State Report for New Hampshire

Qualitative Assessment of Stormwater and Nonpoint Source Control Efforts in the Long Island Sound (LIS) Watershed

September 5, 2013

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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STATE REPORT FOR NEW HAMPSHIRE

QUALITATIVE ASSESSMENT OF STORMWATER AND NONPOINT SOURCE CONTROL EFFORTS IN THE LONG ISLAND SOUND (LIS) WATERSHED

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1 INTRODUCTION

1.1 Purpose

In 2000, the Connecticut Department of Environmental Protection (CTDEP) and the New York State Department of Environmental Conservation (NYSDEC) prepared a Total Maximum Daily Load (TMDL) study to address dissolved oxygen violations in Long Island Sound (LIS) due to excess nitrogen (CTDEP/NYSDEC, 2000). The United States Environmental Protection Agency (EPA) approved the TMDL in April, 2001.

The 2000 TMDL includes recommended load reductions for point and nonpoint sources from each of the five states contributing nitrogen loads to LIS; these include New York (NY), Connecticut (CT), and the "Upper States" that include portions of Massachusetts (MA), Vermont (VT) and New Hampshire (NH). All of the loads from NH and VT are conveyed to LIS via the Connecticut River (see Figure 1). Contributions from MA are from the Connecticut River as well as from the Housatonic, Farmington and Thames Rivers. The baseline for the TMDL is the early 1990s (1990-1993). Load reductions recommended in the TMDL include the following:

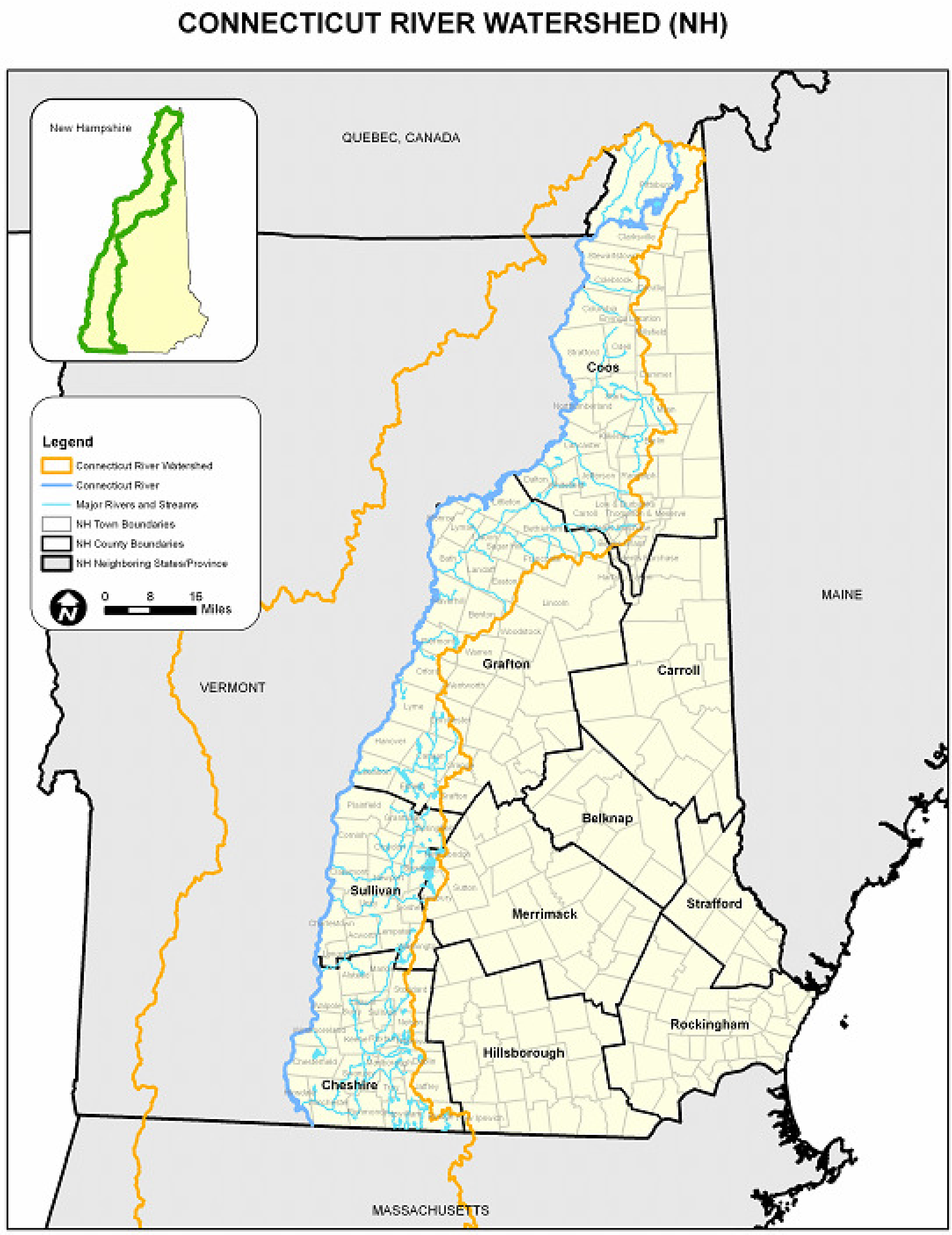
> A 25 percent reduction in point sources from the Upper States
>
> A 10 percent reduction in non-point source reduction loads from urban and agricultural areas from all five states.
>
> An 18 percent reduction in nitrogen loads from atmospheric deposition within the LIS watershed.

Implementation of the 2000 TMDL was to be conducted in phases with a commitment to re-evaluate nitrogen reduction targets and prepare a revised TMDL. That re-evaluation process is currently underway. As part of the revision process, the states and EPA signed an Enhanced Implementation Plan (EIP) in 2012 which includes the following tasks:

c. Within one year of completion of the enhanced implementation plan, all states will complete a preliminary evaluation of current storm water and nonpoint source control efforts with a goal of qualitatively assessing whether they are adequate for meeting the 2000 TMDL LAs. The work should be coordinated among states and with the LISS Nonpoint Source and Watersheds Work Group. The evaluation will:
   i. Assess available monitoring data and published reports on trends in tributary flow and nitrogen concentrations to infer trends in watershed contributions of nitrogen;
   ii. Qualitatively assess the scope and effectiveness of MS4 storm water and urban, agricultural and other NPS control programs being implemented;
   iii. Identify gaps in information on the extent of on-the-ground project implementation and performance of those best management practices regarding nitrogen control; and
   iv. Identify needed improvements in data or tools to quantitatively track and assess the attainment of stormwater WLAs and urban and stormwater LAs.

The purpose of this document is to address items c.i. through c.iv above and qualitatively assess whether New Hampshire is on track to meet the nonpoint source allocations recommended in the 2000 LIS TMDL.

Figure 1: Connecticut River Watershed in New Hampshire



1.2 Report Format

This document is part of a larger (main) report being prepared by the LIS Workgroup that includes representatives of the five LIS watershed states, NEIWPCC and EPA.

Presented first are modeling results to show the relative effect of New Hampshire's impact on LIS with regards to nitrogen loading and impact on dissolved oxygen levels in LIS.

Item c.i. of the EIP (assessment of ambient monitoring data to determine trends in the Connecticut River and other surface waters) is addressed in the main report. Items c.ii, through c.iv are addressed in the sections below. First discussed are trends in factors that can drive nitrogen loadings such as population and land cover. This is followed by a discussion of regulated stormwater under the National Pollutant Discharge Elimination System (NPDES) general stormwater permit program as well the individual wastewater permit program which includes combined sewer overflows. Programs to control urban and agricultural nonpoint sources of nitrogen are discussed next. For the most part, information was obtained from staff in the various DES programs, other state and federal agencies and literature. Due to resource and time constraints, individual communities were not contacted directly for this preliminary assessment. For each program or topic, the following is provided.

Description:
Available data, data gaps[1] *and GIS coverage (1990 to present):*
Relative changes in program scope and effectiveness (1990 to present):
Qualitative assessment of nitrogen reductions (1990 to present):

A summary and recommendations are provided in section 5.0.

2 RELATIVE IMPACT OF NEW HAMPSHIRE ON LIS NITROGEN LOADINGS AND DISSOLVED OXYGEN

Before proceeding, it is useful to put New Hampshire's nitrogen load contribution and impact on dissolved oxygen (DO) levels in LIS in perspective.

In 2010, the New England Interstate Water Pollution Control Commission (NEIWPCC) prepared estimates of total nitrogen loading to LIS based on baseline data used in the LIS TMDL and estimates of the contributions of each Connecticut River state from the New England SPARROW and AVGWLF modeling efforts (Moore, et. al. 2004 and Evans 2008). As shown in Figure 2, New Hampshire contributes only three percent of the total nitrogen load delivered to LIS. This includes loads delivered from the five watershed states (CT, NY, MA, NH and VT) as well as boundary load contributions from the Atlantic Ocean and atmospheric deposition that falls directly on the surface area of LIS. Of the loads contributed by just the five watershed states, New Hampshire's contribution is only five percent (Figure 3).

According to the United States Geological Survey (USGS) New England SPARROW Model, New Hampshire contributed approximately 3933 U.S. tons (or 3568 metric tons) of nitrogen per year to LIS in the early 1990s (Moore et. al., 2004). Estimates of the percent contributed by various nitrogen sources according to the SPARROW model is provided in Figure 4. Atmospheric deposition is by far the largest contributor at 65 percent of the total New Hampshire load followed by agricultural and urban land uses at 16 and 7 percent

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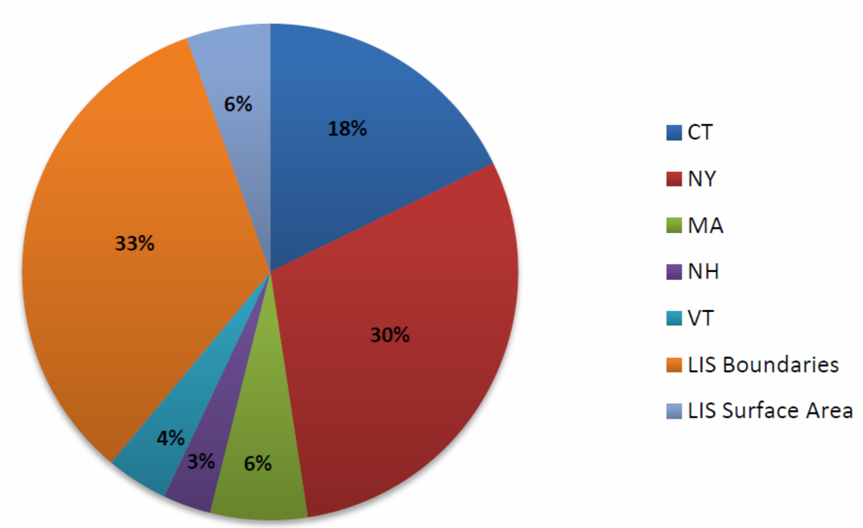
[1] Basic site specific information typically needed to compute nitrogen load reductions from various best management practices (BMPs), was considered to assess data gaps. For example, in all cases good locational information such as latitude/longitude or a GIS layer should be available especially if there is a need to account for attenuation of nitrogen. For stormwater BMPs site specific data such as the drainage area, the area of each land use in the drainage area (i.e., commercial, residential, etc.) and its percent imperviousness is typically needed, as well as the type and condition of the BMP and how it was sized. For other BMPs such as catch basin cleaning or street sweeping, the amount of sediment removed should be available.

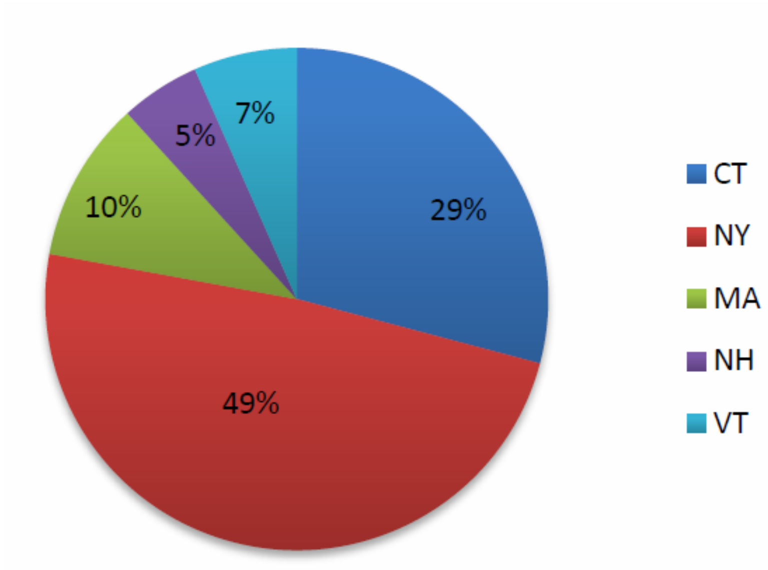
respectively. In all, the SPARROW model estimates that the total load delivered from New Hampshire to LIS in the early 1990s is comprised of approximately 87 percent nonpoint source and 13 percent point source loads. This compares to the AVGWLF model which predicts New Hampshire's load to be 2284 U.S. tons per year delivered to LIS which is about 42 percent lower than the SPARROW model (Table 1). Differences are likely due to differences in model methodologies and data t was used for calibration (i.e.., SPARROW used data from 1990 to 1993 and AVWGLF used data from 1999 to 2004).

Figure 2: Total Nitrogen Loading to LIS



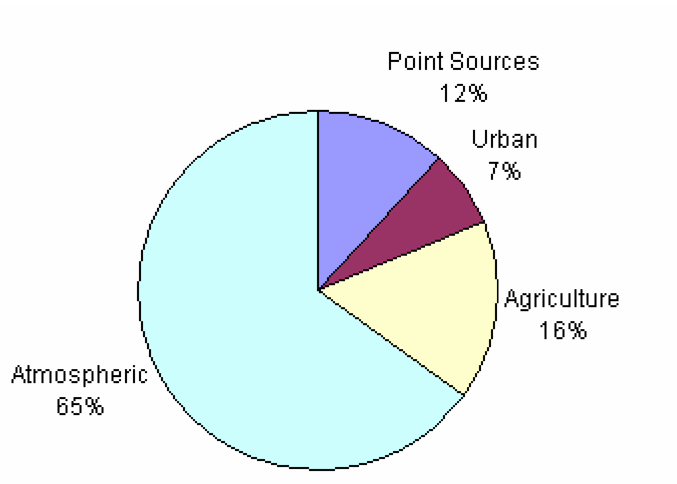
(Graphic from NEIWPCC, 2010)

Figure 3: Contributions of LIS Watershed States to Total Nitrogen Loading



(Graphic from NEIWPCC, 2010)

Figure 4: New Hampshire Nitrogen Sources based on the NE SPARROW Model



While the load estimates are different between SPARROW and AVWGLF, there are similarities (Table 1). On a percentage basis, the AVGWLF model estimates that 83 percent of the load from New Hampshire originates from nonpoint sources and approximately 17 percent is due to point sources which is close to the SPARROW results. The AVGWLF model also predicts that approximately 4 and 11 percent of the nonpoint sources are due to urban and agriculture land practices respectively and the rest (67 percent) is due to "other nonpoint sources" such as forests, wetlands, disturbed areas, etc. (Table 1). This also agrees fairly well with the SPARROW model if one assumes that atmospheric deposition in the SPARROW model is essentially the same as "other nonpoint sources" in AVGWLF. Both models show that the loads from agricultural lands are approximately two to three times larger that the urban loads and atmospheric or "other nonpoint sources" are approximately three to four times the total of the urban and agriculture loads.

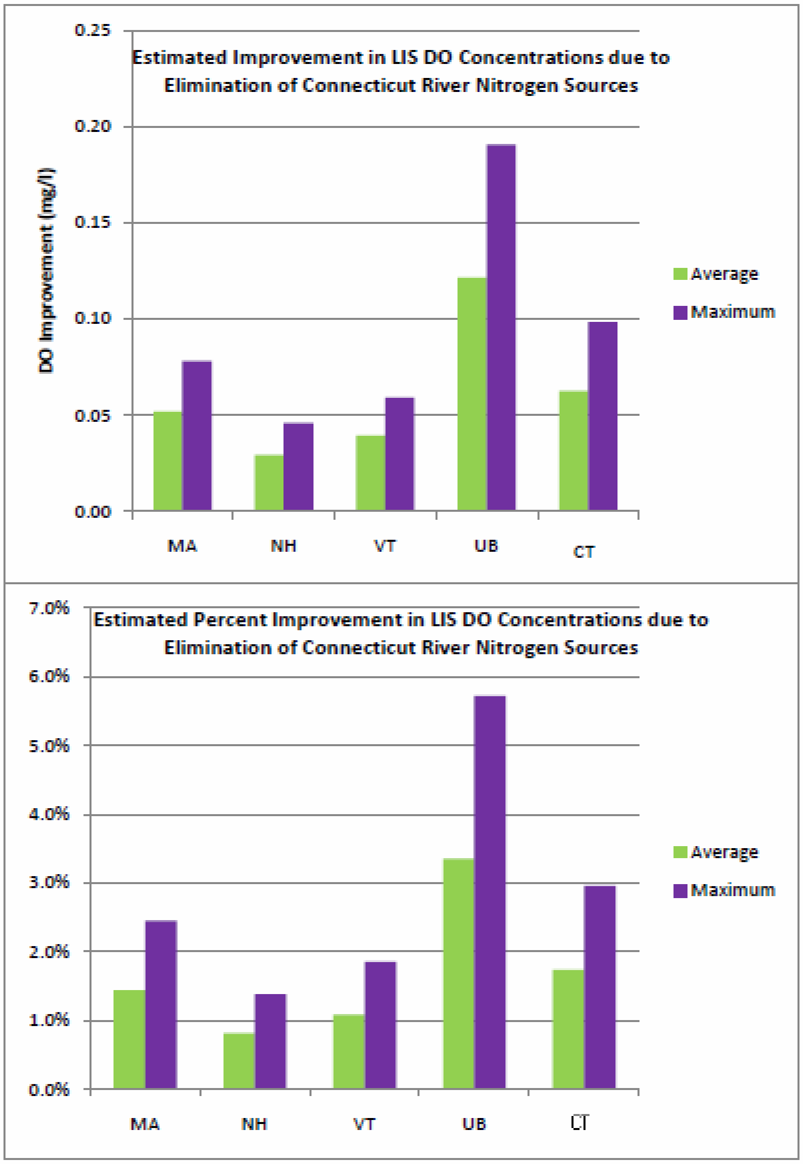
Table 1: NH Nitrogen Loads Delivered to LIS per the NE SPARROW and AVGWLF Models

Model	Calibration Period	Units	PS [2]	NPS[2] - Urban	NPS - Agriculture	NPS - Atmospheric	NPS - Other (Forest, wetlands, disturbed areas, etc.)	NPS - Total	Total
NE SPARROW	1990 - 1993	U.S. Tons TN /Year[1]	472	275	629	2556		3461	3933
		Percent	12%	7%	16%	65%		88%	100%
AVGWLF	1999 - 2004	U.S. Tons TN /Year[1]	393	100	252		1539	1891	2284
		Percent	17%	4%	11%		67%	83%	100%

