main dam for debris removal. • July 1.2012: o Review Operations, Maintenance and Response form (OMR) dated September 4, 2008, and update as necessary. Please note that this OMR is a standalone document and should not reference any other documents. Return the updated form to the Dam Bureau upon completion; • January 2, 2013: o Remove all trees and brush from the footprint of the darn and dike (all man-made portions of the earthen embankment) and downstream and for a distance of 15 feet beyond the footprint of the dam and dike and establish a hearty grass cover on any areas that are not protected by other erosion resistant materials. Stumps may remain if cut flush with the adjacent ground. See typical locations noted below with either Dam or Dike notation. ▪ Dam: upstream embankment slope

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
			▪ Dam: downstream embankment slope ▪ Dam: 15 feet buffer zone beyond the downstream embankments toe ▪ Dike: Upstream and downstream slopes o Remove all trees and brush from auxiliary spillway and maintain a clear unobstructed path downstream and for a distance of 25 feet beyond the pond's edge and continue to maintain the hearty grass cover on any areas that are not protected by other erosion resistant materials. Stumps may remain if cut flush with the adjacent ground. o Regrade, compact, seed and mulch the excavated area on the downstream side of the dam embankment's right side slope. This section is part of the dam embankment and the excavated material needs to be replaced. Return this location to its as-built original slope and grade. o Seed and mulch all areas of the dam and dike embankments that are disturbed as part of completing item #4 as necessary, to promote a growth of hearty grass.
Nottingham	Deer Pond Dam	3/5/2010	• On a continuing basis: o Maintain a smooth and level darn embankment crest (roadway surface). All shimming materials should consist of compacted good quality gravel. o Maintain a clear and free-flowing outlet riser. See photo B. It was apparent from the observations made on October 16tl'that routine maintenance is performed in this regard; • May 1.2010: o Remove brush pile from upstream slope in the area of the riser. Debris piles prevent good growth of vegetative cover on the dam • October 1, 2010: o Cut all trees, brush and weedy growth from the footprint of the dam and 15ft beyond the foot print of the dam to create a buffer zone of clearing to monitor the dam for seepage and other maintenance concerns. Areas to clear include (but not limited to): ▪ Embankment left and right downstream slopes interface into natural ground o Bushes along the upstream and downstream slopes. Bushes of any kind are not recommended on darn embankment as they do not promote the type of ground cover needed to minimize erosion o Both the left and right embankments and a 15' wide swath beyond the downstream toe of the embankment. o Trees and brush at the emergency overflow spillway. For this area to function properly during a high rain event, the flow path must be cleared of trees and brush along the upstream slope, crest and downstream immediate slope to allow unobstructed free flow. o Fill, seed, and mulch all areas of the dam's embankment that have bare or limited growth and establish hearty growth of grass. Bare or limited growth was noted on most areas of the upstream and downstream embankment slopes.
Rochester	Upper City Dam	2/9/2010	• October 1, 2010: o Retain a consultant to provide a hydraulic and hydrologic (h&h) evaluation of the dam, as the dam cannot pass the 50-year design storm with 1 foot of freeboard requiring of a low-hazard dam, per Env-Wr 303.11 (a)(1). This is evidenced by 12" overtopping in the May, 2006 flood, and 30" overtopping in the April, 2007 flood o Remove the trees and brush from the concrete abutments, and within 15 feet of the ends and toe of the dam structure, including the outlet • October 1, 2012: o Redesign and reconstruct the dam and spillway as necessary to meet Env-Wr 303.11 (a)(1); in-line with a report generated by item one. As this will change the discharge capacity of the structure, a Dam Reconstruction Permit will be required.
Rochester	Baxter Lake East Dike	4/12/2010	• October 31, 2010: o Remove all trees and brush from the upstream and downstream sides of the dike, and within 15 feet of the toe of the dike, and 15 feet beyond the ends of the dike
Rochester	Baxter Lake Center Dike	4/12/2010	• October 31, 2010: o Remove all trees and brush from the upstream and downstream sides of the dike, and within 15 feet of the toe of the dike, and 15 feet beyond the ends of the dike. The toe of the dam is approximately where the seepage is present o Stabilize the crest of the dam and center dike by adding loam and seeding, or by installing an

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
			erosion-resistant cover. If necessary, consider installing a gate to prevent vehicle travel over the dam crest
Rochester	Baxter Lake Main Dam	4/12/2010	• Continuing basis o Continuing monitor the seepage on the right groin of the dam. Additionally, monitor the seepage at the downstream face of the center dike. • October 1, 2010: o Complete and submit the Operations, Maintenance, and Response (OMR) form, as enclosed. This form should refer to the entire system of dams, dikes, and spillways o Update and test the Emergency Action Plan for the dam, as it has been overdue since 2007 o Remove all brush and trees on the downstream and upstream embankments of the dam, as well as from within 15 feet of the downstream toe of the dam o Remove the two trees at either end of the upstream side of the dam section o Stabilize the crest of the dam and by adding loam and seed, or by installing an erosion-resistant cover. If necessary, consider installing a gate to prevent vehicle travel over the dam crest o Smooth the crest and upstream face of the dam, so that no preferential drainage paths exist o Loam and seed the downstream face of the dam to establish a hearty grassed vegetative cover. The existing spotty weed and brush growth is inadequate o Armor the sides of the spillway with riprap or equivalent material so that the side abutments of the spillway are protected from high flows. Be sure to not raise the elevation of the spillway channel while performing this work
Rochester	Rochester Reservoir Dam	8/9/2013	• Continuing Basis o Actively monitor any leakage or seepage present on the downstream face of the dam, and watch for signs of internal erosion or foundation erosion • March 31, 2014 o Revise and resubmit the Operation, Maintenance, and Response form to include updated information as warranted o Update the Emergency Action Plan document and include the latest breach analysis information from Wright-Pierce as appropriate • December 31, 2014 o Stabilize the crest of the dam to the extent possible by promoting hearty grassed cover and discontinuing all by necessary vehicular traffic over the dam. Otherwise, stabilize the crest with durable erosion-proof cover o Remove the trees, brush, debris, and weedy growth from all areas of the dam, including the upstream and downstream faces, the crest of the dam, and from within 15 feet of the dam footprint on all sides o Repair the erosion of the shoreline and the animal burrow(s) on the upstream face of the dam o Repair the erosion gullies from surface runoff on the downstream side of the left embankment o Engage the services of a consultant qualified in dam-related work to complete an engineering evaluation or analysis of, at a minimum, the items noted below and submit a report to DES. The report should include all investigation findings and include recommendations and a schedule for repair, as warranted, to make the dam compliant with the current standards for the dam's applicable hazard classification • March 31, 2015 o Provide design plans and the reports requested in item above, and submit a proposed plan for repairing and/or reconstruction the dam in accordance with DES's regulations. This may include securing a Dam Reconstruction permit and/or wetlands Dredge and Fill permit • December 31, 2105 o Complete the work recommended by your consultant and approved by DES as part of item above
Rochester	Rochester Sewage Lagoon	1/28/2010	• Since these items are considered minor in nature at the present time, and because they do not materially detract from the dam's structurally integrity or operability at this time, DES has established no schedule for you to address them nor does it intend to visit your dam again until the next scheduled inspection is to occur in 2016. o Please send formal correspondence regarding the results of the seepage repair and

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
			monitoring downstream of the alum sludge lagoon, as described in previous correspondence on March 5, 2010 o Cut the trees and brush at the southwest end of the dam, and along and abutting the first wildlife lagoon, to a distance 15' beyond the end of the footprint of the dam (assume the toe of slope and the south side of the dam crest mark the footprint of the dam, and extend 15 feet beyond this area). Then, loam and seed the area as necessary to promote growth of a hearty, grassed embankment o Cut the brush along the entire upstream side of the sludge lagoon, and on lagoon #2 on the south side
Strafford	Pine Rock Farm Pond Dam	2/24/2010	• May 1, 2010: o Prepare and submit and Operation, Maintenance, and Response (OMR) form • March 1, 2011: o Remove all trees and brush for a distance of 15 feet beyond the footprint of the dam o Remove any trees and brush that have encroached upon the vegetated emergency spillway
Strafford	Camp Foss Sewage Lagoon	2/26/2010	• June 1, 2010: o Prepare and submit and Operation, Maintenance, and Response form • March 1, 2011: o Remove all trees and brush from the footprint of the dam and for a distance of 15 feet beyond the footprint of the dam
Wakefield	Drew River Mill Dam	10/15/2012	• January 1, 2013: o Prepare and submit an Operations, Maintenance and Response Plan o Formally respond to DES regarding the following issues: ▪ Respond to DES regarding proposal to meet the requirements following the Hydrology and Hydraulics analysis conducted in 2012 ▪ Evaluate the left concrete abutment, right concrete abutment, overflow spillways, gate structure, and downstream training wall, as there is significant concrete spalling, exposed rebar, and a large horizontal crack through the training wall. Additionally, there is flow bypassing the left outlet structure and is flowing beneath, through, or around the deteriorated spillway of the left abutment. ▪ Investigate and implement a repair to the multiple sinkholes on the downstream right embankment section, just upstream of the existing mill building. ▪ Assure that the right abutment structure is structurally sound so that the dam can be readily accessed for emergency purposes. o Remove trees and brush from around the foundation and tailrace of the existing mill o Remove the trees and brush from within 15 feet of the concrete abutments, the upstream and downstream faces of the dam, the dam crest, and within 15 feet of the toe of the dam structure, including the earthen embankments of the structure • January 1, 2014: o Redesign and reconstruct the dam and spillway as necessary. As this will likely change the discharge capacity of the structure, a Dam Reconstruction Permit will be required. A wetlands permit will also likely be required.
Wakefield	Union Village Dam	10/15/2012	• Continuing basis: o Actively monitor the leakage at the base of the dam If the dam is to be breached: • July 1, 2013 o Obtain all necessary permit to remove the dam including, but not limited to, the NHDES Wetlands permit with Dam Bureau • December 31, 2013 o Remove the dam in accordance with the permits referenced in item #1 If the dam is to be retained: • July 1, 1013 o Remove the tree and brush growth located at the left and right ends of the dam (i.e. the left embankment, around the left gate structure, and the right embankment), and within 15 feet of the ends and the toe of the dam o Submit and EAP o Engage the services of a consultant qualified in dam-related work to complete an engineering

Municipality	Dam Name	Issued Letter of Deficiency	Schedule to Correct Deficiencies
			evaluation or analysis of, at minimum, the items noted below and submit a report to DES. The report should include all investigation findings and include recommendations and a schedule for repair, as warranted, to make the dam compliant with the current standards for "High Hazard" dams per Env-Wr 300 and 400 as applicable. o Provide a proposed plan for repairing and/or reconstructing the dam in accordance with DES's regulations for High Hazard Dams. The may include securing a Dam Reconstruction permit and/or wetlands Dredge and Fill permit • December 31, 2013 o Implement the solution proposed in item #3 above, as approved by DES o
Wakefield	Belleau Lake Dam	10/18/2012	• Continuing basis: o Actively monitor the historic leakage/seepage at the toe of the right embankment • December 31, 2012: o Update the February 2008 Operations, Maintenance, and Response form and submit to Dam Bureau • July 31, 2013: o Remove weeds, trees, and brush from the crest, upstream face, and downstream face of the dam, as well as within 15 feet of the ends of the dam. Establish a hearty grassed cover that can be maintained over the dam embankment and within 15 feet of the toe and ends of the dam. o Fill-in the embankment sections so that the settled and eroded material is replaced upstream and downstream, left and right; and there is no preferential path against the concrete training walls. o Consider moving the fencing on both sides of the dam to the limits of your property boundaries.

[Source: NHDES Dam Bureau – 2014]

Emergency Action Plans

In 1988, the New Hampshire State Legislature recognized the need for dam owners to prepare a plan to assist the local community in responding effectively to a dam failure. The legislature amended RSA 482:2 and RSA 482:12 and adopted RSA 482:11-a to require that dam owners develop an Emergency Action Plan (EAP) for all High Hazard and Significant dams whose failure could threaten public safety or result in major economic impact or property loss

What is an Emergency Action Plan?

The Emergency Action Plan (EAP) is a document establishing: (1) a notification plan, (2) information on the potential extent of downstream flooding and (3) pre-planned emergency actions to be taken upon indication of an impending dam failure or unsafe condition.

Table 45 is a list of all the Emergency Action Plans in the region. Of the 32 EAP's in the region, there are 12 (in bold) which have not been updated in the last five years and will need to be addressed by communities.