1. Load delivered to LIS. TN = Total Nitrogen.
2. PS = Point Source. NPS = Nonpoint Source

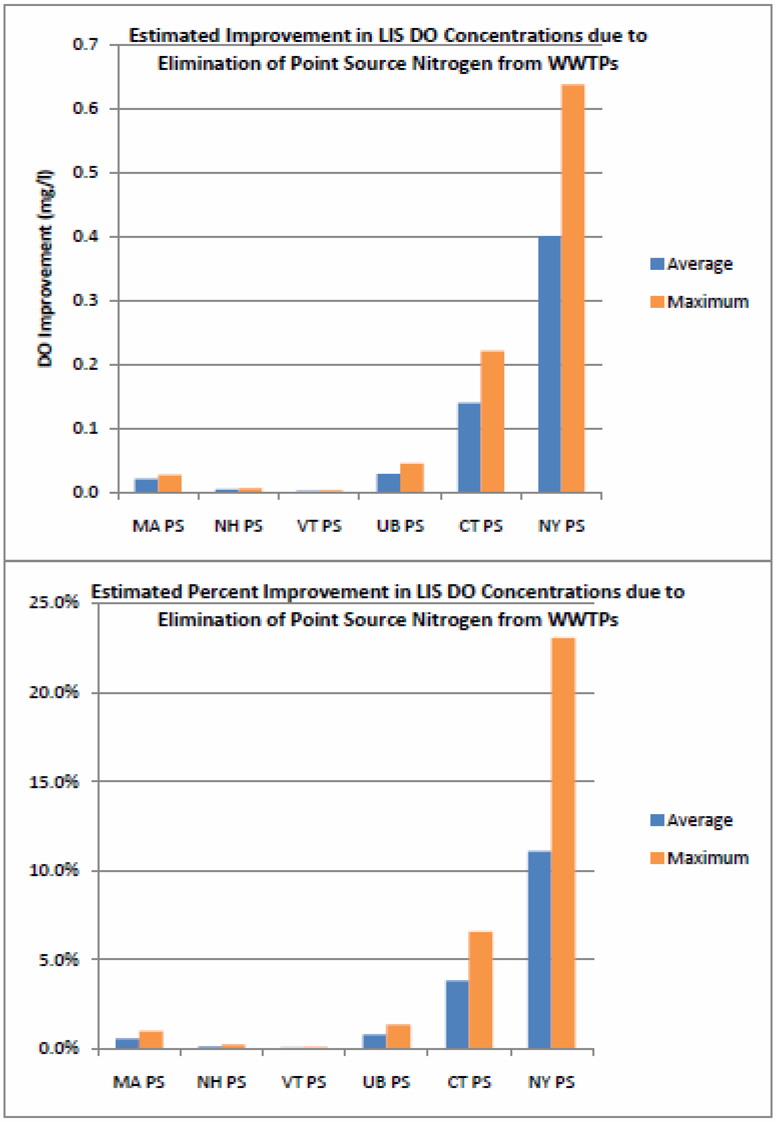
Turning to the issue of dissolved oxygen, the New England Interstate Water Pollution Control Commission (NEIWPCC) used the SWEM Matrix Spreadsheet Tool to estimate the dissolved oxygen (DO) response in LIS for various nitrogen removal scenarios (NIEWPCC, 2010). To better understand the relative impact of each state, the scenarios assumed complete elimination of all point and/or nonpoint sources. The scenarios are an exercise and should not be misinterpreted as alternatives being considered for implementation. As shown in Figure 5, results indicated that if the entire nitrogen load from New Hampshire were eliminated, DO in LIS would improve, on average, only 0.8 percent or approximately 0.03 mg/L. If only New Hampshire's point sources were eliminated, Figure 6 shows that the average improvement in DO in LIS would be just 0.1 percent or approximately 0.01 mg/L which is well below the expected improvement if all of the nitrogen from the wastewater treatment plants in Connecticut and New York was removed.

Figure 5: Estimated Improvements in LIS DO due to Elimination of CT River Nitrogen Sources



(Graphic from NEIWPCC, 2010)

Figure 6: Estimated Improvements in LIS DO due to Elimination of Nitrogen from WWTFs



(Graphic from NEIWPCC, 2010)

3 TRENDS IN DRIVERS OF NITROGEN LOADING

A sense of how nitrogen loadings may have changed over time can be gained by examining the trends of those factors (or drivers) which impact nitrogen loads. Examples of nitrogen load drivers include population, land use and agricultural practices, each of which is discussed below.

3.1 Population

Description: An increase in population may imply an increase in nitrogen loading since more people typically translates to the following:

- More nitrogen laden wastewater discharged to surface waters via municipal wastewater treatment plants or septic systems (via groundwater);
- More impervious surfaces which can lead to more polluted stormwater runoff; and/or
- More managed turf such as golf courses, ballfields and residential lawns which are often fertilized with nitrogen.

Available data, data gaps and GIS coverage (1990 to present*):* An estimate of population change from 1990 to 2010 in the Connecticut River basin in New Hampshire was provided by EPA using data from the U.S. Census in 1990 and 2010. Data was aggregated at the census block level[2]. If the centroid of the census block fell within the Connecticut River watershed, the population in the census block was included in the total.

Relative changes in program scope and effectiveness (1990 to present): NHDES is not aware of any significant changes in the method used by the U.S. Census to determine and report population from 1990 to present.

Qualitative assessment of nitrogen reductions (1990 to present): From 1990 to 2010 the population in New Hampshire within the Connecticut River basin increased by approximately 19,046 people or 11.3 percent. This represents an average increase of only 6.2 people per square mile. As shown in Figure 7, most of the increase occurred in the southern half of the watershed.

This population expansion could lead to increases in nitrogen loading for all of the reasons listed above. However, without more information it is difficult to determine with any certainty the actual change in loading, especially when the average increase per square mile is so small (6.2 people / square mile). For example, there is insufficient knowledge about whether the increased population is connected to wastewater treatment plants or septic systems, where the septic systems are located and how much of the nitrogen from the septic systems is being attenuated prior reaching a surface water or LIS. With regards to the impact of population on impervious surfaces and managed turf, the discussion in the following section indicates that the increase in these land uses has been minimal.

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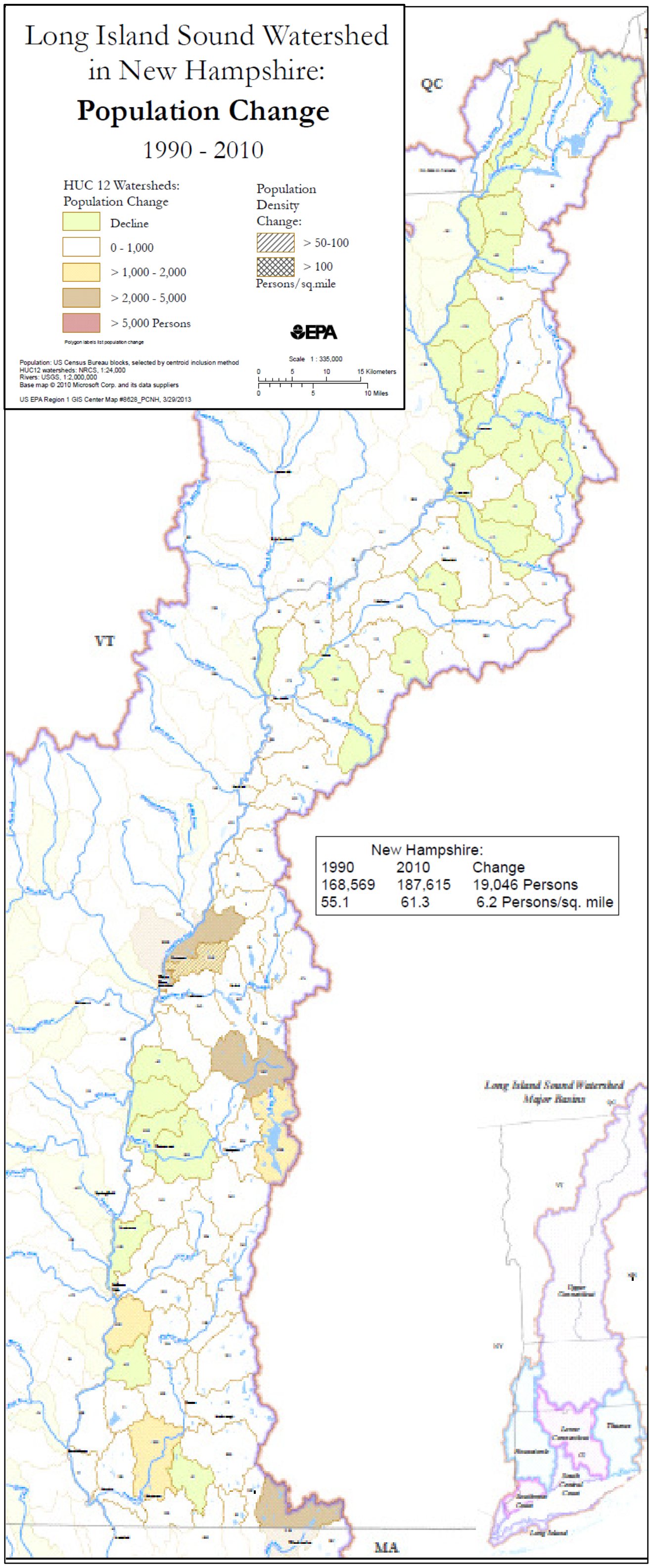
[2] According to the U.S. Census Bureau (http://www.census.gov/geo/www/geo_defn.html#CensusBlock) : "Census blocks are areas bounded on all sides by visible features, such as streets, roads, streams, and railroad tracks, and by invisible boundaries, such as city, town, township, and county limits, property lines, and short, imaginary extensions of streets and roads. Generally, census blocks are small in area; for example, a block bounded by city streets. However, census blocks in remote areas may be large and irregular and contain many square miles."

Figure 7: Population Change in NH in the CT River Basin (1990 - 2010)



3.2 Land Use Based on National Land Cover Database (NLCD)

Description: Changes in land use may imply changes in nitrogen loadings. For example, an increase in impervious or disturbed area may be associated with an increase in nitrogen due to increased stormwater runoff volumes and higher nitrogen concentration due to increased use of fertilizer on managed turf such as golf courses, ballfields and residential lawns. Increased impervious area may also be signal of increased population which may result in increased nitrogen loadings due to more wastewater. Likewise an increase in agricultural land may signal an increase in nitrogen loadings due to application of more crop fertilizer (commercial or manure) and/or more farm animals.

Available data, data gaps and GIS coverage (1990 to present): The National Land Cover Database (NLCD) has land use coverages for the years 1992, 2001 and 2006. Unfortunately, the methodology used to develop the 1992 coverage is not the same as that used to develop the more accurate 2001 and 2006 NLCD coverages. As such, the Multi-resolution Land Characteristics Consortium (the group of federal agencies responsible for the data) recommends against comparing the 2001 or 2006 datasets with the 1992 NLCD data (see the NLCD website). This was confirmed by the USGS NLCD Quality Supervisor who stated there is no way to accurately compare 1992 with 2001 or 2006 coverages for policy-making level decisions. The 2006 coverage can, however be directly compared to the 2001 coverage. The USGS expects to release the 2011 NLCD in the fall of 2013 which can be directly compared to the 2001 or 2006 coverages.

Since comparison of the 1990 NLCD to the 2006 NLCD will not yield accurate results, and is highly discouraged by USGS, the best one can do at this time is to compare the 2001 NLCD to the 2006 NLCD. As discussed below, EPA Region conducted this analysis for New Hampshire for changes in disturbed cover, impervious cover and agricultural land uses. Information on how these coverages were developed may be found in Appendix B. Results are shown in Table 2 and in Figure 8 through Figure 10.

It is recommended that once the 2011 NLCD is available, a similar comparison be conducted between the 2011 and 2001 NLCD to get a better idea of how land use (and potential changes in nitrogen loadings from NH) in the Connecticut River basin is changing with time. Such information coupled with ambient monitoring data and knowledge of specific BMPs that have been implemented may help explain trends in actual nitrogen loadings.

Relative changes in program scope and effectiveness (1990 to present): As stated above, the 1992 NLCD cannot be directly compared to the 2001 or 2006 NLCD coverages due to changes in the methods used to develop these coverages.

Qualitative assessment of nitrogen reductions (1990 to present): A comparison of changes in developed land, impervious cover and agricultural land uses from 2001 to 2006 for the Connecticut River watershed in New Hampshire was conducted by EPA Region 1. Specifics (i.e., metadata) on how these coverages were developed may be found in Appendix B. Results are shown in Table 2 and in Figure 8 through Figure 10. Developed land includes impervious cover and developed open space that mostly consists of managed turf (i.e., lawns, ballfields, golf courses, etc.). Agricultural land includes pastures and cropland.

As shown in Table 2, less than ten percent of the total area within the Connecticut River watershed in New Hampshire consists of developed or agricultural land cover and the overall increase in these coverages from 2001 to 2006 has been less than 1 percent (0.55 percent). Developed land constitutes less than five percent of the total area of the watershed in New Hampshire and increased by only 0.31 percent between 2001 and 2006. Impervious cover (which is included in the developed land) represents only one percent of the total watershed area in the state and increased by only 0.73 percent from 2001 to 2006. Agriculture land (pasture and cropland) constitutes less than five percent of the total watershed area in New Hampshire and increased by only 0.80 percent. Of the agricultural land, pasture land increased by approximately 2.1 percent, however, cropland decreased by approximately 1.76 percent. As discussed in the next section changes in agriculture land use from 1992 to 2007 is available from the U.S. Census of Agriculture.

The increase in these land uses from 2001 to 2006 is very small (less than 0.55 percent overall) and suggests that the impact of land use on nitrogen loadings in the Connecticut River during this time period has been minimal at most. Further, this analysis does not account for disconnected impervious surfaces and other BMPs that may have been implemented which may offset the increase in land uses. Consequently, it is not possible to definitely conclude from the data provided above if the slight increase in developed and agricultural land over the years has resulted in a measurable increase or decrease in nitrogen loading to the Connecticut River.

Table 2: Change in Land Cover in NH in the CT River Watershed (2001-2006)

Land Cover	Units	2001	2006	Change
Developed Land (Impervious and Managed Turf)	**Acres**	94699	94995	296
	Percent Change			0.31%
	Percent of Total Area	4.83%	4.85%	0.02%
Impervious Cover	**Acres**	20142	20290	148
	Percent Change			0.73%
	Percent of Total Area	1.03%	1.04%	0.01%
Agricultural - Pasture	**Acres**	59366	60615	1249
	Percent Change			2.10%
	Percent of Total Area	3.03%	3.09%	0.06%
Agricultural - Crops	**Acres**	30074	29544	-530
	Percent Change			-1.76%
	Percent of Total Area	1.54%	1.51%	-0.03%
Agricultural - Pasture & Crops	**Acres**	89440	90159	719
	Percent Change			0.80%
	Percent of Total Area	4.57%	4.60%	0.04%
Total Developed and Agricultural	**Acres**	184139	185154	1015
	Percent Change			0.55%
	Percent of Total Area	9.40%	9.45%	0.05%
Total Area in NH in CT River Watershed	**Acres**	1,958,581		

Figure 8: Change in Disturbed Land in NH (2001-2006)

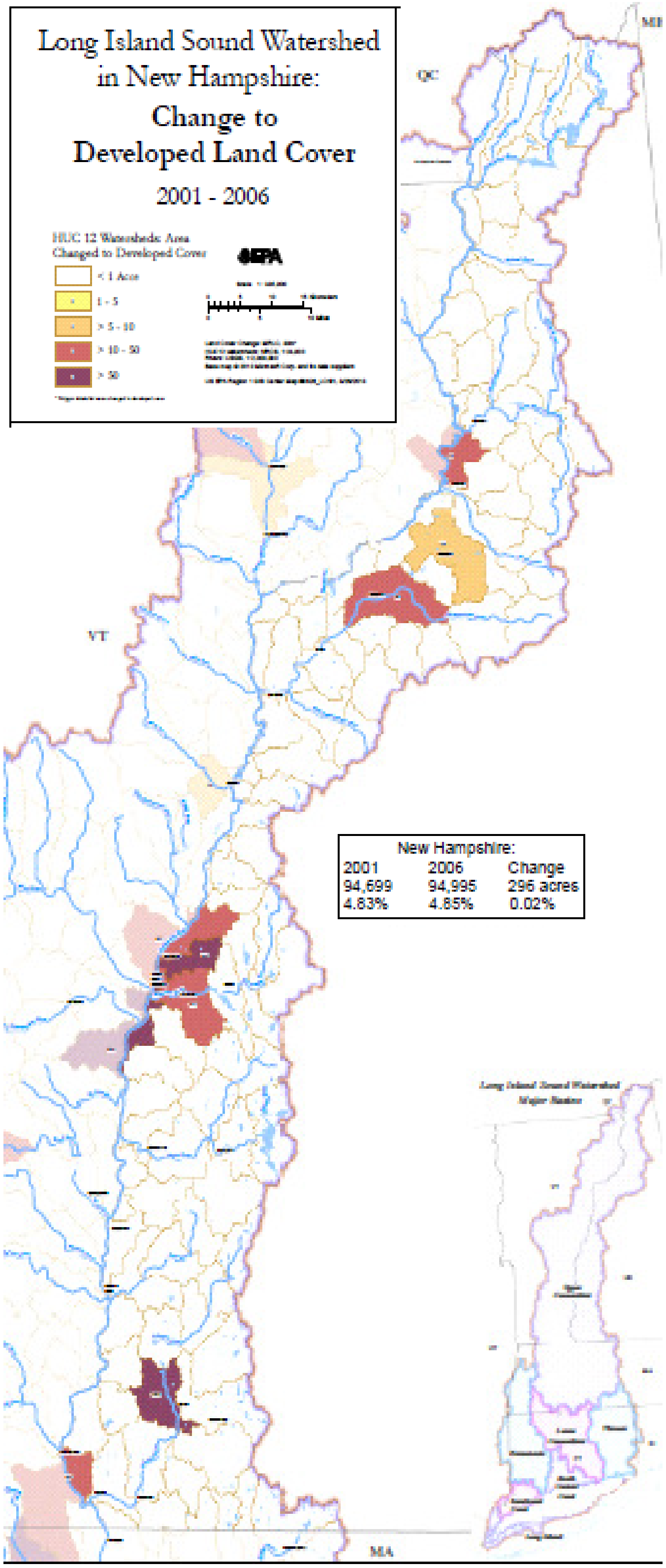


Figure 9: Change in Impervious Cover in NH (2001-2006)