Table 45: Emergency Action Plans in the Region

Municipality	Dam Name (Class)	Owner	Last Updated
Barrington	Ayers Pond Dam (S)	NHDES Water Division	6/1/2013
Barrington	Swains Lake Dam (H)	Town Of Barrington	3/26/2004
Dover	Sawyers Mill Upper Dam (H)	Sawyer Mills Associates	10/25/2010
Dover	Sawyer Mill Lower Dam (H)	Sawyer Mills Associates	10/25/2010
Durham	Durham Reservoir Dam (H)	University Of NH	3/24/2010
Durham	Mill Pond Dam (L)	Town Of Durham	2/14/2003
Durham	Wiswall Dam (S)	Town Of Durham	4/1/1998
Durham	Oyster Reservoir Dam (S)	University Of NH	12/23/2010
Durham	Beards Creek (S)	NHDOT	3/27/2009
Madbury	Bellamy Reservoir Dam (H)	City Of Portsmouth PWD	3/1/2009
Middleton	Sunrise Lake Dam (H)	Sunrise Lake Village District Commission	8/1/2009
Milton	Milton Leather Board Dam (S)	Milton Land Corp	11/23/2005
Milton	Milton Three Ponds Dam (S)	NHDES Water Division	1/31/2001
New Durham	Merrymeeting Lake Dam (H)	NH Fish And Game Department	9/20/2012
New Durham	Jones Dam (H)	NH Fish And Game Department	9/7/2012
New Durham	Marchs Pond Dam (H)	Town Of New Durham	7/6/2009
Newmarket	Macallen Dam (H)	Town Of Newmarket	3/30/2004
Northwood	Gulch Mountain Pond Dam (S)	Town Of Northwood	3/6/2009
Nottingham	Mendums Pond Dam (H)	NHDES Water Division	10/21/2010
Nottingham	Pawtuckaway Lake/Dolloff Dam (H)	NHDES Water Division	7/1/2013
Nottingham	Pawtuckaway Lake/Gove Dike (S)	NHDES Water Division	10/21/2010
Nottingham	Pawtuckaway Lake /Drowns Dam (S)	NHDES Water Division	10/21/2010
Rochester	Spaulding Pond Dam (S)	Spaulding Ave Industrial Complex, Llc.	8/15/2005
Rochester	Baxter Lake Main Dam (S)	Baxter Lake Flowage Association	6/1/2006
Rochester	Rochester Reservoir Dam (H)	City Of Rochester	7/8/2013
Somersworth	Lower Great Falls Dam (H)	Enel North America Inc.	11/26/2013
Strafford	Bow Lake Dam (H)	NHDES Water Division	6/6/2001
Wakefield	Union Village Dam (H)	Siemon Realty	1/14/2010
Wakefield	Union Meadows Dam (S)	NHDES Water Division	10/27/2010
Wakefield	Lovell Lake Dam (S)	NHDES Water Division	10/27/2010
Wakefield	Great East Lake Dam (S)	NHDES Water Division	10/27/2010
Wakefield	Horn Pond Dam (S)	NHDES Water Division	10/27/2010

[Source: NHDES Dam Bureau – 2014]

The dam owner is required to work with the local communities in developing an effective EAP, periodically reviewing and updating the plan, and initiating a test of the emergency communications network. After approval of the Plan by NHDES, it must be kept on file with the local communities including the police department, fire department, and emergency management director, the NH Bureau of Emergency Management, the NH State Police, DES and, if state roads will be impacted, the NH Department of Transportation.

Dam owners and operators must be trained in monitoring and operating the structure and be prepared to act promptly and efficiently when a dam begins to show signs of failure. Early identification of hazardous conditions at the dam will permit prompt implementation of emergency procedures outlined in the Plan. It is important that the dam owner or operator be familiar with operating the structure and be capable of identifying specific types of failure modes such as over-topping and piping.

According to the Prudent Planning Required for Dam Owners Fact Sheet, the following items should be addressed in all Emergency Action Plans.

- **Monitoring**: In order to comply with the state's Administrative Rules, each dam owner shall monitor or assign monitors to the dam during periods of heavy precipitation, flooding, or unusual hydrologic events and potentially dangerous structural conditions. The monitor should be properly trained in the operation of the structure, have authority from the dam owner to operate the structure during emergency situations, be familiar with the dam operating procedures, and be trained in observing and locating various signs of abnormal situations for the particular dam. Timely response to a potential dam emergency is critical and the information given by the monitor to local authorities will be used in determining future actions spelled out in the EAP.
- **Preventive Action:** The dam owner should indicate actions that the monitor may take to correct a malfunction of the dam. The dam owner should also provide the monitor with a list of preventive and mitigative action measures to be undertaken during emergency situations.
- **Warning**: The dam owner should provide a communication system whereby the monitor can effectively communicate with the designated parties in the EAP during emergency situations. NHDES and other state emergency response agencies have developed a general protocol to be tailored specifically to each dam. The NHDES Water Division should be notified as quickly as possible regarding any situation that cannot be rectified by the monitor.
- **Evacuation**: The dam owner must incorporate a map in the EAP indicating the areas below the dam that would be flooded if the dam were to fail. The local community will use this map in planning and implementing the evacuation of personnel and material from the flooded area. Each of these items is outlined in the administrative rules (Env-Wr 505) for the development of an Emergency Action Plan.

The notification flowchart should include the titles of local and state officials to be informed of a pending or actual emergency at the dam. The flowchart should be presented in a clear and logical sequence of calls to inform appropriate local and state officials.

The inundation map should be of sufficient scale and detail to clearly identify physical features in relation to the flooded areas. This map will be utilized by local communities in the evacuation of personnel from the flooded area. It must be recognized that a clear and detailed inundation map is a primary requisite to a successful evacuation plan.

Table 46 describes a detailed summary of each Emergency Action Plan in the region.