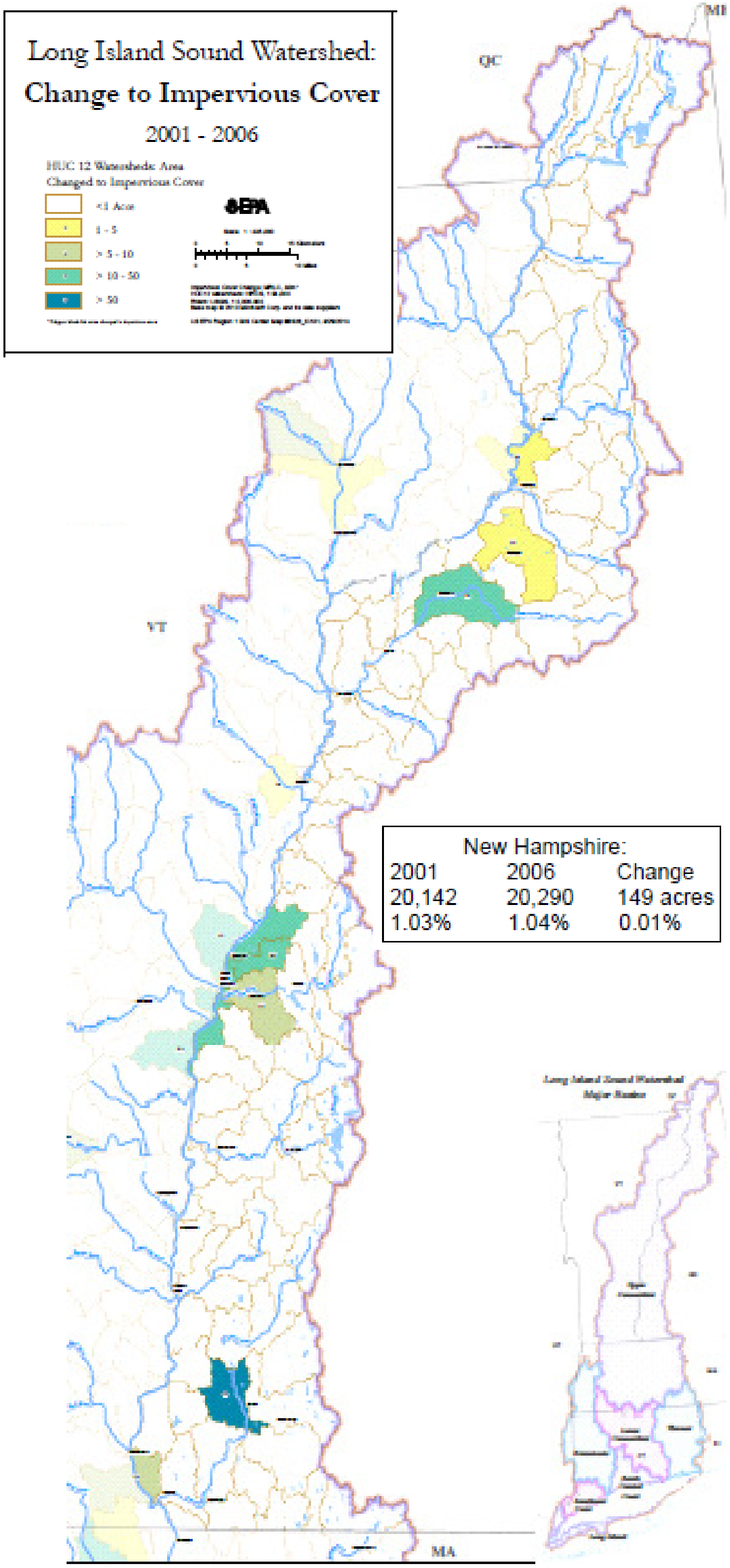
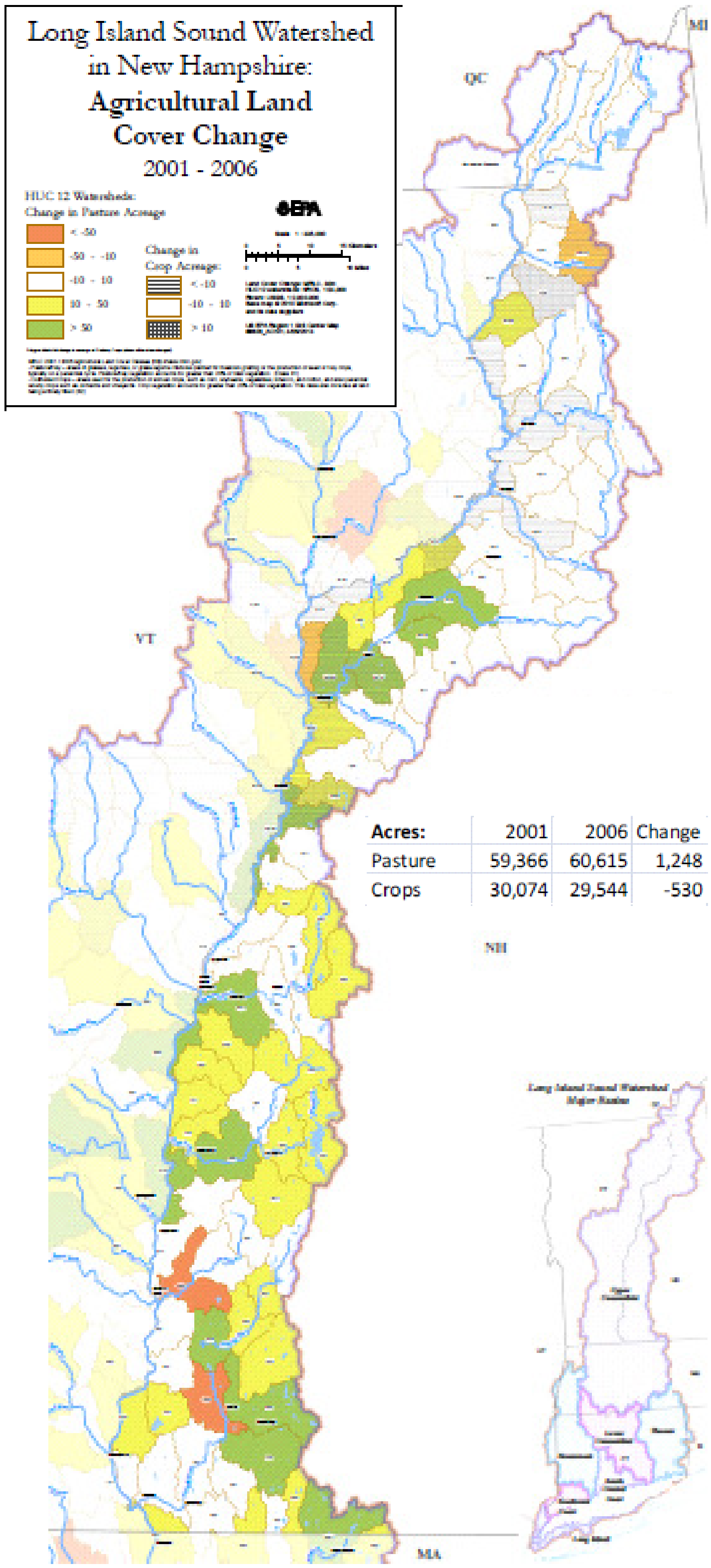


Figure 10: Agricultural Land Cover Change in NH (2001-2006)



3.3 Agricultural Drivers of Nitrogen from the U.S. Census of Agriculture

Description: The "Census of Agriculture Act of 1997," Public Law 105-113 (Title 7, United States Code, Section 2204g) directs the Secretary of U.S. Department of Agriculture (USDA) to conduct a census of agriculture in 1998 and in every fifth year after, covering the prior year. The Census of Agriculture is the only source of uniform, comprehensive agricultural data for every state and county in the United States. Participation in the Census is required by law. The law also protects the confidentiality of all individual responses. According to the USDA website:

> "Respondents are guaranteed by law (Title 7, U.S. Code, and CIPSEA, Public Law 107-347) that their individual information will be kept confidential. NASS uses the information only for statistical purposes and publishes data only in tabulated totals. The report cannot be used for purposes of taxation, investigation or regulation. The privacy of individual Census records is also protected from disclosure through the Freedom of Information Act."

Reports are available at http://www.agcensus.usda.gov/Publications/Historical_Publications/index.php.

Available data, data gaps and GIS coverage (1990 to present): The USDA Census includes data on farms, farm land uses, farm animals, as well as acres treated with commercial fertilizer or manure for the whole state and in some cases by county.

Relative changes in program scope and effectiveness (1990 to present): Not applicable.

Qualitative assessment of nitrogen reductions (1990 to present): As mentioned, the USDA Census is conducted every 5 years with the most recent completed in 2007. The 1992 Census is the closest to the desired 1990 timeframe and was therefore selected as the starting point. To determine statistics within the New Hampshire portion of the Connecticut River basin, the USDA Census county statistics were multiplied by the percent of each county that is within the Connecticut River basin (see Appendix A, Table A1).

Figure 11 shows that the number of NH farms in the Connecticut River basin has increased by 68% from 1992 to 2007. Although the number of farms increased by 68 percent, Figure 12 and Figure 13 show that the total farm land area increased by only 27.8 percent (approximately 30,128 acres).

The USDA Census categorizes farm land uses as cropland, pasture, woodland, and other uses. As shown in Figure 12 and Figure 13, cropland and other uses decreased by 7.1 percent and 13.5 percent respectively. Pasture and woodland increased by 258.8 percent and 47.2 percent respectively, however the increase in acreage for pastureland (7,194 acres) is much less than that for woodland (26,976 acres). The increase in woodlands represents approximately 89.5 percent of the total change in farm land acreage. Figure 14 shows the breakdown of farm land uses by county.

The Census also includes data on farm animals and fertilizer. Figure 15 and Figure 16 show the estimated change in cattle, equine, hogs, and sheep in New Hampshire within the Connecticut River basin. All comparisons are for 1992 to 2007 except for equine which is for 1997 to 2007 since county information was not included in the 1992 census report. Figure 17 shows the breakdown of these farm animals by county. As shown the total number of these farm animals has decreased by about 3,094 (17.2 percent) with cattle representing the majority of the decline (-3057) followed by declines in sheep (-439) and hogs (-146). Equine was the only category that increased.

The number of goats and poultry could not be estimated as above since complete statistics for each county were not available in 1992. However, on a statewide basis, the census indicates that the number of goats in the entire state has increased by 1125 (140 percent) and poultry decreased by 2368 (1.1 percent- see Figure 18 and Figure 19).

The estimated acres of farmland treated with commercial fertilizers or manure in New Hampshire in the Connecticut River basin from 1992 to 2007 is shown in Figure 20. Estimates were made by multiplying the acres for each county by the percent of the county area that is in the Connecticut River basin (see Appendix A, Table A1). Results indicate that between 1992 and 2007 the acres of farmland treated with commercial fertilizer decreased by approximately 25 percent and that from 2002 to 2007 the acres treated with manure decreased by same percentage.

Although the acreage of farmland increased by 28 percent, the reduction in cropland and increase in woodlands, combined with the reductions in the total number of cattle, equine, hogs and sheep (and probably goats and poultry based on the statewide data) and reductions in the acres of farmland treated with commercial fertilizer and manure suggest that nitrogen loads associated with agricultural practices in New Hampshire within the Connecticut River basin have probably decreased from 1992 to 2007.

Figure 11: Change in Number of Farms in NH in the CT River Basin (1992-2007)

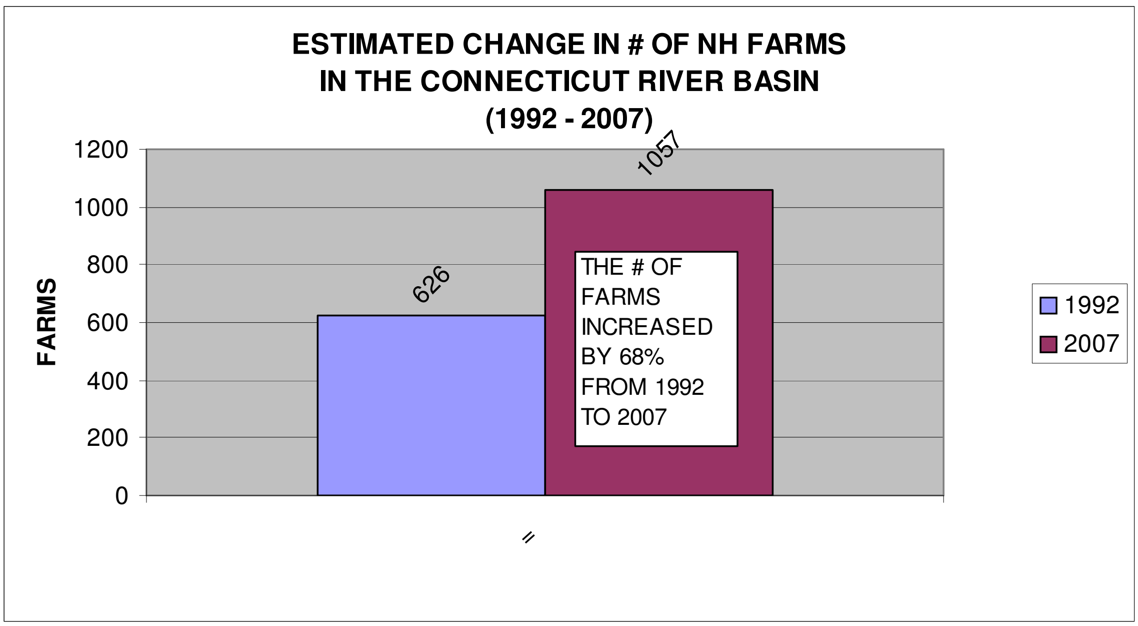


Figure 12: Change in Farm Land Use (in Acres) in NH in the CT River Basin (1992-2007)

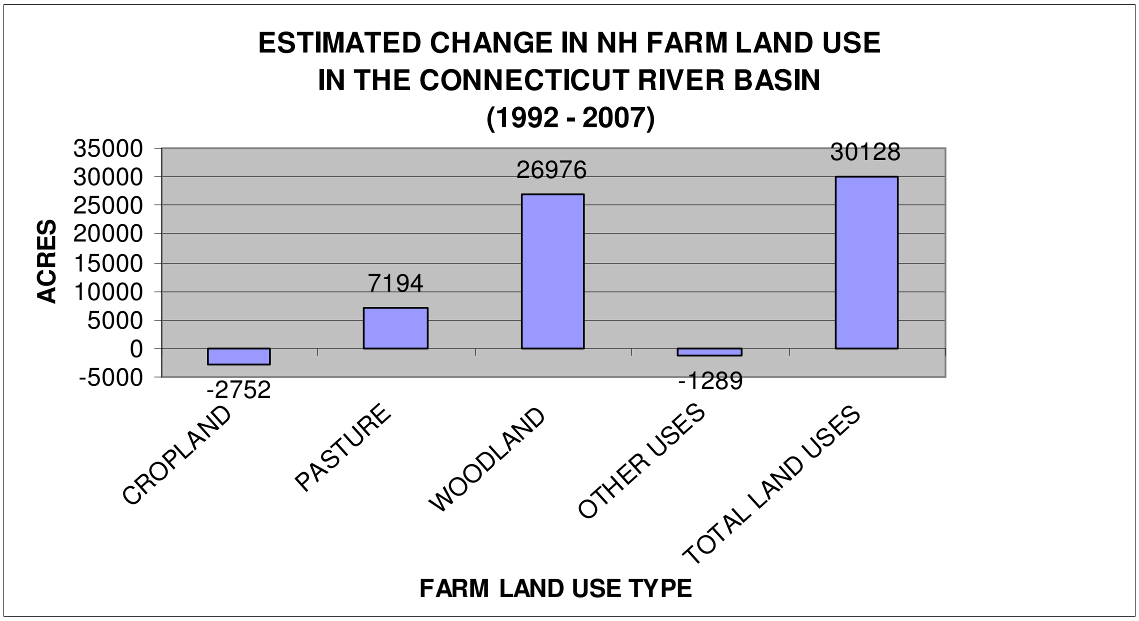


Figure 13: Percent Change in Farm Land Use in NH in the CT River Basin (1992-2007)

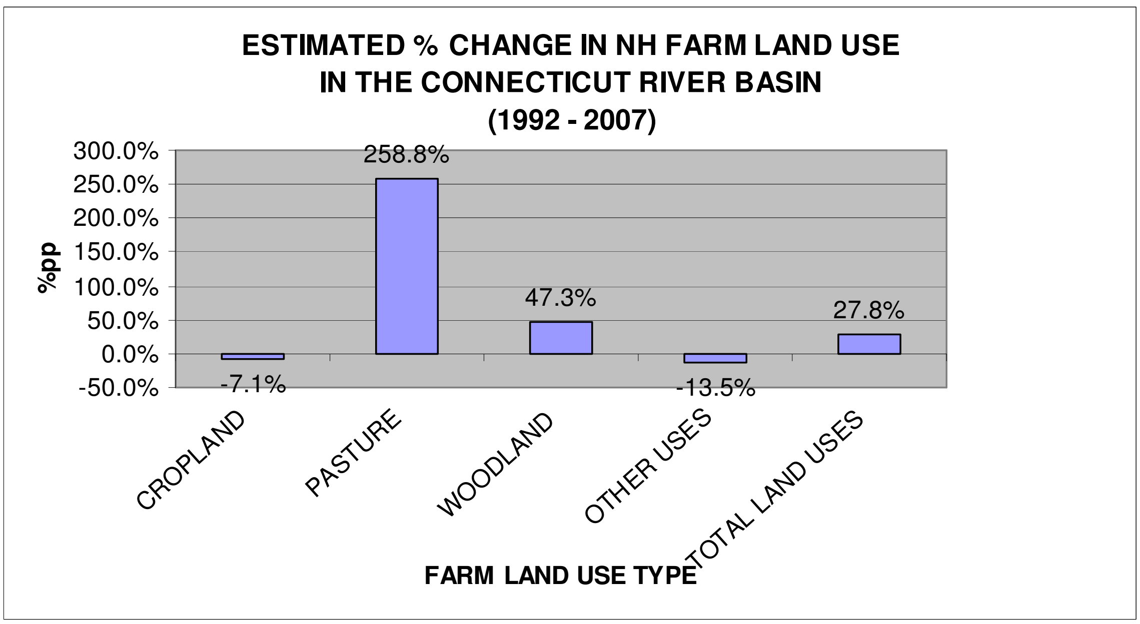


Figure 14: Change in Farm Land Use by NH County in the CT River Basin (1992-2007)

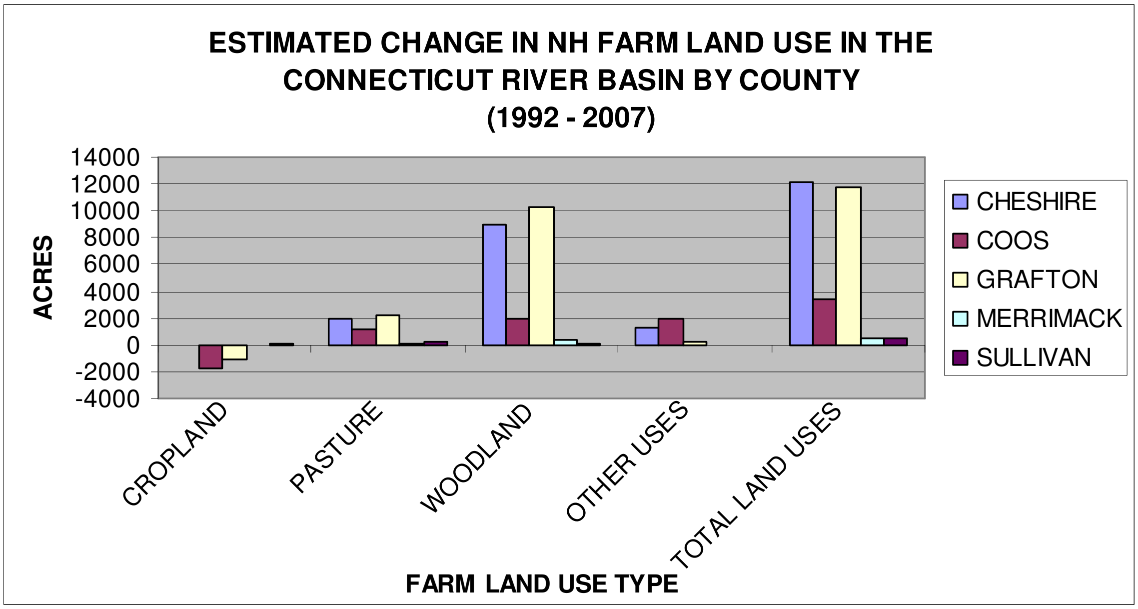


Figure 15: Change in Farm Animals in NH in the CT River Basin (1992-2007)

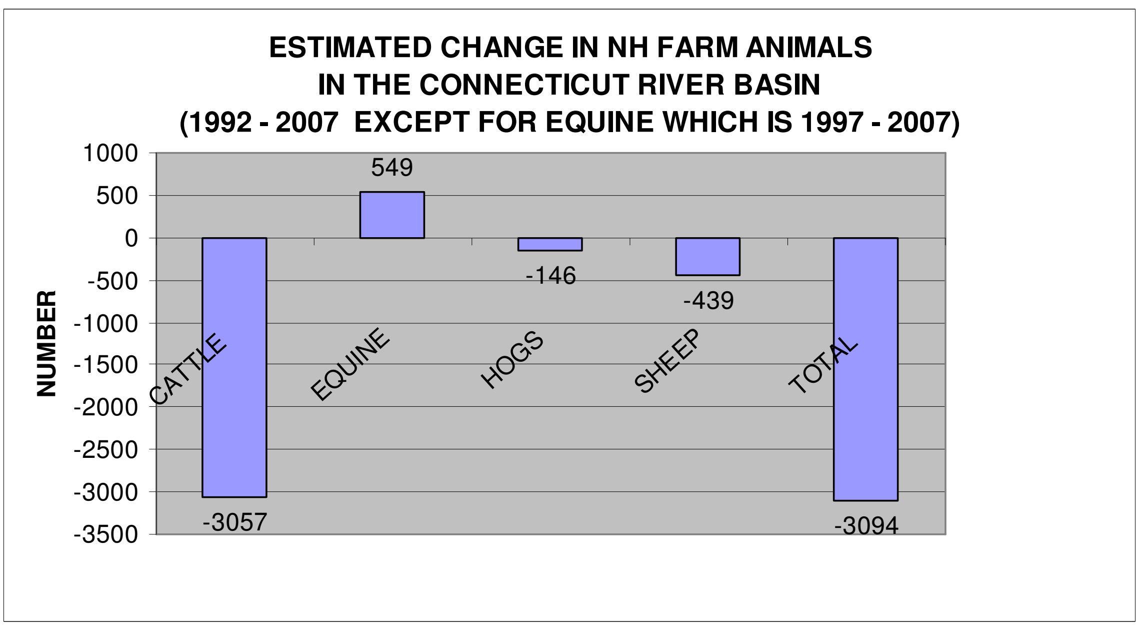


Figure 16: Percent Change in Farm Animals in NH in the CT River Basin (1992-2007)

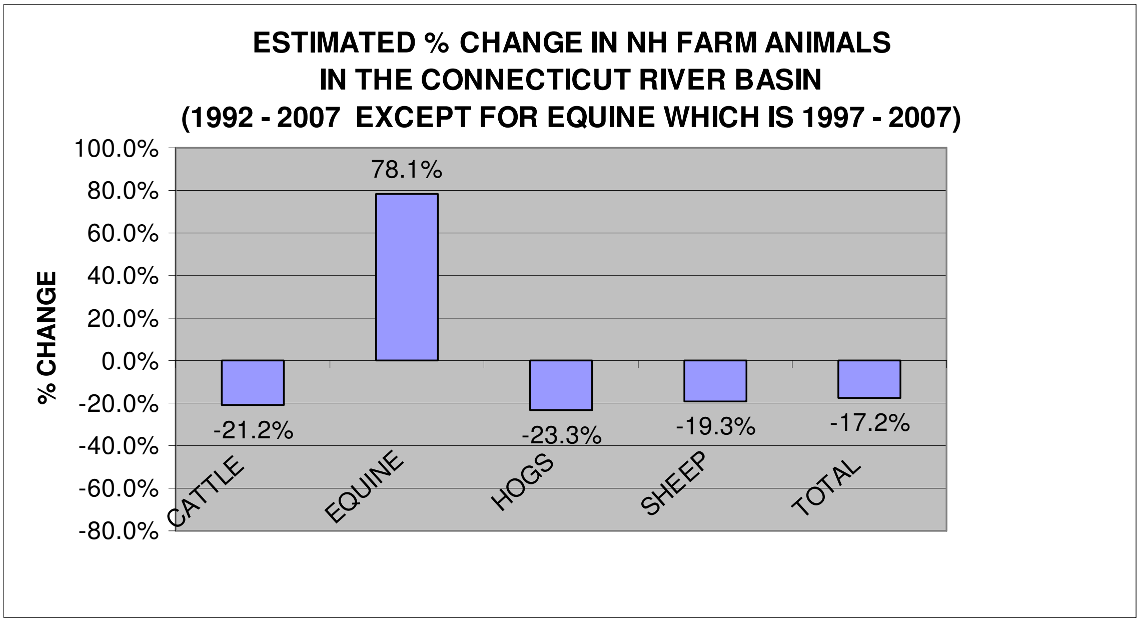


Figure 17: Change in Farm Animals by County in NH in the CT River Basin (1992 - 2007)

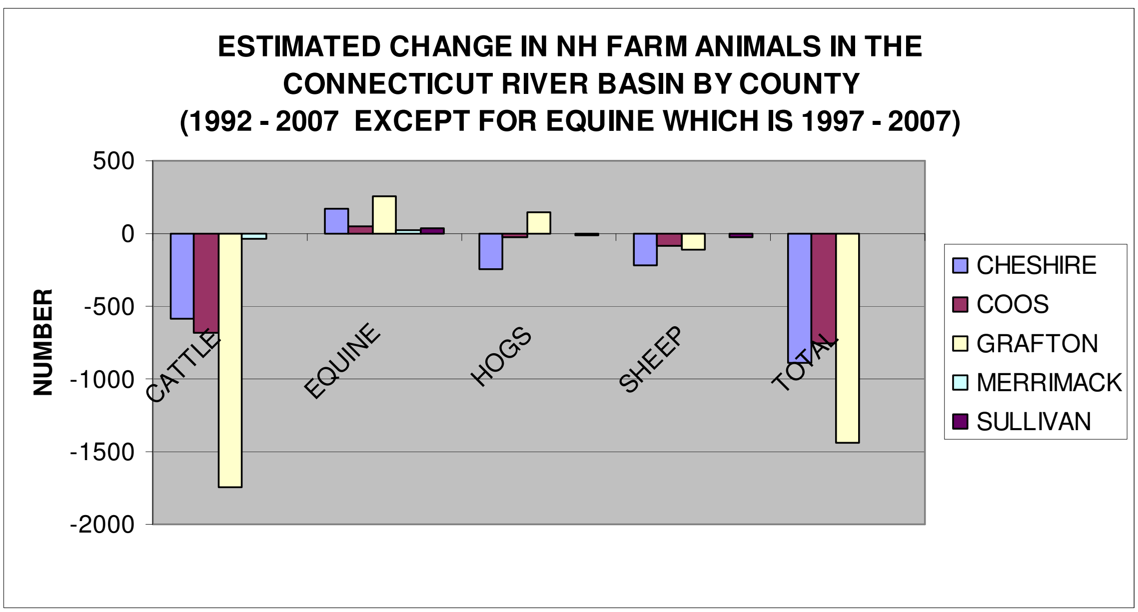


Figure 18: Change in Goats and Poultry in NH (1992-2007)

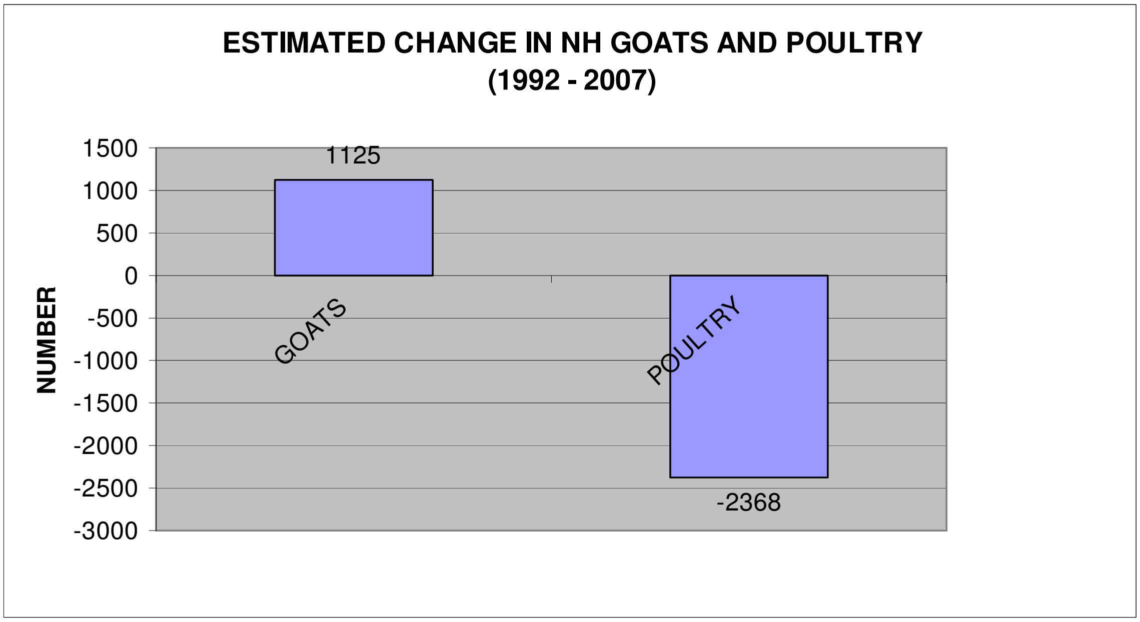


Figure 19: Percent Change in Goats and Poultry in NH (1992-2007)

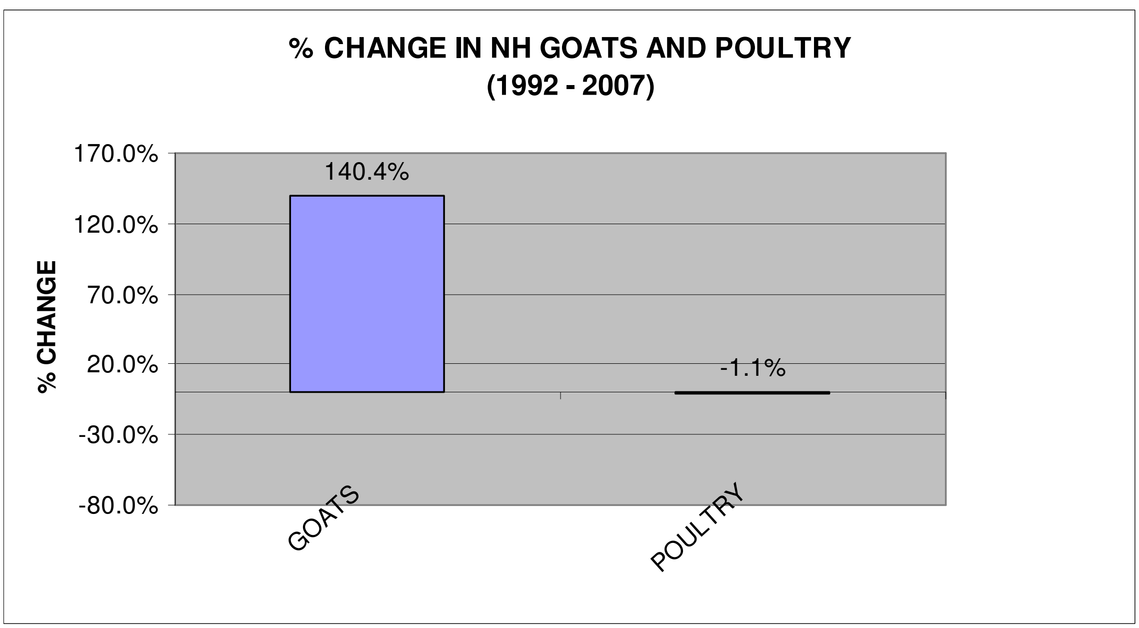
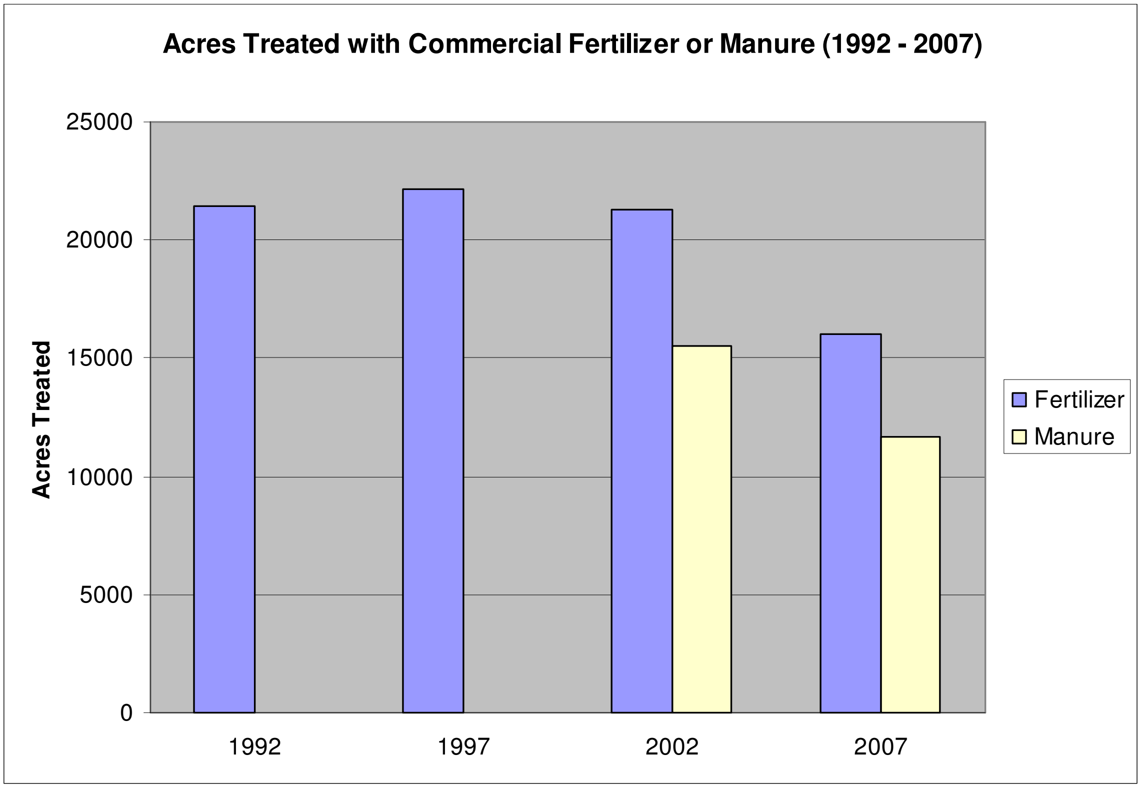


Figure 20: Acres Treated with Commercial Fertilizer or Manure (1992 - 2007)



4. REGULATED STORMWATER (MS4, CGP and CSOs)

4.1 Municipal Separate Stormwater System (MS4) Permits

Description: The Municipal Separate Stormwater System (MS4) permit is one of several permits under the National Pollutant Discharge Elimination System (NPDES) general stormwater permit program. Since New Hampshire is not a delegated state, the MS4 permit program in New Hampshire is administered by the U.S. Environmental Protection Agency (EPA).

Available data, data gaps and GIS coverage (1990 to present): Not addressed since there are no New Hampshire MS4 communities in the Connecticut River basin.

Relative changes in program scope and effectiveness (1990 to present): Not addressed since there are no New Hampshire MS4 communities in the Connecticut River basin.

Qualitative assessment of nitrogen reductions (1990 to present): Not addressed since there are no New Hampshire MS4 communities in the Connecticut River basin.

4.2 Multi-sector General Permits (MSGP)

Description: Industrial activities can contaminate stormwater discharges and receiving waters. The Multi-sector General Permit (MSGP) is one of several general permits under the National Pollutant Discharge Eliminate System (NPDES) general stormwater permit program. The purpose of the MSGP is to help ensure that stormwater discharges from certain industrial activities do not cause or contribute to surface water quality violations. Since New Hampshire is not a delegated state, the MSGP program in New Hampshire is administered by the U.S. Environmental Protection Agency (EPA). Permits are reissued approximately every five years.

The MSGP regulates stormwater discharges from 29 different industrial sectors and requires them to implement and maintain stormwater control measures. Applicants must file a Notice of Intent or submit a No Exposure certification form showing that an MSGP is not required. MSGP requirements include, but are not limited to, non-numeric technology-based effluent limits such as minimizing exposure, good housekeeping, maintenance and spill prevention, water quality based effluent limitations for discharges to impaired waters, antidegradation requirements, inspection requirements, preparation and implementation of Stormwater Pollution Prevention Plans (SWPPPs), as well as monitoring and reporting requirements. Prior to issuance of the MSGP, the State must certify that the permit will comply with state surface water quality standards.

Available data, data gaps and GIS coverage (1990 to present): NOI information for MSGPs from 2000 to the present can be viewed and downloaded at http://cfpub.epa.gov/npdes/stormwater/noi/noisearch.cfm. Information includes permit number, NOI submittal date, date of coverage, organization and project name, county, city, state and status. For the 2008 MSGP, EPA Region I also has access to a more comprehensive database that also includes latitude/longitude, property size, receiving water name, pollutant(s) causing impairment, TMDL status as well as SWPPP contact information. Information regarding specific BMPs that were implemented are not included in either database.

Relative changes in program scope and effectiveness (1990 to present): According to EPA Region I [3], the Final Rule requiring NPDES permits for discharges from large and medium-sized municipal systems and industrial activities (including construction activities disturbing greater than five acres) was finalized in November 1990. At that time, EPA developed and made three permitting options for regulated entities: 1) an individual permit application, 2) a group permit application for a Construction General Permit and an Industrial General Permit, and 3) an NOI for a general permit. Applicants under the first two options were required to apply by October 1992 and implement their SWPPP by October 1993. Entities seeking coverage under a general permit were required to submit data to inform the development of the first MSGP. While there was some very minimal permitting done initially for industrial facilities under an Industrial General Permit, virtually all industrial stormwater dischargers obtained (or converted to) permit coverage under the MSGP once finalized in September 1995. Facilities seeking coverage under the MSGP had until December 1995 to submit an NOI; until June 1996 to implement a SWPPP; and no later than October 1998 to implement any controls that required construction.

Qualitative assessment of nitrogen reductions (1990 to present): Since the Industrial General Permit program was implemented in 1992, and later the MSGP in 1995, many New Hampshire industrial facilities in the Connecticut River basin (approximately 100 since 2000) have filed NOIs and have developed and implemented SWPPPs to minimize contamination of their stormwater discharges. Though not quantified, this implies that since 1990, the MSGP program has very likely helped to reduce pollutants (including nitrogen) in stormwater discharges from industrial facilities.

4.3 Construction General Permits (CGP)

Description: Erosion from construction sites can result in the deposition of sediment containing nitrogen in surface waters. The Construction General Permit (CGP) is one of several general permits under the National Pollutant Discharge Eliminate System (NPDES) general stormwater permit program. Since New Hampshire is not a delegated state, the CGP program in New Hampshire is administered by the U.S. Environmental Protection Agency (EPA). The purpose of the permit is to help ensure that construction activities from eligible sites do not cause or contribute to surface water quality violations. Permits are reissued approximately every five years. Construction operators seeking coverage under EPA's CGP must submit a Notice of Intent (NOI) certifying that they have met the permit's eligibility conditions and that they will comply with the permit's effluent limits and other requirements. CGP requirements include, but are not limited to, requirements for erosion and sediment

[3] Personal communication with D. Gray of EPA Region 1.

control, stabilization and pollution prevention, water quality based effluent limitations for discharges to impaired waters, antidegradation requirements, inspection requirements, corrective actions, and preparation and implementation of Stormwater Pollution Prevention Plans (SWPPPs). Prior to issuance of CGP, the State must certify that the permit will comply with state surface water quality standards.

Available data, data gaps and GIS coverage (1990 to present): According to staff of the EPA Region 1 stormwater permit program, site specific information for permits issued since 2003 can be obtained by reviewing individual project files at the EPA Construction General Permit Public Search website[4]. This website includes operator and project information such as the mailing address, latitude and longitude, the area of disturbance, receiving water name and impairment status, and whether chemical flocculants are being used. Information regarding specific BMPs that were implemented are not provided.

Relative changes in program scope and effectiveness (1990 to present): One of the most significant changes that has occurred since the early 1990s that could impact water quality, is the area of disturbance which triggers whether a project needs to apply for and comply with the CGP (USEPA, 2003). From 1992 to 2003, projects disturbing five or more acres were required to have permit coverage under the CGP. In 2003, coverage was expanded to include construction activity that disturbs one or more acres of land (or less than one acre of disturbance if it is part of a larger plan of development or sale totaling one acre or more).