Table 46: Detailed Dam Summary from Emergency Action Plans in the Region

Name	Class	Municipality	Drainage Area	Impound Area	Effects/Impacts Of Failure
Ayers Pond Dam	S	Barrington	2.35 sq. mi	263 ac	Possible loss of life and considerable damage to the town of Barrington.
Swains Lake Dam	H	Barrington	2.9 sq. mi	405 ac	Loss of life and considerable road and structural damage in Barrington.
Sawyers Mill Upper Dam	H	Dover	27.5 sq. mi	18 ac	Only property and lives threatened are limited to the Sawyer Mill Complex or the 10 unit apartment building 500 ft. downstream.
Sawyer Mill Lower Dam	H	Dover	27.5 sq. mi	.5 ac	Only property and lives threatened are limited to the Sawyer Mill Complex or in the 10 unit apartment building 500 ft. downstream.
Durham Reservoir Dam	H	Durham	.42 sq. mi	17.8 ac	Impacts Mast Road, Old US Rt. 4, through the recreation fields and into college brook. Several buildings are in the flow path.
Mill Pond Dam	L	Durham	N/A	24 ac	The park downstream of the Rt. 108 bridge may be inundated.
Wiswall Dam	S	Durham	N/A	30 ac	Three houses along the Lamprey River between the Wiswall Dam and Packers Falls Road bridge may be affected as well as a section of Packers Falls Road just downstream of the bridge.
Oyster Reservoir Dam	S	Durham	16.58 sq. mi	27.8 ac	Flooding of several structures occurs along the Oyster River.
Beards Creek	S	Durham	3.21 sq. mi	16 ac	No adverse effect to downstream properties. Concern for Route 108 which crosses over the dam outlet. Erosion around municipal sewer line potentially causing wastewater pollution in Beard's Creek.
Bellamy Reservoir Dam	H	Madbury	N/A	N/A	Dam Breach Analysis on file with – Portsmouth Public Works Department and N.H. Water Resource Division
Sunrise Lake Dam	H	Middleton	3.3 sq. mi	257 ac	Breach will impact: 3 residences immediately below the dam, one .01 mi below, Nicola Road, one residence by Fowler Pond, Silver Street, 3 residences in Silver St. area, Tibbetts Hill Road (Farmington), 2 residences in this area. Other areas potentially affected if river level is 1-2 ft. above 100-yr flood level.
Milton Leather Board Dam	S	Milton	N/A	N/A	Breach will impact the Milton Hydro Dam and the Tillotson Healthcare Dam and a subdivision along the Maine shoreline.
Milton Three Ponds Dam	S	Milton	108 sq. mi	1,025 ac	Strong possibility of the failure of the Spaulding Pond Dam if Milton Three Ponds Dam Fails. If so, possible damages are: damage of homes near Spaulding Pond, inundation of water treatment lagoons downstream of Spaulding Pond, and damage of Flatrock Bridge.
Merrymeeting Lake Dam	H	New Durham	11 sq. mi	1,244 ac	Failure will result in major damage downstream inundating homes and road crossings until 8 miles downstream when the river reaches the Alton Bay.
Jones Dam	H	New Durham	16.3 sq. mi	80 ac	Dam failure will result in possible isolation of residences upstream and will affect one residence near Drowning Pond, Drowning Pond, and Alton Power Dam.
Marchs Pond Dam	H	New Durham	1.1 sq. mi	127 ac	Failure will result in the impact of 3 homes, Birch Hill Road, Miller Road, Middleton Road, and Bay Road.

Name	Class	Municipality	Drainage Area	Impound Area	Effects/Impacts Of Failure
Macallen Dam	H	Newmarket	N/A	N/A	No Dam Breach Analysis as part of the EAP
Gulch Mountain Pond Dam	S	Northwood	N/A	N/A	IMAP not EAP
Mendums Pond Dam	H	Nottingham	6.79 sq. mi	265 ac	Failure will effect: the bridge at Rt. 4, upstream of the bridge on Kennard rd., downstream of the bridge on smoke St., the upper end of Nottingham Lake, the bridge at Rt. 125, upstream of the bridge on Cartland rd., the bridge at Rt. 155, the bridge at Lee Hook rd., the bridge at Wiswall rd., Wiswall dam, and the bridge at Packers Falls.
Pawtuckaway Lake/Dollof Dam	H	Nottingham	21 sq. mi	900 ac	Failure will inundate numerous residences and: Rt. 156, Seasonal rd. on Pawtuckaway River, Folsom Mill Ln, Rt. 27, Blake rd., Main St, Mill St, Rt. 125, Ladds Lane, Rt. 87, and Rt. 152.
Pawtuckaway Lake/Gove Dike	S	Nottingham	21 sq. mi	900 ac	Failure will result in the washing out of Rt. 156 in Nottingham and a seasonal rd. in Raymond.
Pawtuckaway Lake /Drowns Dam	S	Nottingham	21 sq. mi	900 ac	Failure will result in the inundation of many residences and Long Hill rd., Rt. 152, McCrillis rd., Rt. 125, and roads and driveways downstream of the bridge on Rt. 125.
Spaulding Pond Dam	S	Rochester	N/A	N/A	N/A
Baxter Lake Main Dam	S	Rochester	3.88 sq. mi	288 ac	No homes will be affected but damage to Four Rod rd., and 202A.
Rochester Reservoir Dam	H	Rochester	0.48 sq. mi	56 ac	Failure will result in the inundation of 23 inhabited structures, Rt. 125, Chesley Hill rd., and Estes Road crossing.
Lower Great Falls Dam	H	Somersworth	220 sq. mi	476 ac	Failure will result in the damage of an apartment complex immediately downstream of the dam and the water treatment facility located adjacent to Buffumsville Road.
Bow Lake Dam	H	Strafford	14.3 sq. mi	1,152 ac	Failure would result in the possible failure of the Waldron Dam downstream, and the Central Ave Dam in Dover. Rt. 202A, Rt. 126 bridge, Rt. 202, Greenhill rd., Rt. 125, Rochester Neck rd., Near County Farm, Whittier St., Fourth St., Cocheco St., and near Woodman Park would be affected by the flood wave.
Union Village Dam	H	Wakefield	35 sq. mi	3 ac	Failure will result in the inundation of: riverside of main St. (16), Maple St., Chapel St., and the railroad bridge 750 ft. downstream of the dam.
Union Meadows Dam	S	Wakefield	31.1 sq. mi	210 ac	Result in damages to homes and businesses in the village of Union. Two downstream dams would possibly fail but not increase the flood wave.
Lovell Lake Dam	S	Wakefield	4.9 sq. mi	530 ac	Failure will result in damage to homes and businesses and the inundation of Rt. 153, Rt. 109, and Rt. 16. Also will result in the overtopping of Union Meadows Dam.
Great East Lake Dam	S	Wakefield	16 sq. mi	1,800 ac	Failure will result in the probable failure of Horn Pond Dam in Wakefield.
Horn Pond Dam	S	Wakefield	22.8 sq. mi	198 ac	Failure will result in the damage of several road crossings: Rt. 109, Hopper St., Church St., School St. (Milton). Possible failure of Waumbek and Rowe Dams

[Source: NHDES Dam Bureau - 2014]

Dam Inundation Mapping

The purpose of inundation mapping is to delineate and quantify the extent of the likely inundation area in the event of a dam-break for use only in emergency planning. The actual inundation area may vary, depending on the conditions existing at the time of dam failure, and the degree of failure. These maps represent the approximate limits of the area inundated by a failure of the dams. All structures in and near the inundation area may not be represented.

This inundation mapping is approximate and in most instances is limited to the accuracy of 20 foot USGS contour maps. The inundation area shown is based upon the assumed dam break conditions. The dam break conditions in the event of an actual dam failure may vary based upon the specific failure conditions.

Table 47 breaks down the inundation acreage by municipality, dam name, and discharging waterbody in the region.