Qualitative assessment of nitrogen reductions (1990 to present): Since the CGP program was implemented in 1992 it seems reasonable to conclude that control of construction related erosion and deposition of sediment containing nitrogen to surface waters, including the Connecticut River, has most likely improved. Further, reducing the size of the disturbed area from five to one or more acres in 2003 increased the number of projects that must comply with the CGP which should further help to reduce construction related sediment/nitrogen loadings to surface waters.

4.4 Combined Sewer Overflows (CSOs)

Description: A combined sewer collects municipal wastewater or sewage, as well as storm water runoff, in a single pipe system. Storm water 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 (WWTF) where it is treated before being discharged to a nearby water body, such as a river or a stream. During heavy rains, the storm water combined with sewage may overwhelm the collection system, causing an overflow into the nearest stream or river. The locations where these discharges occur, as well as the discharge events themselves, are called combined sewer overflows. CSOs are located at various locations along combined sewers, and are unique to each system. CSOs are regulated under the NPDES permit for the municipality's wastewater treatment facility. As discussed below, the city of Lebanon had seven CSOs that discharged to directly or indirectly to the Connecticut River in the 1990s and plans to eliminate all the CSOs via separation by the end of 2020.

Available data, data gaps and GIS coverage (1990 to present): To estimate the net change in nitrogen load due to elimination of CSOs via separation it is necessary to know the annual load of treated and untreated combined sewage prior to separation, and the annual load of untreated stormwater and treated separated sewage after separation. Based on information provided by the DES Wastewater Engineering Bureau, some of this information is available or can be estimated. However, prior to conducting such a study, the City of Lebanon should be contacted to determine if they have additional information that would benefit the analysis.

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http://ofmpub.epa.gov/CGPSearch/faces/CGPPublicSearch.jspx?_afrWindowMode=0&_afrLoop=8389788960786879&_adf.ctrl-state=118lohq218_4.

Relative changes in program scope and effectiveness (1990 to present): As discussed below, since the 1990s the City has eliminated three of their seven CSOs and is under an Administrative Order to eliminate the remaining four CSOs via sewer separation by 2020.

Qualitative assessment of nitrogen reductions (1990 to present): In 1995, the City of Lebanon had seven CSOs which discharged millions of gallons per year of stormwater and untreated sewage to the Connecticut River in the 1990s (Wright Pierce, 1998). In the spring of 1996, EPA issued an administrative order to the City to complete a CSO facility plan, the purpose of which was to identify the least cost alternative to abate CSOs to meet water quality standards. EPA reviewed and approved the CSO facility plan and issued an administrative order in June 2000 requiring the City to eliminate their then seven remaining CSO outfalls by December 31, 2012. In 2007, the City requested that the date to eliminate its CSOs be extended to December 31, 2020. In August 2009, Lebanon entered into a consent decree (CD) with EPA and DES. Under the terms of the decree, the City is to eliminate its six then remaining CSOs by December 31, 2020. Also under the terms of the CD, the City will complete an assessment of its wastewater collection system's capacity, management, operation and maintenance practices to identify sources of infiltration/inflow and elimination of sanitary sewer overflows. As of 2012, the City of Lebanon has four remaining CSOs, three of which discharge to the Mascoma River (which discharges to the Connecticut River), and one which discharges directly to the Connecticut River.

The total nitrogen concentration of untreated wastewater is typically much higher (often by more than order of magnitude) than that of separated stormwater [5]. As CSOs are separated, discharges of untreated wastewater are eliminated. Since secondary wastewater treatment plants can typically reduce influent total nitrogen by approximately 10 to 30 percent (USEPA, 2010), its possible that CSO separation will reduce the total nitrogen loading to the Connecticut River since all of the nitrogen laden untreated sewage in the CSOs will be treated and reduced at the wastewater treatment plant. However, an analysis that also accounts for net difference in nitrogen loadings between stormwater that was treated at the WWTF prior to separation and the discharge of untreated stormwater after separation would be needed to confirm if there is a net reduction. The percent of nitrogen actually removed by the Lebanon wastewater treatment facility should also be determined.

5. NONPOINT SOURCE PROGRAMS

5.1 Urban

5.1.1 Alteration of Terrain Permit Program

Description: Since 1981, New Hampshire has had an Alteration of Terrain (AoT) permit program to help protect surface waters, and since 2009, drinking water supplies and groundwater, from stormwater runoff from developed areas [6]. The AoT permit program applies to the construction and operation of earth moving operations, such as industrial, commercial, and residential developments as well as sand pits, gravel pits, and rock quarries. Statutory authority and regulations for issuing AoT permits are provided under RSA 485-A:6, VIII and RSA 485-A:17 and Env-Wq 1500 respectively. An AoT permit is required whenever a project proposes to disturb more than 100,000 square feet of contiguous terrain (50,000 square feet, if any portion of the project is within the protected shoreland), or disturbs an area of greater than 2,500 square feet with a grade of 25 percent or greater which is located within 50 feet of any surface water. In addition to these larger disturbances, the AoT General Permit by Rule applies to smaller sites and projects such as timber harvesting and trail construction. Permits are issued by the NHDES Alteration of Terrain bureau after a technical review of the

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[5] The range of total nitrogen in untreated domestic wastewater typically ranges from 20 to 85 mg/L (USEPA, 1993). The average total nitrogen in separated stormwater in Concord New Hampshire ranged from to 1.3 to 5.5 mg/L (NHDES, 1997).

[6] According to Part Env-Wq 1505.01 of the Alteration of Terrain regulations "No person undertaking any terrain-alteration activity shall cause or contribute to, or allow the activity to cause or contribute to, any violations of the surface water quality standards established in Env-Wq 1700."

application, which includes the project plans and supporting documents. Normal agricultural operations are exempt from the AoT program provisions (RSA 485-A:17, III).

Available data, data gaps and GIS coverage (1990 to present): Hard copies of AoT permits and supporting information going back to 1998 are currently maintained by the NHDES Alteration of Terrain Bureau. However, on-going efforts to reduce file storage needs by culling historical files will reduce the number of files available for retrieval and review in the future.

The Alteration of Terrain Bureau also has a GIS point layer showing the location of permits issued from 2004 to 2009 and a GIS polygon layer showing the location of issued permits from 2009 to present.

In addition, the bureau maintains a database (MS Access) with permit information going back to July, 1986. Although the current database goes back to 1986, the treatment type (i.e., BMP) for the developed condition was not tracked until 2004. Based on the database, approximately 7100 AoT permits have been issued statewide since 1986 with approximately 1000 [7] of those permits being in the Connecticut River basin. The database is set up to track 138 permit attributes, however not all attributes are applicable for each permit and there are numerous gaps, especially with the older permits because certain treatment types were not tracked in the database prior to 2004. Attributes considered of most useful for this qualitative nonpoint source assessment include the following:

- File / permit number;
- Action date;
- Owner / Applicant contact information;
- Project name, general description and location (community, county, lot and tax map number);
- Receiving water name and list of known impairments;
- Area of disturbance, impervious cover, undisturbed cover;
- Number of lots and length of roadway; and
- Type of permanent stormwater BMPs proposed (i.e., grass lined treatment swales, detention ponds, gravel wetlands, porous pavement, infiltration basins, etc.).

The number of each type of permanent stormwater BMP permitted in the Connecticut River basin since 2004 is provided in Table 3. The actual number is greater because AoT permits have been issued since 1981 but treatment type was not tracked in the database until 2004.

Table 3: BMPs Permitted by AoT in the Connecticut River Basin since 2004

BMP TYPE	TOTALS
Bioretention Area	8
Gravel Wetland	1
Infiltration Practice	85
Mechanical System	21
Pervious Pavement	11
Treatment Swale *	126
Tree Box Filters	0
Stormwater Pond	90
Stormwater Wetland (Non-Gravel)	5
Vegetated Buffer Practice	75

[7] The town or city was used to estimate permits issued in the Connecticut River basin (see Appendix A, Table A2). Approximately 794 permits were in communities that are entirely in the basin, 116 are in communities that are primarily in the basin, and 275 were in communities that are partially, but not primarily, in the Connecticut River basin.

BMP TYPE	TOTALS
TOTAL	422

(* criteria changed significantly with adoption of 2009 AoT regulations)

With regards to data needed to quantify nitrogen load reductions, there are several gaps in the AoT database. Examples include drainage area characteristics for each BMP [such as the impervious area and land use types (i.e. residential, commercial, forested, etc.)], the condition of the BMP (which can impact pollutant removal efficiency) and if the project was ever constructed. Although not available in the database, some of this information may be available in the individual project files but would take a significant amount of time and effort to confirm.

Relative changes in program scope and effectiveness (1990 to present): The AoT program began in 1981 and, with regards to stormwater BMP requirements, operated under essentially the same set of rules (Env-Ws 415) for 28 years. In 2009, NHDES adopted new, more stringent AoT rules (Env-Wq 1500 [8]) and developed a new, more comprehensive and user friendly Stormwater Manual [9] to further protect New Hampshire surface waters from degradation due to stormwater runoff from the construction and operation of developed land. A few examples of where the new AoT regulations are more stringent and provide enhanced protection are presented in the table below.

Table 4: Improvements to the AoT Regulations made in 2009

New AoT Regulation	Description
Env-Wq 1505.02	Limits the area of unstabilized soil to a maximum of 5 acres at any time unless certain other conditions are met. A maximum area of disturbance was not specified in the old AoT regulations.
Env-Wq 1506	Includes specifications for erosion and sediment control during construction including mulching, vegetation, erosion control blankets, silt fences, hay bale barriers, check dams, catch basin inlet protection, temporary sediment traps, construction dewatering and use of flocculants to control turbidity and suspended solids. Similar criteria were not specified in the old AoT regulations.
Env-Wq 1507.02 (a) (1)	Requires stormwater to be treated using one of the following permanent methods; stormwater ponds, stormwater wetlands, infiltration practices, filtering practices, treatment swales, vegetated buffers and/or other stormwater practices provided certain criteria are (such as it must remove no less than 80% of the total suspended solids. In addition pretreatment is required for all the permanent measures except treatment swales and vegetated buffers. Pretreatment can be in the form of sediment forebays, vegetated filter strips, pretreatment swales, flow-through devices or deep sump catch basins. The old AoT regulations considered vegetated filter strips, grassed swales, dry extended detention ponds, wet ponds, constructed wetlands and infiltration trenches/basins and water quality inlets to be acceptable permanent stormwater BMPs. The old AoT regulations did not include filtering practices (such as bioretention) and did not require pretreatment. BMP design criteria for the new regulations are also

[8] See http://des.nh.gov/organization/commissioner/legal/rules/index.htm#envwq1500
[9] See http://des.nh.gov/organization/divisions/water/stormwater/manual.htm.

New AoT Regulation	Description
	substantially different in that they require the BMPs to be designed for either the Water Quality Volume (WQV) or the Water Quality Flow (WQF).
Env-Wq 1507.02 (a) (2)	Requires permanent stormwater systems to be designed to protect groundwater resources by reducing the amount of water diverted off-site by the proposed development. The old AoT regulations did not specifically address groundwater recharge.
Env-Wq 1507.02 (a) (3)	Requires protection of channels, downstream receiving waters, and wetlands from erosion and associated sedimentation resulting from urbanization within a watershed and includes criteria for doing so. The old AoT regulations did not include a similar regulation but did require applicants to compare pre and post development flows.
Env-Wq 1507.02 (a) (4)	Requires control of peak runoff to address increases in the frequency and magnitude of flooding caused by development and includes specifications for accomplishing this objective. The old AoT regulations did not include a similar regulation but did require applicants to compare pre and post development flows.
Env-Wq 1507.02 (a) (5)	Requires implementation of long term maintenance practices and includes implementation plan criteria. The old AoT regulations did not address long term maintenance.

Qualitative assessment of nitrogen reductions (1990 to present): It is difficult to say with certainty how the AoT program has influenced nitrogen loadings since data is not readily available to quantify pollutant load reductions. However it can be said that the AoT rules adopted in 2009 are substantially more protective of surface and groundwaters that receive stormwater from developed land than the rules in effect prior to 2009. Assuming these rules translate to increased nitrogen removal as compared to pre-2009 projects, the program is on the right track to reduce the impacts of present and future development as well as redevelopment projects which also fall under the purview of the program.

5.1.2 Shoreland Water Quality Protection Act (SWQPA) Program

Description: The Shoreland Water Quality Protection Act (SWQPA) was originally named the Comprehensive Shoreland Protection Act (CSPA) and was enacted into law in the 1991 session of the Legislature. The Act establishes minimum standards for the subdivision, use and development of shorelands adjacent to the state's public water bodies. On July 1, 2005, Senate Bill 83 established a commission to study the effectiveness of the Comprehensive Shoreland Protection Act. Among other things, the commission was charged with assessing land-use impacts around the state's public waters; size, type, and location standards pertaining to structures as outlined in the CSPA; shoreland buffer and setback standards; and nonconforming use, lot, and structure standards. The final report of the commission contained 17 recommendations for changes to the CSPA. Sixteen of those recommendations for change were enacted into law and became effective April 1, 2008 and July 1, 2008. The changes were broad in scope and included limits on impervious surfaces, a provision for a waterfront buffer in which vegetation removal was limited, shoreland protection along rivers designated under RSA 483 (Designated Rivers), and the establishment of a permit requirement for many new construction, excavation and filling activities within the Protected Shoreland. During the 2011 legislative session, the CSPA was renamed to the Shoreland Water Quality Protection Act (SWQPA) changes were made to vegetation requirements within the natural woodland and waterfront buffers, the impervious surface limitations and a new shoreland permit by notification process was established. Statutory authority for the SWQPA program is provided under RSA 483-B:17 and regulations are included under Env-Wq 1400[10].

In general, the SWQPA permit program protects shoreland to maintain the integrity of surface waters. The protected shoreland extends 250 feet landward from the reference line of protected waterbodies which includes lakes, ponds, and impoundments greater than 10 acres, fourth order and greater streams and rivers and the highest observable tide line for coastal waters. Within the protected shoreland, the regulations include, but are not limited to, impervious surface area limitations, setback requirements for septic systems, natural woodland buffer limitations, primary building setbacks, maintenance of natural ground cover, no fertilizer application within 25 feet of protected shoreland and only low phosphorus, slow release nitrogen fertilizer beyond 25 feet.

The Shoreland Program provides multiple services to the public. Permitting staff review shoreland permit applications and waiver requests for compliance with the Shoreland Water Quality Protection Act. The review process is designed to provide a level of oversight for construction, fill, and excavation activities to ensure that projects are carried out in a manner that meet the minimum standards of the Act and protect water quality.

Compliance staff respond to written complaints documenting possible violations of the SWQPA. Complaints are triaged according to the level of environmental impact and investigated. A typical investigation involves a site inspection and follow-up with the appropriate parties to restore any violations.

Available data, data gaps and GIS coverage (1990 to present):

The SWQPA program shares a GIS/Foxpro database with the NHDES Wetlands Permit program. In addition to general project and applicant information, the database also tracks the following:

> Location (includes the project address which NHDES uses to develop a GIS coverage);
> Waterbody Name;
> Area of the lot;
> Existing area of impervious surface;
> Post-Construction area of impervious surface;
> Post-Construction area of alternative technologies used;
> Post-Construction area of buffer restored; and
> Post-Construction area of disturbed area excluding impervious surface.

Other information that might be useful for determining nitrogen loads such as drainage area, land use type, BMP type and condition, whether the project was actually constructed, etc., are not tracked in the database. To determine if this information is available, individual project files would need to be reviewed.

Data was first entered into the database in 1998, which is the first year SWQPA permits were issued. Since 2008, approximately 652 permit applications have been processed in the Connecticut River basin.

Relative changes in program scope and effectiveness (1990 to present):

The SWQPA was first enacted in 1991, however permits were not required until 2008. Consequently, since 2008, the program has become much more focused and effective.

Qualitative assessment of nitrogen reductions (1990 to present): The requirement to obtain permits in 2008 significantly increased the program's effectiveness. Assuming this translates to increased nitrogen removal as compared to pre-2008 efforts, the program is on the right track to reduce the impacts of projects which fall under the purview of this program.

[10] See http://des.nh.gov/organization/commissioner/legal/rules/documents/env-wq1400.pdf

5.1.3 Section 401 Water Quality Certification Program

Description: The purpose of the Water Quality Certification (WQC) program is to protect surface water quality and uses (such as swimming and aquatic life) by ensuring compliance with State surface water quality standards. Examples of surface waters include lakes, ponds, rivers, streams, wetlands and tidal waters. The WQC program is authorized by NH RSA 485-A:12, III and IV. WQC for federal National Pollutant Discharge Elimination System (NPDES) permits are administered by the NHDES Wastewater Engineering Bureau. All other WQCs are administered by the NHDES Watershed Management Bureau. WQCs typically include enforceable conditions, including monitoring requirements, to ensure compliance with surface water quality standards.

Section 401 of the federal Clean Water Act (CWA) requires any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities that may result in any discharge into navigable waters, to provide the licensing or permitting agency with a certification from the state where the discharge originates or will originate, that the discharge will meet state surface water quality standards. It is important to note that the WQC must be written to ensure that both the construction (if applicable) and operation of the facility will comply with state surface water quality standards. Examples of projects that require WQC under section 401 of the CWA include activities that require a CWA Section 404 permit from the U.S. Army Corps of Engineers (ACOE) for the discharge of dredged or fill material in navigable waters, hydropower projects requiring a Federal Energy Regulatory Commission (FERC) license, and discharges of wastewater and/or stormwater that require a U.S. Environmental Protection Agency NPDES permit.

There are two types of Section 404 ACOE permits: an individual permit and the New Hampshire Programmatic General Permit (PGP). Projects determined by the Army Corps of Engineers to require an individual Section 404 permit must file an application with and receive a WQC from the NHDES Watershed Management Bureau. The PGP is a general permit, which is issued every five years. Prior to issuance, NHDES issues a 401 Water Quality Certification for the PGP. In general, the conditions in the PGP 401 WQC require all eligible projects to meet New Hampshire surface water quality standards. Since PGP projects are already covered by the PGP 401 WQC, most applicants do not need to do anything more with regards to obtaining 401 Water Quality Certification approval. However, NHDES may modify the PGP 401 WQC for any Programmatic General Permit project to include more specific conditions to ensure compliance with surface water quality standards. NHDES will notify applicants in advance if their project requires modification of the PGP 401 WQC.

For all projects requiring 401 WQC (except those applying for an NPDES permit), applicants must submit a complete WQC application to the NHDES Watershed Management Bureau. With regards to nonpoint source nitrogen loading, many development projects involving landscape change impact wetlands and therefore require a Section 404 permit from the U.S. Army Corps of Engineers (ACOE). Most projects fall under the 404 PGP and, therefore (for reasons previously discussed) don't require further action with regards to 401 WQC. The few projects which require an individual 404 permit require an individual 401 WQC.

Certifications include conditions necessary to ensure compliance with applicable surface water quality standards. For development projects conditions typically include surface water monitoring, erosion protection during construction, implementation and maintenance of permanent stormwater BMPs designed per the Alteration of Terrain regulations and reporting requirements. Since around 2005, and depending on the type of project, many applicants are required to conduct pollutant loading analyses to satisfy antidegradation requirements. The goal of the analysis is to show that post development loadings do not exceed existing loadings. Total suspended solids, total nitrogen and total phosphorus are typically modeled. Many projects that require 401 WQC also require a NHDES Alteration of Terrain permit which includes other requirements for abating stormwater pollution (see section 5.1.1).

Available data, data gaps and GIS coverage (1990 to present): The 401 WQC program has records going back to about the mid-1980s. Prior to 2000, records are scant and only in hard-copy form. From 2000 to the present information is in a combination of electronic and hard-copy form. A GIS coverage specifically for 401 WQC projects does not currently exist.

An Excel spreadsheet is used to track the status of current water quality certifications. To obtain specific information that would be useful for estimating nitrogen loads (such as project location, drainage area, land coverage, BMPs, pollutant loading, etc) the electronic and/or hard copy files would need to be reviewed.