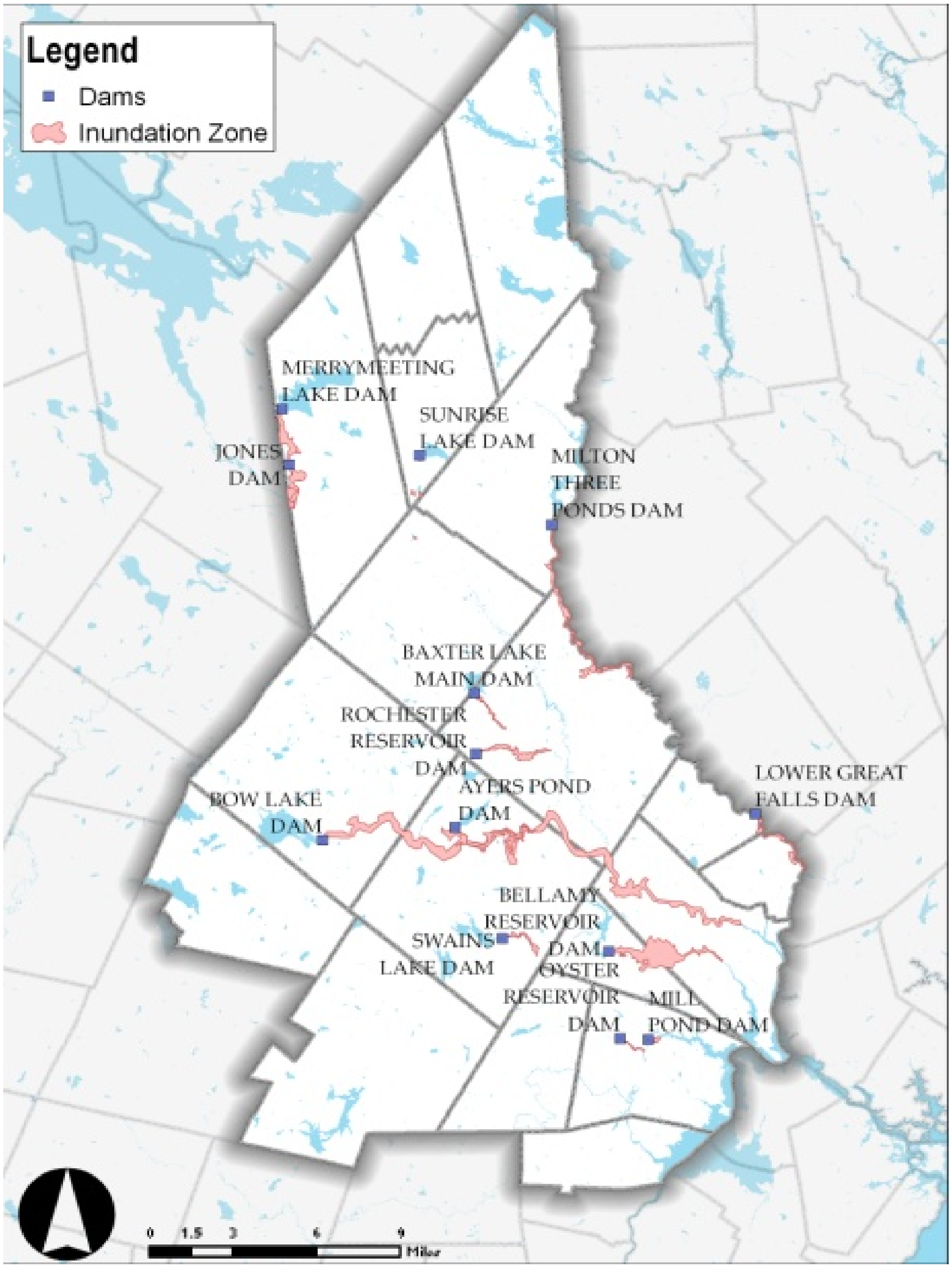
Table 47: Inundation Acreage for Selected Dams Following Failure or Breach

Municipality	Dam Name (Class)	Waterbody	Acres of Inundation
Barrington	Ayers Pond Dam (S)	Tributary to Isinglass River	468.5
Barrington	Swains Lake Dam (S)	Bellamy River	92.8
Barrington	Bow Lake Dam (H)	Isinglass River	1308.8
Dover	Bow Lake Dam (H)	Isinglass River	831.5
Dover	Bellamy Reservoir Dam (H)	Bellamy River	596.1
Durham	Mill Pond Dam (L)	Oyster River	20.9
Durham	Oyster Reservoir Dam (S)	Oyster River	25.2
Farmington	Sunrise Lake Dam (H)	Tributary to Cocheco River	4
Madbury	Bellamy Reservoir Dam (H)	Bellamy River	467.5
Middleton	Sunrise Lake Dam (H)	Tributary to Cocheco River	27.3
Milton	Milton Three Ponds Dam (S)	Salmon Falls River	89.4
New Durham	Merrymeeting Lake Dam (H)	Merrymeeting River	562.2
New Durham	Jones Dam (H)	Merrymeeting River	254.03
Rochester	Milton Three Ponds Dam (S)	Salmon Falls River	357.1
Rochester	Baxter Lake Main Dam (S)	Rickers Brook	68.9
Rochester	Rochester Reservoir Dam (S)	Howard Brook	218.2
Rochester	Bow Lake Dam (H)	Isinglass River	318.7
Rollinsford	Lower Great Falls Dam (S)	Salmon Falls River	119.5
Somersworth	Lower Great Falls Dam (S)	Salmon Falls River	36.3
Strafford	Bow Lake Dam (H)	Isinglass River	571.2

[Source: NHDES Dam Bureau – 2014]

Table 47 displays several high and significant hazard dams (one low hazard) in the region. These dams have various acreages of land that would be flooded if the dams were to fail. The acreages of inundation are separated by dam per municipality. If certain dams were to fail the flooding would span over multiple town lines. The effects of the failure of the Bow Lake Dam, for example, would extend through four separate towns. Altogether, 3,030.2 acres would be submerged along the Isinglass River in Rochester, Barrington, Strafford, and Dover. Some dams, on the other hand, such as the low hazard Mill Pond Dam in Durham, would have a lesser effect than the Bow Lake Dam failure. The Mill Pond Dam on the Oyster River would inundate 20.9 acres in Durham, a significant amount of land, but minute compared to the effects of the high hazard dams in the region. Analyzing the acreages of inundation pending dam failure helps to show the potential effects on municipalities surrounding these dams. Figure 16 represents the inundation zones and their associated dams in the region.

Figure 16: Dam Inundation Zones



[Source: NHDES Dam Bureau – 2014]

Management and Protection

The management and protection of the dams in our region is important, not only to protect public safety and the environment, but also to maintain the large economic and recreational benefits that they provide.