Since 2005, approximately 14 pollutant loading analyses demonstrating no additional nitrogen loading have been conducted for the 401 WQC program. Three were in towns located wholly (Lebanon) or partially (Berlin and Warren) within the Connecticut River basin.

Relative changes in program scope and effectiveness (1990 to present): The major change regarding program effectiveness began around 2005, when applicants proposing projects with significant land use change (and associated changes in pollutant loading), were required to conduct pollutant loading analyses as discussed above.

Qualitative assessment of nitrogen reductions (1990 to present): As discussed above, since 2005, development projects requiring 401 WQC associated with individual Army Corps section 404 permits and which involve significant landscape change have conducted pollutant loading analyses demonstrating no significant change in loadings for nitrogen, as well as phosphorus and total suspended solids. For projects that were issued 401 WQCs prior to 2005, the majority also required Alteration of Terrain permits which are discussed in section 5.1.1.

5.1.4 Wetlands Permit Program

Description: Land development and other human activities that require dredging, filling, and construction in wetland and surface water resources can impact the functions and values of wetlands and surface waters, such as wildlife habitat, water quality renovation, or flood storage and desynchronization, among others. The purpose of the wetlands permit program is to protect and preserve submerged lands under tidal and freshwaters and its wetlands (both salt water and fresh-water) from unregulated alteration that would adversely affect the natural ability of wetlands to absorb flood waters, treat stormwater and recharge groundwater supplies, impact fish and wildlife of significant value and depreciate or obstruct the commerce, recreation and the aesthetic enjoyment of the public. Statutory authority and regulations for issuing wetland permits are provided under RSA 482-A and Env-Wt 100-900 respectively. The wetlands permit program is administered by the NHDES Wetlands Bureau.

A wetlands permit is required whenever a project proposes to do work in a jurisdictional area. Examples of jurisdictional vegetated wetlands include, but are not limited to swamps, bogs, marshes, forested wetlands, wet meadows and vernal pools. Wetlands that have been municipally designated as prime wetlands and have a 100 foot prime wetland buffer zone are also considered jurisdictional wetlands. Jurisdictional surface waters include, but are not limited to: lakes, ponds, tidal waters, rivers and streams, including their beds and banks. All land within 100 feet of the highest observable tide line, known as the tidal buffer zone, is also considered a jurisdictional wetland area.

The types of activities that would require a wetland permit include, but are not limited to, construction of roadways through wetlands under non-frozen conditions, installation, replacement or modification of culverts, pond construction that is not for an active farm, beach construction or replenishment of beach sand, constructing and repairing boat houses, breakwaters and/or docking structures, installing watercraft lifts, and construction repair or modification of any retaining wall in a jurisdictional area. In order to protect the resource during construction and until the disturbed area is completely stabilized, wetland permits typically require implementation of appropriate erosion / sediment control measures .

State law requires that dredging and filling of jurisdictional areas must be avoided and impacts minimized. Mitigation for wetland losses is a requirement of most wetland permits[11]. The purpose of mitigation is to achieve no net loss of wetland functions and values from development projects. A functional assessment is an evaluation of a wetland to determine the functions and values it performs within the context of the broader landscape and must be completed by a qualified professional. Once the functions and values to be lost are identified, compensatory mitigation can be provided to achieve the replacement or protection of similar functions and values lost through a project. When the impacts are significant, the permittee is required to compensate for the loss of the functions and values. NHDES requires that certain projects mitigate for the impacts by conducting one (or more) of the following activities:

1. Restoring a previously existing wetland
2. Creating a new wetland, or
3. Preserving land (at least 50 % upland) to protect the values of the adjacent wetlands or water resource.

In 2006, the wetlands program created the Aquatic Resource Mitigation Fund (ARM) Fund. The ARM Fund was established by enactment of RSA 482-A:28 through RSA 482:33 to provide wetlands permit applicants with an additional option to address federal and state mitigation requirements when impacts to jurisdictional wetlands and other aquatic resources are permitted that require mitigation. NHDES manages and implements the ARM Fund in accordance with both the state statutory requirements (RSA 482-A:28-32) and a Memorandum of Understanding between NHDES and the United States Army Corps of Engineers that ensures consistency and compliance with federal standards. The ARM Fund Program provides wetlands permit applicants with the option to contribute payments to this fund in lieu of implementation of several other possible and more traditional compensatory mitigation alternatives. These other wetlands mitigation options might include restoration of existing impaired wetlands, land acquisition and preservation, or construction of new wetlands. In many circumstances, these other options may be more costly, time consuming or complex to implement for the wetlands permit holder as compared with an ARM Fund contribution.

Available data, data gaps and GIS coverage (1990 to present): Hard copies of wetlands permits and supporting information are currently maintained by the Wetlands Bureau. However, on-going efforts to reduce file storage needs by culling historical files will reduce the number of files available for retrieval and review in the future. The wetlands program shares a GIS/Foxpro database with the NHDES Shoreland Protection program. In addition to general project and applicant information, the database also tracks the following:

- File / permit number;
- Action date;
- Owner / Applicant contact information and a list of abutters;
- Project name, general description and location (community, county, lot and tax map number);
- Receiving water name;
- Area of disturbance / restoration / mitigation
- Description of project and the mitigation associated with the project; and
- Type of stormwater BMPs proposed (i.e., siltation fencing, siltation booms, temporary or permanent detention ponds, infiltration basins, etc.).

The number of wetlands permits issued varies per year but on average, statewide, the Wetlands Bureau issues approximately 2,000 to 3,000 permits per year across the state. Wetland application data was first entered into the database in 1998. Since then, approximately 6870 permit applications have been processed in the Connecticut River basin. This number represents the number of applications received and not necessarily what was actually constructed, restored, mitigated. Other information that might be useful for determining nitrogen loads such as drainage area, land use type, BMP type and condition, whether the project was actually constructed, etc, are not tracked in the database. To determine if this information is available, individual project files would need to be reviewed.

[11] Mitigation is not required for "minimum impact" projects as defined in Env-Wt 303.03 or Env-Wt 303.04

Relative changes in program scope and effectiveness (1990 to present): The State of New Hampshire began regulating activities in wetlands in 1967. The administrative rules Env-Wt 100-900 requiring permits for activities in wetlands were enacted in 1969. Significant changes to the administrative rules since that time includes enforcement authority granted to the State in 1978. After 1978, most changes to the Statue and Rules were of an administrative nature with the exception of 2006 when the Aquatic Resource Mitigation Fund (ARM) Fund was created (discussed above).

Qualitative assessment of nitrogen reductions (1990 to present): As stated above, wetland permits typically require detailed erosion control plans and BMPs that must be in place prior to construction and until the disturbed area is completely stabilized. As erosion from construction can result in deposition of sediment containing nitrogen, such measures have helped to minimize nitrogen loadings during construction. In addition, the requirement to mitigate for all losses of wetlands, with a goal of no net loss of wetland function or value, has further helped to minimize changes in nitrogen loadings due to development.

5.1.5 NH Department of Transportation (NHDOT) Highway Projects:

Description: The purpose of the New Hampshire Department of Transportation (NHDOT) is to " provide safe and secure mobility and travel options for all of the state's residents, visitors, and goods movement, through a transportation system and services that are well maintained, efficient, reliable, and provide seamless interstate and intrastate connectivity." Many of the construction projects sponsored by DOT would normally require an Alteration of Terrain (AoT) permit (see section 5.1.1) which would address water quality concerns associated with stormwater runoff. However, in accordance with RSA 485-A:17 [12], NHDES has historically exempted NHDOT highway projects and since 2003, all NHDOT projects (i.e., public works and highway) from having to obtain an AoT permit, provided DOT incorporates practices that are substantially equivalent to those required in the AoT program. Since 2003, NHDES and NHDOT have had Memorandum of Agreements (MOAs) that defines how NHDOT will incorporate BMPs for erosion control and stormwater management that are substantially equivalent to AoT requirements.

Available data, data gaps and GIS coverage (1990 to present): DOT maintains a GIS database which tracks the following stormwater BMP attributes:

BMP Type;
Asset Id;
Owner;
Date the BMP went into service;
Location (Northing and Easting Coordinates, as well as a narrative description); and
Contract Number.

As shown in Table 5, three underground BMPs, four constructed wetlands, and five dry detention basins have been constructed, or are under construction to control highway stormwater runoff in the Connecticut River basin since 1983. Only one of these BMPs (constructed wetland) was in place prior to 1990 (a constructed wetlands). According to NHDOT, BMP maintenance is a standard part of the DOT highway program.

[12] RSA 485-A:17, III. Normal agricultural operations shall be exempt from the provisions of this section. The department may exempt other state agencies from the permit and fee provisions of this section provided that each such agency has incorporated appropriate protective practices in its projects which are substantially equivalent to the requirements established by the department under this chapter.

Table 5: DOT Stormwater BMPs in the Connecticut River Basin (1983 to 2012)

Type	Asset_Id	Owner	In_Service	Northing	Easting	Contract	Location
Underground	020	PS 405	2/29/2004	141490.539	747598.666	11999	NH Route 9 at Connecticut River Vortechs
Underground	044	PS 207	6/15/2006	418086.466	848355.211	13185A	NH Route 4A
Underground	051	PS 405	2/29/2004	141495.478	747629.440	11999	NH Route 9 Connecticut River
Underground	058	PS 412	7/1/1999	148656.990	875484.083	12268	NH Route 101 at Old Common Road
Constructed Wetland	099	PS 105	1/26/1983	665231.944	948233.611	P3874M	I-93 Exit 43
Constructed Wetland	133	PS 407	12/16/1996	184936.239	852345.639	P2445A	NH Route 9 WB On-Off Ramp Loop
Constructed Wetland	134	PS 407	12/16/1996	184645.897	852324.600	P2445A	NH Route 9 EB On-Off Ramp Loop
Dry Detention	136	PS 213	9/28/1998	314260.510	836345.262	10644	NH Route 11 & 103 and Chandlers Mill Road
Dry Detention	137	PS 213	9/28/1998	314108.015	836690.093	10644	NH Route 11 & 103 and Chandlers Mill Road
Dry Detention	170	PS 224	Under Construction	412859.340	811717.796	11700A	I-89 SB On-Ramp Exit 20 (D Pond 1)
Dry Detention	171	PS 224	Under Construction	413336.014	811044.251	11700A	I-89 NB On-Ramp Exit 20 (D Pond 2)
Dry Detention	172	PS 224	Under Construction	413021.424	810812.342	11700A	I-89 SB Off-Ramp Exit 20 (D Pond 3)

The NHDOT database does not track BMP design characteristics that might assist with nitrogen loading estimates such as drainage area, land use(s), impervious cover, how the BMPs were sized or how well the BMPs have been maintained. Assuming this information is available, individual project files would need to be reviewed for this information.

Relative changes in program scope and effectiveness (1990 to present): NHDOT program effectiveness is expected to closely parallel that of the AoT program since NHDOT stormwater BMPs must be substantially equivalent to AoT requirements (see section 5.1.1).

Qualitative assessment of nitrogen reductions (1990 to present): Since NHDOT BMPs for stormwater control must be substantially equivalent to AoT program requirements, the qualitative assessment is expected to be similar to that of the AoT program (see section 5.1.1).

5.1.6 Municipal Practices

Description: Although none of the New Hampshire's municipalities in the Connecticut River basin are regulated under the USEPA Municipal Separate Stormwater System (MS4) NPDES general permit, many of the communities most likely implement best management practices such as street sweeping, catch basin cleaning, etc. which can reduce nitrogen loads to surface waters. Further since the 1990s, it is likely some towns have implemented improved site plan requirements relative to stormwater management.

Available data, data gaps and GIS coverage (1990 to present): The individual communities would need to be contacted to determine the type and availability of their BMP data. This was not done as it was considered by NHDES to be beyond the scope of this qualitative study.

Relative changes in program scope and effectiveness (1990 to present): See above.

Qualitative assessment of nitrogen reductions (1990 to present): As mentioned above the municipalities would need to be surveyed for specifics regarding the BMPs they implement that could reduce nitrogen loads in the Connecticut River basin as well as local site plan requirements relative to stormwater management . This was not done as it was considered by NHDES to be beyond the scope of this qualitative study.

5.2 Agriculture Programs

5.2.1 New Hampshire Department of Agriculture Programs

Description: The New Hampshire Department of Agriculture (NHDA), Division of Regulatory Services is responsible for assuring compliance with New Hampshire laws and regulations governing the marketing of certain farm commodities, including the regulation of feed, seed and fertilizer. In consultation with the USDA Natural Resources Conservation Service and the UNH Cooperative Extension, the Division publishes and distributes the *Manual of Best Management Practices for Agriculture in New Hampshire* [13] to educate

[13] See http://agriculture.nh.gov/divisions/markets/documents/bmp.pdf

landowners of ways to protect water quality. In accordance with State law (RSA 431:33), the Division is also responsible for investigating complaints involving mismanagement of manure, agricultural compost and chemical fertilizer. Complaint response focuses on non-punitive methods and includes collaboration with the New Hampshire Department of Environmental Services where appropriate.

The Regulatory Division also administers the Agricultural Nutrient Management (ANM) grant program which was enacted by the New Hampshire Legislature in 2001. The primary purpose of the program is to assist agricultural land and livestock owners with efforts to prevent or mitigate water pollution by better managing agricultural nutrients including commercial fertilizers, animal manures and agricultural composts. Applicants may apply for cost assistance up to $2500. Examples of ANM projects include the following all of which can reduce nitrogen levels to varying degrees:

- Fencing livestock out of surface water;
- Controlled wetland crossings;
- Concrete pads or roofs for manure/compost storage;
- Barn roof gutters/downspouts;
- Pasture pumps or other watering systems as alternatives to surface water sources; and
- Vegetated buffers/divergence berms.

Available data, data gaps and GIS coverage (1990 to present): According to NHDA staff, ANM project records are kept in both hard copy form and in an electronic database (spreadsheet). Database attributes include the Grant Number, Farm Name, Owner/Contact, Town, Inspector, Type (i.e., the source of the nutrient problem such as cattle, equine, etc.), Project Name, Grant Award Amount, Match, Final Report Receipt Date, Inspection Date, Phone Number and Due Date. NHDA does not maintain a GIS data layer and its database does not include BMP specifics that might be useful for determining nitrogen load reductions such as the exact location of each BMP, it's condition, acres of crop management, drainage area to BMPs, etc. although some of this information may be available in the hard copy files.

NHDA also collects data on commercial fertilizer sold in New Hampshire. Each person distributing commercial fertilizer in the state is required to provide a semi-annual tonnage report. NHDA then transmits this data each year to the National Agricultural Statistics Service, who then compiles the information and creates a final report.

Relative changes in program scope and effectiveness (1990 to present): With regards to program activities that might impact nitrogen loads from agricultural lands, technical assistance, outreach and education efforts by NHDA staff have been on-going prior to the 1990. Publication and distribution of the *Manual of Best Management Practices for Agriculture in New Hampshire* in its present format has been on-going since around 1995 with regular updates made every few years. Prior to that other documents were used to educate landowners on how to manage agricultural practices in a manner that protects resources. Enactment of the ANM in 2001, has probably had the most impact on nitrogen loads since 1990. Based on the ANM database provided by the NHDA, it is estimated that a total of approximately 69 ANM grants totaling $156,862 have been awarded in the Connecticut River basin from 2001 to 2012[14]. A breakdown of these projects by year and county is provided in Figure 21.

Qualitative assessment of nitrogen reductions (1990 to present): As discussed above, since the ANM grant program was enacted in 2001, the NHDA has awarded approximately $156,862 for 69 projects in the Connecticut River basin and continues to provide on-going technical assistance and public education/outreach efforts to educate landowners on ways to prevent agricultural practices from adversely impacting surface water quality. Without more detailed analysis it is difficult to quantify the impact of ANM efforts on nitrogen levels

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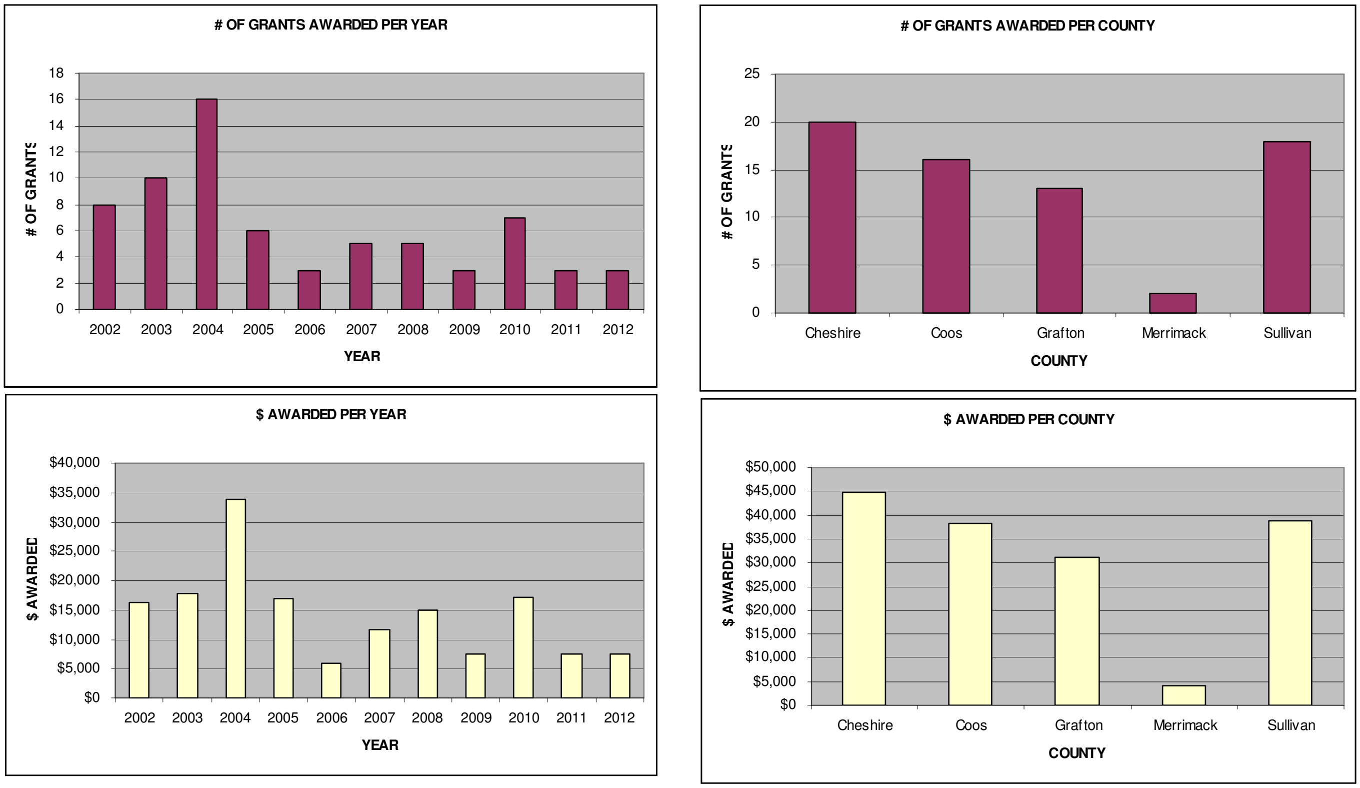
[14] Totals include ANM projects that were completed in towns that are entirely or partially within the CT River basin.

in the Connecticut River basin, however, from a qualitative standpoint, NHDA programs have certainly helped to reduce the impact of agricultural practices on surface water quality.