Ongoing and Recently Passed NH Legislation

Annual Dam Registration Fee [Env-Wr 303.01]

New Hampshire established the dam safety program in the early 1900s to protect lives, health and property from damages due to catastrophic dam failures, which have cost thousands of lives and millions of dollars in property damage throughout the United States. In order to adequately implement the state's program, an annual dam registration fee schedule was adopted for all High, Significant, or Low Hazard dams.

New Hampshire's dam safety program benefits both dam owners and residents in downstream areas who may be at risk if a dam were to fail. Owners receive periodic safety inspections of their dams, technical assistance during emergency situations, information on maintenance and operational procedures, and assistance with developing emergency action plans. Downstream residents receive additional protection from catastrophic failure of the upstream dam.

The following fee amount specified in RSA 482:8-a, which allows DES to charge the dam owner for the actual cost of examination of plans, specifications, and the inspection of the dam.

FEE SCHEDULE
Low Hazard – $400
Significant Hazard – $750
High Hazard – $1,500

This fee structure is more cost effective for the dam owner. All monies collected are placed in a dedicated fund solely for the purpose of dam inspections.

Dam registration fee bills are sent to dam owners annually in October, with payments due by January 1 of the following calendar year.

New Hampshire's Dam Maintenance Revolving Loan Fund

New Hampshire's Dam Maintenance Revolving Loan Fund was established (2009) under state statute RSA 482:55-a to provide low interest loans to fund the maintenance, repair, or reconstruction of privately owned dams. Some rules still need to be established, but the current balance of the Fund is still very small.

Comprehensive Flood Management Study Commission

This commission, created by House Bill 648 in 2007, was charged with studying possible measures for controlling floods to minimize their impact on communities and individual properties. The scope of the commission's work included land use management to reduce flood runoff, flood hazard assessment, evaluation of dams and reservoirs, implementing possible zoning and floodplain regulations, cooperative efforts between private dam owners and the New Hampshire Office of Emergency Management in the event of serious flood threats, and flood forecasting practices. The commission issued its final report titled, New Hampshire House Bill 648 Chapter 179 Laws of 2007 Comprehensive Flood Management Study Commission, published in September 2008.

State Programs

Dam Removal and River Restoration Programs

Selective dam removal can eliminate a public safety hazard, relieve a dam owner's financial and legal burdens and restore a river to a healthier, free-flowing condition. Consequently, some dam owners, government agencies and communities are taking a second look at dams. One such agency is the Dam Removal and River Restoration Program, which was created by the NH Department of Environmental Services (DES) to assist dam owners and communities through the dam removal process by providing:

- information about various components of the dam removal option
- technical assistance in obtaining the necessary permits
- assistance in developing a funding package to offset the costs of removal
- general assistance through the process

According to a fact sheet titled, The New Hampshire Initiative to Restore Rivers through Selective Dam Removal, there are more than 4,800 active and inactive dams in New Hampshire. Many of these dams were built during the Industrial Revolution in the 19th and early 20th centuries, and they played central roles in New Hampshire's economic and societal growth during that period. But as technological and societal needs have changed, so too has the need for some dams.

Macallen Dam Removal: Feasibility and Impact Analysis – Newmarket, NH

In a collaborative partnership between the Town of Newmarket, NOAA, NH Department of Environmental Services, NH Fish and Game, and Gomez and Sullivan Engineers a feasibility and impact analysis for the removal of the Macallen Dam is underway. The motivation behind this effort largely stemmed from the Town receiving a letter of deficiency from NHDES requiring dam repairs and noting inadequate spillway capacity. Currently, the dam cannot pass 100-year flood (10,259 cfs) with one foot of freeboard, as required by the Dam Bureau safety requirements. There have also been some residents who petitioned the Town Council to evaluate dam removal as an option to dam modification.

This project is being funded by the Town of Newmarket and the Conservation Law Foundation.

Dam Inspection and Repair

Table 48: Periodic Inspection Schedule

Hazard Classification	Number of Structures	Inspection Interval	Scheduled Inspections Per Year	Scheduled Inspections Per Month
High	107	I yrs.	99	14
Significant	185	2 yrs.	49	7
Low	535	5 yrs.	97	14

[Source: NHDES Dams Bureau – 2014]

The state's inspection schedule requires that DES inspect dams each and every year. An inspection year has a seven month average, May through September. If deficiencies are found during the inspection, DES sends a Letter of Deficiency (LOD) to the dam owner identifying the deficiencies and specifying the work that must be done to correct the deficiencies and the schedule for completing the corrective measures. The deficiencies are typically related to overdue maintenance and upkeep issues rather than imminent threats to downstream lives or property. In those cases where the deficiencies do pose an imminent threat, DES orders that the impoundments be drained. Between January 1, 2010 and December 31, 2012, DES issued 28 LODs (Table 50). The breakdown, by calendar year and hazard classification, is presented in Table 48.

During that same timeline, NHDES approved 3 reconstruction applications for existing dams to correct identified deficiencies and one construction application. Those projects are highlighted in Table 49.

Table 49: Reconstruction and Construction Applications in the Region (1/1/2010 – 12/31/2012)

Municipality	Dam Name (Class)	Dam Owner	Activity
Durham	Durham Reservoir (H)	University of New Hampshire	Reconstruction
Durham	Wiswall Dam (S)	Town of Durham	Reconstruction
Nottingham	Rocky Hill Detention Pond Dam (NM)	Ledge Farm Nottingham LLC	Construction
Rochester	Boston Felt Dam (L)	Bacon Felt Company Inc.	Reconstruction

[Source: NHDES Dam Bureau – 2014]

In addition to its responsibility for regulating the safety of the 2,618 dams in the State, the DES Dam Bureau is responsible for performing all the repairs and reconstruction required on all the 260 active state-owned dams, with design engineering, permitting, and construction oversight conducted by staff engineers. In addition, DES dam operators perform daily operations and maintenance on the 113 dams owned by DES, as well as the 105 dams owned by the New Hampshire Fish and Game Department. With an average expected design life of 50 years, DES must perform five to six major reconstruction projects per year to keep up with the work required on the inventory of 260 active state-owned dams.