Figure 21: NHDA Agricultural Nutrient Management Awards (2002-2012)



5.2.2 NRCS Programs

Description: The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers the following conservation programs many of which are currently funded from the 2008 Farm Bill appropriations and can result in implementation of agricultural best management practices (BMPs) that could reduce nitrogen levels:

Agricultural Management Assistance (AMA)

Environmental Quality Incentives Program (EQIP)

Conservation Stewardship Program (CSP)

Wildlife Habitat Incentives Program (WHIP)

Grassland Reserve Program (GRP)

Healthy Forest Reserve Program (HFRP)

Wetland Reserve Program (WRP)

As reported on the NRCS website [15], participation in any of the above conservation programs is voluntary. Interested clients contact the local NRCS Conservation Planner to discuss problems with their land that they want to correct. A site visit is then conducted and a Conservation Plan is developed. Financial assistance may be available to help implement certain practices in the Conservation Plan. If the client is interested they then submit a completed application to NRCS. If the land and landowner are eligible, the Conservation Planner then prescreens the application to determine priority. Applications are approved based on the availability of funds, with the highest priority and highest ranking application being funded first. NRCS policy ensures owner

[15] http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/

confidentiality. NRCS typically provides approximately two to five million dollars in financial assistance each year.

Since NRCS is not regulatory and participation in their programs is voluntary, NRCS does not share data that may contain personal identifiable information of its clients, or could be linked to one particular tract of land that would make it possible to identify the owner. The data is input into the national database at the time of planning.

Available data, data gaps and GIS coverage (1990 to present): The Concord, New Hampshire office of NRCS was contacted for information regarding agricultural BMPs associated with NRCS conservation programs in the NH portion of the Connecticut River basin. The NRCS has been collecting data ever since the NRCS/SCS (Soil Conservation Service) started planning conservation practices, but not in the same database. The data is a record of the conservation plan and the contractural obligations for cost share activities. Data is input into the National Conservation Planning Database when a client applies for an NRCS program. In accordance with NRCS policy, which protects the confidentiality of conservation program participants, certain records are deemed to be sensitive and confidential (such as the exact location and owner) and cannot be shared with the public.

NRCS does not have a single digital source for data going back to around 1990. Sometimes only paper files are kept and some information on expired contracts are no longer available. Data can be extracted from the enterprise database into an ESRI geodatabase. Extraction capabilities were made possible at the state office level about two years ago.

Extraction for the Connecticut River watershed in New Hampshire produced 636 records for the period 2003-2011. Table 6 shows a summary of this data arranged by town and acreage or number of agricultural BMPs implemented. Definitions of the NRCS practice codes (i.e., #313, #317, etc) are provided in Table 7.

Table 6: USDA NRCS Agricultural BMP Statistics by Town (2003 to 2011)

Town	Number of Waste Storage Facilities (NRCS #313)	Number of Compost Facilities (NRCS #317)	Acres of Conserva-tion Cover (NRCS #327)	Acres of Cover Crop (NRCS #340)	Acres of Field Border (NRCS #386)	Acres of Riparian Herbaceous Cover (NRCS #390)	Area of Riparian Forest Buffer (NRCS #391)	Acres of Pre-scribed Grazing (NRCS #528)
ACWORTH	2			33.4				31.5
ALSTEAD	1		0.5	18.4				
BATH			2.2	30			7.6	80.9
BRADFORD				242.6				
CANAAN			3.8					4.1
CHARLESTOWN			3.5					
CLAREMONT	7		0.5	4.3			1	7.5
COLEBROOK			20.9					
CORNISH	3			7.7				72.7
CROYDON	1							4.8
DUBLIN				1				
ENFIELD			0.2	8.7				6
ETNA								44.1
FITZWILLIAM				0.8			0.8	

Town	Number of Waste Storage Facilities (NRCS #313)	Number of Compost Facilities (NRCS #317)	Acres of Conserva-tion Cover (NRCS #327)	Acres of Cover Crop (NRCS #340)	Acres of Field Border (NRCS #386)	Acres of Riparian Herbaceous Cover (NRCS #390)	Area of Riparian Forest Buffer (NRCS #391)	Acres of Pre-scribed Grazing (NRCS #528)
FRANCONIA			0.1	2.2				27.6
GOSHEN		1	2					
GROVETON	1	1	4					
HANOVER			7.2					
HAVERHILL	2		1.2	359.5			0.8	219.2
HOLLIS			0.4					
JEFFERSON			1				0.1	
KEENE	1	2		5.9		2		2.1
LANCASTER	1						3	18.5
LANDAFF	1			224.5				
LANGDON	1							30
LUNENBURG,VT							2.6	
LYME	1		1.6	40			0.1	76
MARLBOROUGH							2	
MERIDEN							0.3	
MILAN								14
MONROE								24.6
NELSON				0.1				
NEW HAMPTON			3					
NEW LONDON		1						
NEWBURY			1					
NEWPORT			6.7	0.5			1	4.8
NORTH HAVERHILL				503.2				76
NORTH STRATFORD	2							
NORTHFIELD					50		5	
ORFORD	1		3	93.4				234.3
PIERMONT	2		0.4	253.5				251.2
PIKE			18.5					63.9
PITTSBURG								48
PLAINFIELD	2			6.7				
SPOFFORD								13.9
STEWARTS-TOWN	1						2.2	
SUGAR HILL								15.8
SULLIVAN			2.7					
SUNAPEE								18.5
TROY							4.3	

Town	Number of Waste Storage Facilities (NRCS #313)	Number of Compost Facilities (NRCS #317)	Acres of Conserva-tion Cover (NRCS #327)	Acres of Cover Crop (NRCS #340)	Acres of Field Border (NRCS #386)	Acres of Riparian Herbaceous Cover (NRCS #390)	Area of Riparian Forest Buffer (NRCS #391)	Acres of Pre-scribed Grazing (NRCS #528)
WALPOLE	2		3.5	56.6				71.8
WEST CHESTER-FIELD							0.9	5.2
WEST SWANZEY							1	
WESTMORE-LAND	1			96.8				45.7
WINCHESTER			1	35.2			6.4	
WINDSOR							9	
WOODSVILLE								6
TOTAL	33	5	88.9	2025	50	2	48.1	1518.7

Table 7: Definition and Purpose of NRCS Practice Codes

NRCS Practice Code # and Title	Definition	Purpose
313 Waste Storage Facility	A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.	To temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.
317 Composting Facility	A structure or device to contain and facilitate the controlled aerobic decomposition of manure or other organic material by micro-organisms into a biologically stable organic material that is suitable for use as a soil amendment.	To reduce the pollution potential and improve the handling characteristics of organic waste solids; and produce a soil amendment that adds organic matter and beneficial organisms, provides slow-release plant-available nutrients, and improves soil condition.
327 Conservation Cover	Establishing and maintaining permanent vegetative cover	This practice may be applied to accomplish one or more of the following: • Reduce soil erosion and sedimentation. • Improve water quality. • Improve air quality • Enhance wildlife habitat and pollinator habitat. • Improve soil quality • Manage plant pests

NRCS Practice Code # and Title	Definition	Purpose
340 Cover Crop	Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.	• Reduce erosion from wind and water. • Increase soil organic matter content. • Capture and recycle or redistribute nutrients in the soil profile. • Promote biological nitrogen fixation and reduce energy use. • Increase biodiversity. • Suppress Weeds. • Manage soil moisture. • Minimize and reduce soil compaction.
386 Field Border	A strip of permanent vegetation established at the edge or around the perimeter of a field.	This practice may be applied to accomplish one or more of the following: • Reduce erosion from wind and water • Protect soil and water quality • Manage pest populations • Provide wildlife food and cover and pollinator habitat • Increase carbon storage • Improve air quality
390 Riparian Herbaceous Cover	Grasses, sedges, rushes, ferns, legumes, and forbs tolerant of intermittent flooding or saturated soils, established or managed as the dominant vegetation in the transitional zone between upland and aquatic habitats.	This practice may be applied as part of a conservation management system to accomplish one or more of the following purposes • Provide or improve food and cover for fish, wildlife and livestock, • Improve and maintain water quality. • Establish and maintain habitat corridors. • Increase water storage on floodplains. • Reduce erosion and improve stability to stream banks and shorelines. • Increase net carbon storage in the biomass and soil. • Enhance pollen, nectar, and nesting habitat for pollinators. • Restore, improve or maintain the desired plant communities. • Dissipate stream energy and trap sediment. • Enhance stream bank protection as part of stream bank soil bioengineering practices.
391 Riparian Forest Buffer	An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.	• Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms. • Create or improve riparian habitat and provide a source of detritus and large woody debris. • Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow. • Reduce pesticide drift entering the water body. • Restore riparian plant communities. • Increase carbon storage in plant biomass and soils.

NRCS Practice Code # and Title	Definition	Purpose
528 Prescribed Grazing	Managing the harvest of vegetation with grazing and/or browsing animals.	This practice may be applied as a part of conservation management system to achieve one or more of the following: • Improve or maintain desired species composition and vigor of plant communities. • Improve or maintain quantity and quality of forage for grazing and browsing animals' health and productivity. • Improve or maintain surface and/or subsurface water quality and quantity. • Improve or maintain riparian and watershed function. • Reduce accelerated soil erosion, and maintain or improve soil condition. • Improve or maintain the quantity and quality of food and/or cover available for wildlife. • Manage fine fuel loads to achieve desired conditions.

Relative changes in program scope and effectiveness (1990 to present): The USDA has been assisting farmers for decades. However, in the mid-1990's there was a major shift in the number of agricultural BMPs actually implemented when the 1996 Farm Bill provided appropriations to finance BMPs. Since the mid-1990s, two to five million dollars in financial assistance has been typically awarded to farmers each year by NRCS. NRCS has recently initiated a Long Island Sound Initiative (LISI) whereby a pool of money will be set aside for agricultural BMPs that will benefit water quality in the Long Island Sound. The LISI will be funded through the EQIP program.

Qualitative assessment of nitrogen reductions (1990 to present): As shown in Table 6, 33 manure facilities, 5 compositing facilities, and approximately 3733 acres of various crop and farm land management practices have been implemented in New Hampshire within the Connecticut River watershed since 2003. Additional practices have been implemented prior to 2003 but records are not readily available. In addition, the newly created NRCS Long Island Sound Initiative will fund more projects in the Connecticut River basin through the EQIP program that will benefit water quality in Long Island Sound. Many of the existing and proposed practices have the potential to reduce nitrogen levels. For example, proper management of manure can prevent raw manure from being deposited directly or washed into surface waters during storms, and various farmland crop and cover practices can reduce the amount of erosion and deposition of nitrogen laden soil into surface waters. It is difficult to quantify the amount of nitrogen which has been removed since 1990 without more information.

5.2.3 Concentrated Animal Feeding Operations (CAFO) Permits

Description: According to the USEPA[16] "Animal Feeding Operations (AFOs) are agricultural operations where animals are kept and raised in confined situations. AFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland."

An operation is considered an AFO if animals are confined for at least 45 days in a 12-month period, and there is no grass or other vegetation in the confinement area during the normal growing season.

Concentrated Animal Feeding Operations (CAFOs) are AFOs that meet certain EPA criteria. CAFOs require a federal National Pollutant Discharge Elimination System (NPDES) permit and make up approximately 15

[16] See http://www.epa.gov/region07/water/cafo/index.htm.

percent of total AFOs. Since New Hampshire is not a delegated state, CAFO permits in New Hampshire are issued by EPA Region 1.

Available data, data gaps and GIS coverage (1990 to present): According to NPDES permitting staff at EPA Region 1, no CAFO permits have been issued to date in the New Hampshire portion of the Connecticut River basin. EPA is, however, in the process of reviewing one CAFO permit application submitted by the Forbes Farm Partnership in Lancaster New Hampshire.

Relative changes in program scope and effectiveness (1990 to present): Not addressed since no CAFO permits have been issued in New Hampshire.

Qualitative assessment of nitrogen reductions (1990 to present): Not addressed since no CAFO permits have been issued in New Hampshire.

5.3 Other Nonpoint Source Programs

5.3.1 Individual Sewage Disposal Systems (i.e., Septic Systems)

Description: The NHDES Subsurface Systems Bureau is responsible for the review and issuance (or denial) of individual sewage disposal systems (i.e., septic system) permits. In particular, the bureau is responsible for the following activities:

- Review of applications for the subdivision of land and the design of individual sewage disposal systems (ISDS).
- On-site inspections of all ISDS installed in order to ensure strict compliance with the approved plans.
- Administration and implementation of the program for licensing both designers and installers of ISDS. No individual may submit an application nor install a septic system without first obtaining a license from this bureau.
- Investigation of written complaints received by the Department of Environmental Services relative to situations which are or may be causing degradation of the state's waters due to failed or failing ISDS.
- Coordination with other necessary permits involved in a particular project or development.

Rules regarding design of subsurface disposal systems are included in Env-Wq 1000 [17].

Available data, data gaps and GIS coverage (1990 to present): To determine the nitrogen loading from ISDS on the Connecticut River, it would be useful to have the location, size, type (i.e., nitrogen removal) and age of each ISDS. Unfortunately, the NHDES Subsurface Bureau does not currently have a searchable database or GIS layer that would allow one to readily determine any of this information. To obtain such information one would have to manually search through individual hard-copy files which would be extraordinarily time-consuming and labor intensive. At the present time, files going back to 2008 are maintained in the NHDES Concord office and other regional offices. Older files are archived in the State archive building and would be difficult to access. Fortunately, the Subsurface Bureau is in the process of developing a new database which is expected to be operational in 2013. Through the NHDES One Stop (http://des.nh.gov/onestop/index.htm), the new database will provide access to all aspects of an application including the approved plan, location/address of the site, GPS coordinates, type of system including the type of effluent disposal (e.g., stone or pipe), and the type of pretreatment system as applicable.

The NHDES Wastewater Engineering Bureau was also consulted to see if they had information regarding areas that were sewered and treated at the wastewater treatment facility in 1990 and presently. Unfortunately, a searchable database with this information is not available. To obtain this information, it would be necessary to

[17] See http://des.nh.gov/organization/commissioner/legal/rules/documents/env-wq1000.pd

search individual hard-copy files, which would be very resource and time intensive and there is no guarantee the information would be found for all communities.

Information on areas and population served by sewers in 1990 and present may be available from the towns. Using 1990 and 2010 U.S. Census population estimates for each town, the difference between the total population and the estimated sewered population would provide an estimate of the population served by septic systems in each town in 1990 and 2010. These values could then be multiplied by the typical mass of nitrogen generated by each person per year to yield the estimated annual nitrogen loading discharged to septic systems in 1990 and 2010. To determine the delivered nitrogen load to the Connecticut River and LIS, attenuation factors would need to be applied to account for factors such as soil type and distance from the septic systems to surface waters which can impact the magnitude of the delivered load.

Relative changes in program scope and effectiveness (1990 to present):

The NHDES Individual Subsurface Disposal System rules have been revised three times since 1990 (i.e., in 1999, 2008 and 2011). For the most part there were no major changes that would have a significant impact on water quality with the exception that the rules now include an "Innovative and Alternative" approval process (Env-Wq 1024)[18]. The Innovative and Alternative approval process describes how NHDES approves technologies that improve the function of individual subsurface disposal sytems. For example, NHDES is currently reviewing an application for a pretreatment system which treats effluent to secondary standards and reduces nitrogen.

Qualitative assessment of nitrogen reductions (1990 to present):

Based on the above, there is little individual subsurface disposal system information that is readily available at NHDES that would allow one to assess how nitrogen loadings from these systems to the Connecticut River has changed since 1990. To estimate septic loading changes, population change in each town could be obtained from the U.S. Census. This information coupled with information provided by the towns regarding areas served by septic systems in 1990 and the present, could be used to estimate loads to the septic systems. To determine the delivered nitrogen load to the Connecticut River and LIS, attenuation factors would need to be applied to account for factors such as soil type and distance from the septic systems to surface waters which can impact the magnitude of the delivered load.

5.3.2 Section 319 Program

Description: Amendments made to the Clean Water Act in 1987 established the Section 319 Nonpoint Source Management Program. Under Section 319 states receive federal grant money to support a variety of nonpoint source activities such as technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to determine the success of specific nonpoint source implementation projects. Fiscal year 1990 was the first year of State implementation of nonpoint source programs with Congressional funding. Section 319 grant recipients are required to enter detailed information in the federal Grants Reporting and Tracking System (GRTS) which is the primary tool used by EPA for management and oversight of the EPA's Nonpoint Source (NPS) Pollution Control Program[19].

Available data, data gaps and GIS coverage (1990 to present): GRTS is the primary tool used to track progress of Section 319 funded projects. From 1990 to 2001, NHDES submitted the required information to EPA for upload into the GRTS database (Confirm with Jeff M). Prior to 2001, the system focused on limited aspects of Section 319 program implementation, such as where and how Section 319 money is spent. On September 27, 2001, EPA issued a memorandum regarding "Modifications to Nonpoint Source Reporting Requirements for

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[18] Personal communication with the DES Administrator of the Subsurface Systems Bureau
[19] See http://www.epa.gov/owow_keep/NPS/index.html

Section 319 Grants" [20]. The new reporting requirements became effective in 2002. According to the memorandum, the most significant new reporting elements include the following:

- More precise geolocation of Section 319 projects, which will enable projects to be linked to information from Section 303(d) and other programs, and which will allow tracking of water quality improvements.
- Reporting, where applicable, load reductions for nutrients and sediment.
- Reporting, where applicable, acres of wetlands restored and created and feet of streambank protected and stabilized.
- Providing a cost breakdown by main source category after project closeout.
- Providing a full description of each project.

A review of the GRTS database revealed nine projects in the Connecticut River basin with the potential to reduce nitrogen loadings since 1990 (Table 8). Two of the projects included estimates of nitrogen load reductions in GRTS. The total for these two projects was 27 lbs/year of nitrogen removed. Additional work would be needed to determine nitrogen load reductions for the other projects.

Table 8: Section 319 Projects in the Connecticut River Basin (1990 - 2012)

Award Fiscal Year	Project Name	Town	BMP Type	Nitrogen Load Reduction in GRTS (lbs/year)
1999	Beck Brook Runoff Response Program (B-99-CT-09)	Sunapee	Grade Stabilization Structure	6
2002	Bog Brook Restoration Project	Stratford	Channel Bank Vegetation, Stream Channel Stabilization	Not provided
2003	Sunapee Roadway NPS Reduction, Phase II	Sunapee	Catch Basins, Vegetated Filter, Infiltration Basin, Runoff Management System	21
2004	Bank Stabilization Implementation and Assessment of the Connecticut River near Colebrook and Groveton	Colebrook and Groveton	Conservation Easements, Grade Stabilization Structure, Stream Channel Stabilization, Tree/Shrub Establishment	Not provided
2004	Nash Stream Restoration Project	Odell, Stratford and Stark	Stream Channel Restoration	Not Provided
2005	Partridge Lake NPS Phosphorus Load Reduction Project	Littleton	Camp Road Crowning/Ditching	Not Provided
2007	Granite Lake Association Granite Lake Watershed Management Plan	Nelson and Stoddard	Road Ditch Creation/Improvements, Check Dams	Not Provided
2007	Stream Restoration at Lower Mohawk and Colebrook Industrial Park	Colebrook	Stream Channel Restoration (stream bed), Streambank and Shoreline Protection	Not Provided

[20] See http://www.epa.gov/owow/NPS/Section319/grts.html

Award Fiscal Year	Project Name	Town	BMP Type	Nitrogen Load Reduction in GRTS (lbs/year)
2010	Nash Stream Watershed Management Plan Implementation: Phase 2, Culvert Remediation/Instream Restoration	Odell, Stratford and Stark	Replace undersized culverts	Not Provided

Relative changes in program scope and effectiveness (1990 to present): As reported above, EPA made significant improvements to GRTS in 2001 which included a new web-enabled version of the program and requirements to report more accurate spatial information and estimated nutrient and sediment load reductions (where applicable).

The requirement to provide better project spatial information combined with the requirement to report estimated nutrient load reductions where applicable, greatly assists efforts to determine nitrogen load reductions associated with specific projects in the Connecticut River basin.