Table 50: Letters of Deficiency in the Region (1/1/2010 – 12/31/2012)

Municipality	Dam Name (Class)	Dam Owner	Year Sent
Barrington	Swains Lake Dam (H)	Town Of Barrington	1/20/2012
Dover	Sawyers Mill Upper Dam (H)	Sawyer Mills Associates	1/21/2011
Dover	Sawyers Mill Upper Dam (H)	Sawyer Mills Associates	1/6/2012
Dover	Sawyer Mill Lower Dam (H)	Sawyer Mills Associates	1/6/2012
Dover	Sawyer Mill Lower Dam (H)	Sawyer Mills Associates	1/21/2011
Dover	Redden Pond Dam (L)	City Of Dover	3/3/2010
Farmington	Tufts Pond Dam/Berry Brook Res (L)	City Of Rochester	4/28/2011
Madbury	Bellamy Reservoir Dam (H)	City Of Portsmouth PWD	2/19/2010
Madbury	Bellamy Reservoir Dam (H)	City Of Portsmouth PWD	5/5/2011
Madbury	Gangwer Wildlife Pond Dam (L)	Mr Jesse Gangwer	2/16/2010
Milton	Milton Waste Water Lagoons (S)	Milton Sewer Commission	7/29/2011
New Durham	Downing Pond Dam (L)	Town Of New Durham	4/29/2011
Newmarket	Macallen Dam (H)	Town Of Newmarket	9/27/2010
Northwood	Gulch Mountain Pond Dam (S)	Town Of Northwood	1/20/2012
Northwood	Sauls Pond (L)	Mr Alfred Brown	4/26/2012
Nottingham	Deer Pond Dam (L)	Mr Chris Stillbach	3/10/2010
Rochester	Upper City Dam	City Of Rochester	2/16/2010
Rochester	Baxter Lake East Dike (L)	Baxter Lake Flowage Association	3/19/2010
Rochester	Baxter Lake Center Dike (L)	Baxter Lake Flowage Association	3/19/2010
Rochester	Baxter Lake Main Dam (S)	Baxter Lake Flowage Association	3/19/2010
Rochester	Rochester Reservoir Dam (S)	City Of Rochester	2/19/2010
Rochester	Rochester Sewage Lagoon (S)	City Of Rochester	2/2/2010
Strafford	Pine Rock Farm Pond Dam (L)	Gary And Janice Stiles	2/24/2010
Strafford	Camp Foss Sewage Lagoon (S)	Greater Manchester Family YMCA	2/26/2010
Wakefield	Drew River Mill Dam (NM)	Union Village Community Association	10/15/2012
Wakefield	Drew River Mill Dam (NM)	Union Village Community Association	7/20/2010
Wakefield	Union Village Dam (H)	Siemon Realty	10/17/2012
Wakefield	Belleau Lake Dam (L)	Belleau Lake Dam Association Inc.	10/18/2012

[Source: NHDES Dams Bureau – 2014]

<u>Dam Permitting Program</u>

The purpose of the Dam Permitting Program is to protect and regulate the water levels of lake and ponds and the flow of water for fire prevention, lessen flood damage, the maintenance and improvement of recreational facilities, and to ensure that dams are maintained in a manner so that public, health, safety and the environment are protected. New dams and the reconstruction of existing dams require a permit from DES through both the Dam Bureau and the Wetlands Bureau. Each dam is classified as to hazard potential and the owner must prepare an Emergency Action Plan for all dams that may be a menace to public safety due to their condition, height and location.

Federal Programs

Federal H.R. 6254 the Dam Rehabilitation and Repair Act of 2012

H.R. 6254, was introduced in the 112th Congress on August 1, 2012, and would have amended the National Dam Safety Program Act to require the Federal Emergency Management Agency (FEMA) to establish a program to provide grant assistance to states for use in rehabilitating publicly-owned dams that fail to meet minimum safety standards and pose an unacceptable risk to the public. The bill died in the Senate and was referred to the Committee on Transportation and Infrastructure.

Implementation

Implementation Process

Local Solutions is a vision and resource for the eighteen communities within the Strafford region. The findings of this plan reflect the 'advisory only' role of Regional Planning Commissions under RSA 36:45, which outlines the Purpose of Commissions and specifically the preparation of a "coordinated plan for the development of the region, taking into account the present and future needs with a view towards encouraging the most appropriate use of land". The RSA further defines the role of the comprehensive plan as that which promotes the "health, safety, morals, and general welfare of the region and its inhabitants" Regional Planning Commissions are also asked to "render assistance on local planning problems" and "make recommendations on the basis of…plans and studies to any planning board." This Plan represents not only a consultative resource for local-decision making, but also a foundation for the future work-planning of Strafford Regional Planning Commission and Strafford Metropolitan Planning Organization. Findings within each appendix shall shape the priorities and goals of this organization. The first step in this process is the identification of specific strategies, extracted from each appendix that fit within the goals created by the Strafford Regional Planning Commission, the Strafford Metropolitan Planning Organization, and Executive Director.

Strafford Regional Planning Commission staff, with the support of the Regional Master Plan Advisory Team, have compiled a comprehensive list of high, medium, and low priority implementation strategies within the following implementation table. These strategies are designed to carry forward the findings and conclusions of this Master Plan and its appendices, as well as to provide support functions and build capacity of our regional communities and stakeholders. Each strategy identified in the table below was extracted from a larger list of strategies within each appendix. Thus, these represent the most important (but not always those with the highest priority rating) implementation strategies from each plan appendix. It is important to note that for each strategy identified, Strafford Regional Planning Commission or Metropolitan Planning Organization is the acting or responsible body.

On the following page, please find the implementation table key. This key is intended to provide important information about each field within the table. Such information includes a list of possible values for the field, additional formatting elements, and a description of the field's contents.

Implementation Table Key

Priority Rating

Field Values: *High, Medium, Low*

Field Description: *Represents a qualitative ranking by SRPC staff based on the following weighted factors (weighted as ordered below):*

1. Need
   How great is the need for the strategy

2. Impact
   How large of an impact with the strategy have on stakeholders

3. Feasibility
   How feasible is the strategy from a budgetary and staffing perspective

4. Term
   How long will the strategy take to complete and is the strategy a long, mid, or short term effort

Strategy

Field Values: *(Open Response)*

Field Description: *Includes narrative of the action to be taken by SRPC/SMPO.*

Stakeholder Level

Field Values: *Local, Regional, State*

Field Formatting: **Bold** or *Italic*

Field Description: *Who will a strategy impact.. Primary stakeholder level shall be in bold font, while secondary level(s) shall be italicized.*

Functional Areas

Field Values: *Land Use, Housing, Transportation, Economic, Water Infrastructure, Environment, Climate, Energy, Engagement*

Field Formatting:

● *Primary Functional Area Affected*

○ *Secondary Functional Area(s) Affected*

Field Description: *Strategies may bridge multiple planning areas. The Functional Areas field is an opportunity to identify those connections on both a primary and secondary level. Each strategy shall have only one primary functional area, but may have secondary functionality in multiple appendices.*

Potential Partners

Field Values: *(Open Response) Listed by acronyms, please see Partner Acronym List on following page.*

Field Description: *Identifies a list of potential partners.*

Organizational Capacity

Field Values: *Support the Development of Statewide and Regional Data Systems, Align Data Collection, Performance Measures, and Outcomes with Policy Making, Incorporate Consistency into Plans and Processes, Modernize Planning and Development Tools, Improve Capacity to Use Decision Making and Planning Tools*

Field Description: *SRPC Organizational Goals were drafted by the Strafford Regional Planning Commission Executive Director with guidance from the Strafford Regional Planning Commission Executive Committee. These values represent long term organizational goals.*

Partner Acronym List

Table 51: Partner Acronym Lists

Partner Acronym	**Full Partner Name**
CAW	Climate Adaptation Workgroup
CEDS Committee	Comprehensive Economic Development Strategy Committee
CSNE	Carbon Solutions New England
DRED	New Hampshire Department of Resources Economic Development
EDA	Economic Development Administration
EMD	Emergency Management Director
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ICNET	Infrastructure and Climate Network
GBNERR	Great Bay National Estuarine Research Reserve
GRANIT	Geographically Referenced Analysis and Information Transfer System
HEAL	Healthy Eating Active Living
NHDA	New Hampshire Department of Agriculture
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
NHDPS	New Hampshire Department of Safety
NHEDA	New Hampshire Economic Development Association
NHFG	New Hampshire Fish and Game
NHHFA	New Hampshire Housing Finance Authority
NHHSEM	New Hampshire Homeland Security and Emergency Management
NHOEP	New Hampshire Office of Energy and Planning
NOAA	Nation Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Services
PREP	Piscataqua Region Estuaries Partnership
RPC	Regional Planning Commission
SAU	School Administrative Unit
SPNHF	Society for the Protection of New Hampshire's Forests
SWA	Southeast Watershed Alliance
TNC	The Nature Conservancy
UNH	University of New Hampshire
UNH T2	University of New Hampshire Technology Transfer Center
UNHCE	University of New Hampshire Cooperative Extension
UNHSC	University of New Hampshire Stormwater Center
USACE	United States Army Corps of Engineers
VHB	Vanasse Hangen Brustlin
WHCGS	Workforce Housing Coalition of the Greater Seacoast

Priority Rating*	Strategy	Stakeholder Level	Functional Areas*									Potential Partners					
			Land Use*	Housing	Transportation	Economic	Water Infrastructure	Environment	Climate	Energy	Engagement		Support the Development of Statewide and Regional Data Systems	Align Data Collection, Performance Measures, and Outcomes with Policy	Incorporate Consistency into Plans and Processes	Modernize Planning and Development Tools	Improve Capacity to Use Decision Making and Planning Tools
High	Work with communities to ensure they have adequate drinking water protection measures in place for both surface and groundwater sources for present and future drinking water supplies	**Local** *Regional*	○			○	●	○	○		○	NHDES, PREP, Conservation Commissions, Public Works, Planning Boards, and Local Water Advocacy Groups		X	X		X
High	Work with communities to identify opportunities to reduce stormwater runoff and imperious coverage by implementing green infrastructure and low impact techniques	**Local** *Regional*	○	○	○	○	●	○	○			UNH Stormwater Center, Public Works, PREP, NHDES			X	X	
High	Encourage public outreach and awareness campaigns to local residents on the effects caused by certain lawn care practices and pet waste	**Local** *Regional* *State*	○				●	○			○	NHDES, NH Listens, UNH Cooperative Extension, and Local School Administrative Units (SAUs)			X		X
High	Encourage outreach campaigns on best management practices for farming and agricultural methods	**Regional** *Local*	○				●				○	Department of Agriculture, NHDES, NRCS			X		X
High	Encourage communities to incorporate higher standards for water quality and stormwater management	**Regional** *Local*	○		○		●	○	○			UNH Stormwater Center, NHDOT, NHDES, SWA, Planning Boards		X	X	X	X
High	Work to ensure that communities with wastewater treatment facilities all have an asset management plan	**Local**				○	●	○	○	○		NHDES and Local Water Divisions	X		X	X	X

High	Encourage communities to conduct annual private well testing to ensure safe drinking water	**Local** *Regional* *State*				○	●	○			○	NHDES, EPA, Public Works, Conservation Commissions, and Local Water Advocacy Groups	X	X	X		X
High	Work with state and regional partners to conduct an updated study on the future drinking water supply and demands for the region using new populations projections and expected climate change	**Regional** *State*				○	●		○		○	NHDES, Private Groundwater Engineering Firms (Emery & Garrett, Wright-Pierce, VHB)	X	X		X	X
Medium	Develop community-wide or watershed-wide databases of septic system users, which in turn could be used by communities in developing ways to address non-point source pollution associated with leaking or failing septic systems	**Regional** *Local* *State*		○			●	○	○		○	NHDES, Public Works, Conservation Commissions	X	X	X	X	X
Medium	Encourage both private and public sectors to participate in the Green SnowPro training and certification program and implement basic techniques of road salt reduction	**Regional** *Local*				○	●	○	○		○	Public Works, UNH T^2, Private Contractors, NHDOT			X	X	X
Medium	Provide assistance in delineating updated dam inundation zones by using new LiDAR and contour data	**Regional** *Local*		○	○		●				○	GRANIT, OEP, FEMA, NHDES, HSEM, Emergency Management	X	X	X	X	X
Medium	Public education and outreach for residents living within dam inundation zones	**Local** *Regional*		○			●				○	Emergency Management, NHDES, FEMA				X	X
Medium	Work with communities to identify potential areas to expand water/sewer networks to adjacent homes currently served by septic as opportunities arise	**Local** *Regional*	○	○		○	●	○	○		○	Public Works, EPA, NHDES, Town Planning	X		X		X
Medium	Provide data support to communities for the removal of dams that are no longer active or serve a purpose (i.e. recreation, agriculture, hydropower, water supply, etc.)	**Local** *Regional* *State*	○		○	○	●	○	○		○	NHDES, Public Works, Conservation Commissions, Fish and Game, Local Water Advocacy Groups	X	X	X		X
Medium	Work with communities to ensure that communities with high hazard and significant dams have an up-to-date emergency action plan	**Local**					●	○	○		○	Emergency Management, NHDES, FEMA, HSEM	X	X	X	X	X

Medium	Conduct outreach and education about household water consumption and conservation methods	**Regional** *Local*				○	●	○	○	○	○	NH Listens, PREP, UNH Cooperative Extension, EPA, NHDES			X		X
Low	Public education and outreach on both the economic benefits and public usage, as well as the adverse effects and potential risks of dams	**Regional** *Local* *State*	○			○	●	○	○	○	○	NHDES, FEMA, DRED, Fish and Game			X		X
Low	Identify the feasibility of hydropower in select dams in the region	**Regional** *Local*				○	●	○	○	○		Army Corps of Engineers, EPA, OEP, NHPUC	X	X	X		X

Endnotes

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