Qualitative assessment of nitrogen reductions (1990 to present): As reported above, nine New Hampshire Section 319 projects in the Connecticut River basin were identified as having the most potential to result in nitrogen reductions. The GRTS database included nitrogen reduction estimates for two of the projects which totaled 27 lbs/year. These projects were all implemented after 1990, the baseline year for the Long Island Sound TMDL. As mentioned above, the 2001 requirements to provide better spatial information and estimated nutrient load reductions where applicable indicates that the 319 program is on the right track with regards to documenting nitrogen reductions.

5.3.3 Fertilizer Legislation

Description: Efforts to reduce nitrogen (and phosphorus) loadings from fertilizer application is gaining momentum in New Hampshire. For example, the New England Governors' Committee on the Environment, along with the environmental agency commissioners from the New England states, has recently agreed to initiate in 2012 a voluntary regional approach to better control nutrient pollution from turf fertilizer. The goal will be to develop and implement voluntary region-wide guidelines for fertilizer formulation, management, sale and application to better control nutrients and improve water quality. The framework for this approach is outlined in a joint statement by the Commissioners entitled R*educing Nutrient Pollution through Voluntary Turf Fertilizer Guidelines* in which the Commissioners have expressed their common commitment to address nutrient pollution from turf fertilizer through voluntary guidelines related to the formulation, sale and application of turf fertilizer. A key component of this initiative, which will be led by the New England Interstate Water Pollution Control Commission (NEIWPCC), will be meeting in 2013 with stakeholder groups to develop final turf fertilizer guidelines that are mutually agreeable to regulators, industry representatives (which include manufacturers, retailers, golf course superintendents and landscapers) and non-industry stakeholders, such as watershed groups and homeowners. It is expected that this effort will ultimately result in voluntary agreements between stakeholders and the New England states.

In addition, on June 4, 2013, the Governor signed legislation (HB 393) passed by the NH House of Representative and the NH Senate which placed limitations on the nutrient content (total phosphorus and soluble and total nitrogen) in residential turf fertilizer. The law, which becomes effective January 1, 2014, is consistent with similar requirements recently enacted by statute in Maryland and New Jersey in 2011 and regulations adopted in Florida with respect to nitrogen content of fertilizers to address water quality problems in coastal waters.   These states have required virtually identical nitrogen concentrations in turf fertilizer to those proposed in HB 393.

Available data, data gaps and GIS coverage (1990 to present):   Not applicable

Relative changes in program scope and effectiveness (1990 to present): Not applicable

Qualitative assessment of nitrogen reductions (1990 to present): As discussed above, the recently passed fertilizer bill (HB 393) is expected to result in significant reductions in nitrogen loadings from residential turf.

6 SUMMARY AND RECOMMENDATIONS

6.1 Qualitative Assessment Summary

Although data gaps prevent a precise quantification of how nitrogen loadings delivered from New Hampshire to Long Island Sound (LIS) have changed since the early 1990s (the baseline for the 2000 TMDL), there is evidence that progress has, and continues to be made to reduce New Hampshire's contribution of nonpoint source nitrogen to LIS. Furthermore, it is possible that New Hampshire is meeting or is close to meeting the total nonpoint source reduction in the 2000 TMDL. As indicated in the following summary, nitrogen loadings from atmospheric deposition, which constitutes 65 percent of New Hampshire's total nitrogen load to LIS and is the state's largest source, have decreased by approximately 26 percent from 1990 to 2011. This exceeds the 2000 TMDL target reduction goal of 18 percent.   There is also evidence that nitrogen loadings from agricultural practices, which constitute approximately 16 percent of New Hampshire's total nitrogen load to LIS, and are the state's second largest source of nonpoint nitrogen, have also likely decreased significantly but by an unknown percentage. The smallest nonpoint source of nitrogen is the urban category which constitutes approximately seven percent of the total delivered nitrogen load from the state to LIS. Changes in population and developed land cover suggest that urban nitrogen loads may have increased since the 1990s, but only by a very small amount, if at all. More information would be needed to quantify the percent change and to confirm if urban loads have increased or decreased. Since the 1990s, many existing programs have been made more effective and new programs have been or are expected to soon be implemented to further reduce nitrogen loadings from nonpoint sources. As nitrogen control efforts continue, it is important to bear in mind that New Hampshire contributes only five percent of the total delivered nitrogen load to LIS (two-thirds of which is atmospheric), and the total elimination of nitrogen delivered from New Hampshire is predicted to improve the dissolved oxygen in LIS by an average of less than one percent or 0.03 mg/L.

*Atmospheric Nitrogen Load Reductions***:**

- According to the USGS SPARROW model (Moore et.al., 2004), atmospheric deposition of nitrogen represents approximately 65 percent of New Hampshire’s total nitrogen load in the Connecticut River basin.   As reported in the main body of this document , data from 34 eastern reference sites of the EPA Clean Air Status and Trends Network (CASTNET) indicate a decline in total atmospheric nitrogen deposition of approximately 26 percent from 1990 to 2011. This exceeds the 2000 TMDL atmospheric total nitrogen target reduction goal of 18 percent.

Nonpoint Urban Nitrogen Load Changes:

- Urban nonpoint sources are estimated to contribute four to seven percent of the total nitrogen load delivered from New Hampshire to LIS.

- From 1990 to 2010 the population in New Hampshire within the basin increased by approximately 19,046 people or 11.3 percent. This represents an average increase of 6.2 people per square mile. While this increase could imply an increase in nonpoint source nitrogen, it is difficult to determine with any certainty the actual change in loading, especially when the average increase per square mile is so small (6.2 people / square mile). For example, to determine the change in wastewater load, information would be needed on the number and location of additional people that use wastewater treatement plants or septic systems, how much nitrogen is removed at the treatment plants and how much of the nitrogen discharged from the septic systems is attenuated prior to reaching a surface water or LIS

- Developed land cover (which is a possible indicator of increased nitrogen loads) represents less than five percent of the total area of New Hampshire in the Connecticut River watershed. From 2001 to 2006, developed land increased by approximately 296 acres of which approximately 50 percent was associated with impervious cover and 50 percent with managed turf such as lawns, ballfields, etc. This represents an increase of only 0.31 percent and less than 0.02 percent of total area of New Hampshire in the watershed. Taken alone, and with respect to the stormwater pollutant loadings, this suggests that any increase in nitrogen loadings from developed land cover has been minimal. This is further supported by the following:

    - Not all impervious cover is directly connected to surface waters;

    - Some of the stormwater from the developed land is treated with best management practices to reduce stormwater pollutant loadings (such as those required by the New Hampshire Alteration of Terrain Permit (AoT), Shoreland Water Quality Protection Act (SWQRA) and the 401 Water Quality Certification (WQC) programs);

    - Any sites that have been redeveloped during this period would have been subject to new state, federal and local requirements. Some projects are regulated at the local level where some towns have likely implemented improved site plan requirements relative to stormwater since the 1990s.

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- The AoT, SWQRA , Wetlands and 401 WQC programs cover a large portion of development projects. AoT permits are required for projects that disturb more than 100,000 square feet of contiguous terrain, or 50,000 square feet, if any portion of the project is within a protected shoreland, or greater than 2500 square feet with a grade of 25 percent or greater which is located within 50 feet of any surface water. SWQRA permits are required for construction with approximately 250 feet of "protected" surface waters, wetland permits are required for any project which impacts jurisdictional wetlands or surface waters, and a 401 WQC is required for any project that may result in a discharge and which requires a federal license or permit (such as a Section 404 dredge and fill permit administered by the U.S. Army Corps of Engineers).

- Within the Connecticut River basin many permits have been issued which require stormwater best management practices including approximately 1000 AoT permits since 1986, approximately 652 SWQRA permits since 2008 and three certifications (with pollutant loading analyses) since 2005 under the WQC program. Since 2004, the AoT program has approved approximately 422 permanent stormwater best management practices in the basin. Many more were approved and installed prior to 2004.

- The AoT, SWQRA and 401 WQC programs have become more effective since 1990 with the development of the New Hampshire Stormwater Manual in 2009 (NHDES, 2008), the requirement to obtain SWQRA permits in 2008, and the condition, since 2005, that most development projects requiring an individual Section 404 permit submit a pollutant loading analyses for 401 WQC.

- Although none of the New Hampshire municipalities are currently subject to EPA's Municipal Separate Stormwater System (MS4) general permits, it is believed, though not confirmed, that many of the New Hampshire communities in the Connecticut River basin regularly implement best management practices that can reduce nitrogen loadings such as street sweeping and catch basin cleaning. It is also likely that some towns in the basin have developed and are implementing improved site plan requirements relative to stormwater since the 1990s.

- Since the Industrial General Permit program was implemented in 1992, and later the Multisector General Permit (MSGP) in 1995, many New Hampshire industrial facilities in the Connecticut River basin (approximately 100 since 2000) have filed NOIs and have developed and implemented SWPPPs to minimize contamination of their stormwater discharges. Though not quantified, this implies that since 1990, the MSGP program has very likely helped to reduce pollutants (including nitrogen) in stormwater discharges from industrial facilities in the Connecticut River basin.

- Erosion and deposition of sediment in surface waters from construction sites (and associated nitrogen loadings due to eroded sediment) has been regulated under the AoT program since 1985 and under the federal NPDES Construction General Permit (CGP) since 1992. In 2003, coverage under the CGP was expanded from projects disturbing 5 or more acres to those that disturb one or more acres. This increased the number of projects that must comply with the CGP which has likely helped to reduce construction related sediment/nitrogen loadings to surface waters.

- In the 1990s, the City of Lebanon had seven combined sewer overflows (CSOs) that discharged millions of gallons per year of stormwater and untreated sewage to the Connecticut River. The City is under a Consent Decree to eliminate all CSOs via separation by the end of 2020 and, to date, has eliminated three CSOs. Assuming the Lebanon secondary wastewater treatment facility, like other secondary treatment facilities, can remove 10 to 30 percent of influent nitrogen, nitrogen loadings to the Connecticut River due to CSOs may have been reduced since the 1990s due to the elimination of untreated sewage to the Connecticut River. However, to confirm if separation results in a net reduction in nitrogen loadings, further analysis is needed that also accounts for the difference in nitrogen loadings between stormwater that was treated at the WWTF prior to separation of the CSOs and the discharge of untreated stormwater after separation. The percent of nitrogen actually removed by the Lebanon wastewater treatment facility should also be determined.

Nonpoint Agricultural Nitrogen Load Reductions:

- Agricultural nonpoint sources are estimated to contribute 11 to 16 percent of the total nitrogen load delivered from New Hampshire to LIS.

- Agricultural land cover (which is a possible indicator of increased nitrogen loads) represents less than five percent of the total area of New Hampshire in the Connecticut River watershed.

- Although the USDA Census of Agriculture indicates that from 1992 to 2007 there has been an approximate 68% increase (431 farms) in the number of New Hampshire farms and an approximate 27.8 percent (30,128 acres) increase in the amount of land associated with New Hampshire farms in the Connecticut River basin, nitrogen loadings from agricultural land uses are believed to have decreased for the reasons below.

    - Of the four farm land uses (cropland, pasture, woodland and other uses) that comprise the total farm land area, approximately 89.5% (26,976 acres) of the total increase in farm land from 1992 to 2007 is associated with woodland, which is believed to have the least potential of the four categories to increase nitrogen loadings

    - The amount of cropland (which can be associated with high nutrient loadings if not properly mitigated due to application of manure and chemical fertilizers, etc.), decreased by approximately 7.1 percent (-2752 acres) from 1992 to 2007.

- Although the amount of pastureland increased by approximately 259 percent (7194 acres), the total number of reported cattle, equine, hogs and sheep decreased by 17.2 percent (-3094 animals) from 1992 to 2007 with cattle representing the greatest decline (-3057). Of these four animal categories, equine was the only one that increased (549 equine). The change in the number of goats and poultry could not be estimated in the Connecticut River basin but on a statewide basis the number of goats increased by 1125 while the number of poultry decreased by approximately 2368.

- The acres of farmland treated with commercial fertilizers from 1992 to 2007 has decreased by approximately 25 percent and the acres treated with manure from 2002 to 2007 has decreased by approximately 25 percent.

- The New Hampshire Department of Agriculture (NHDA) began administering the Agricultural Nutrient Management (ANM) program in 2001 to assist farmers with efforts to prevent or mitigate water pollution by better managing agricultural nutrients including commercial fertilizers, animal manures and agricultural composts. Since 2001, approximately 69 ANM projects have been implemented in the Connecticut River watershed.

- The NHDA in consultation with the USDA National Resource Conservation Service and the UNH Cooperative Extension updates and publishes the Manual of Best Management Practices for Agriculture in New Hampshire.

- The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers several conservation programs (such as the Environmental Quality Incentives Program or EQIP and the Agricultural Management Assistance Program or AMA) which can result in implementation of best management practices that reduce nitrogen loadings from agricultural practices. From 2003 to 2011, the conservation programs have constructed or implemented 33 manure facilities, 5 composting facilities and approximately 3733 acres of various crop and farmland best management practices in the Connecticut River basin.

Other Programs:

- Since 1990, the Section 319 program administered by the NHDES has funded nine projects involving implementation of best management practices in the Connecticut River basin, two of which were estimated by the grantees to result in a total nitrogen reduction of 27 lbs/year.

- The NHDES Subsurface Systems Bureau is responsible for the review and issuance (or denial) of individual sewage disposal systems (i.e., septic system) permits but does not currently have a searchable database that would facilitate determination of nitrogen loads from these systems (such as size, location and condition). Without this information it is difficult to determine the impact of septic systems on nitrogen loadings since the 1990s.

- Efforts to reduce nutrient loadings from fertilizer applied in New Hampshire are gaining momentum with the 2012 agreement by the New England Governor's Committee on the Environment along with the environmental commissioners from the New England states to initiate a voluntary regional approach to better control nutrient pollution from fertilizer. In addition, in June, 2013 the Governor signed fertilizer legislation passed by the New Hampshire legislature that places limitations on the nutrient content (phosphorus and nitrogen) in residential turf fertilizer similar to those recently enacted in Maryland and New Jersey.

6.2 Recommendations

- To confirm if the 2000 TMDL allocation is being met and to track the trend of all nitrogen control efforts, year-round ambient monitoring in the Connecticut River at the New Hampshire/ Massachusetts border is needed. Similar monitoring may be needed further upstream in the Connecticut River as well as in major tributaries to help determine the relative contributions from New Hampshire and Vermont. Such information could also be used to calibrate a nitrogen loading model. Additional funding would be needed to conduct this monitoring.

- If TMDL compliance is based on tracking load reductions, a common methodology for estimating the load reductions needs to be developed. The methodology should be comprehensive so that states can document as many types of nonpoint source nitrogen reductions as possible. Examples of reduction types include structural stormwater BMPs, agricultural BMPs, septic system loads, amount of fertilizer applied, street sweeping, cleaning catch basins, atmospheric loading, etc.

- Once the methodology is selected, data needed to populate the tracking database can be determined. Once the data needs are known, an analysis is needed to determine the feasibility of collecting this information. The results of this qualitative assessment suggests that much of the basic data typically needed to track and quantify loads from various BMPs (i.e. such as drainage area, land use characteristics of the drainage area, as well as BMP location, condition and size for stormwater BMPs; septic system location, size and condition; volume of sediment removed due to catch basin cleaning or street sweeping; etc.) is not currently available or readily available for most programs.

- Resources needed to input data and manage the tracking database are also a concern. NHDES does not currently have staff time to dedicate to this effort. Consideration should be given to allow other parties to populate the database. If made available to others, protocols would have to be developed to ensure proper quality assurance and quality control.

- The database discussed above would track nonpoint source BMP load reductions at the source. In order to predict the load reductions at LIS, a watershed model is needed that accounts for attenuation of nitrogen from the source to the LIS. The model should include point and nonpoint sources so that it can be calibrated to actual loads in the river. Funds would be needed to develop and run the model as well as to gather the water quality data needed to calibrate the model.

  Such a watershed model might help prioritize management efforts. For example, the USGS SPARROW model and the AVGWLF model categorize the nonpoint source loads into those associated with urban and agricultural land uses. They do not further differentiate the major nitrogen sources within urban and agricultural lands. For example, distinguishing the nitrogen load from fertilizer, animal waste, human waste (i.e. septic systems) or atmospheric might help guide management decisions and efforts to develop a tracking system. To help identify the major sources of anthropogenic nonpoint sources of nitrogen in the watershed, it might be useful to develop and run a model such as the Nitrogen Loading Model (Valiela, 1997). NHDES is currently working on such a model for the Great Bay Estuary

  The Nitrogen Loading Model assumes that nitrogen pollution from humans enters the watershed from four major sources: 1) air pollution settling onto the land; (2) chemical fertilizers; (3) feed imported for animals; and (4) and food imported for people. The nitrogen imported from each source is applied to different types of land use (or to subsurface flow). The combination of a source and a land use/disposal practice is called a pathway by which nitrogen passes through the watershed. The pathway for air pollution is deposition on different land use types; for chemical fertilizer the pathway is agricultural lands, recreational fields, and lawns; for animal feed the pathways are manure on agricultural lands, and pet waste on different land use types; and for food for people the pathway is septic systems. Nitrogen loadings from these sources are estimated through research of actual practices and literature values.

Some of the nitrogen that enters the watershed from these sources is permanently removed by being converted back to nitrogen gas.   Other nitrogen amounts are stored, either temporarily or for the long-term, in groundwater, soil, and biomass (plant and animal tissue). The rest of the imported nitrogen is discharged from the watershed to the estuary. The model includes point and nonpoint sources and accounts for land cover such as disconnected and connected impervious area. Because the model does not include input for stormwater best management practices, it's probably better for prioritizing practices and funding than it is for tracking and calculating nitrogen reductions over time.

7 REFERENCES

CTDEP/NYSDEC, 2000. A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound. Prepared by the Connecticut Department of Environmental Protection and the New York Department of Environmental Conservation. December, 2000.

Evans, 2008. An Evaluation of Potential Nitrogen Load Reductions to Long Island Sound from the Connecticut River Basin. Barry M. Evans Ph.D. The Pennsylvania State University. University Park, PA.

Metcalf & Eddy, 2001. Wastewater Engineering Treatment, Disposal, Reuse. Third Edition. Metcalf & Eddy, Inc. 2001.

Moore et. al., 2004. Estimation of Total Nitrogen and Phosphorus in New England Streams Using Spatially Referenced Regression Models. 2004. Richard Bridge Moore, Craig M. Johnston, Keith W. Robinson, and Jeffrey R. Deacon. United States Geological Survey in cooperation with the New England Interstate Water Pollution Control Commission and U.S. Environmental Protection Agency. Scientific Investigations Report 2004-5012.

NEIWPCC, 2010. An Overview of the Long Island Sound Total Maximum Daily Load for Dissolved Oxygen and the Connecticut River Workgroup. New England Interstate Water Pollution Control Commission. August 2010.

NHDES, 2008. New Hampshire Stormwater Manual. Volumes 1, 2 and 3. New Hampshire Department of Environmental Services. December, 2008.

NHDES, 1997. Stormwater Characterization Study. New Hampshire Department of Environmental Services. NHDES-WD-97-2. 1997.

Valeila, et. al., 1997. Nitrogen loading from coastal watersheds to receiving estuaries: New method and application. I. Valiela, G. Collins, J. Kremer, K. Lajtha, M. Geist, B. Seeley, J. Brawley, and C.H. Sham. Ecological Applications 7: 358-380. 1997.

USDA, 1997. United States Department of Agriculture Census of Agriculture.1997. Available at http://www.census.gov/prod/ac97/ac97a-29.pdf

USDA, 2007. United States Department of Agriculture Census of Agriculture.2007. Available at http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/New_Hampshire/

USEPA, 1993. Manual Nitrogen Control. United States Environmental Protection Agency. EPA/625/R-93/010. September, 1993.

USEPA, 2003. Storm Water Permit Basics: New Hampshire Digging Needs a Federal Permit. United States Environmental Protection Agency. Available at http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/NH-Digging.pdf

USEPA, 2010. Nutrient Control Design Manual. United States Environmental Protection Agency. EPA/600/R-10/100. August 2010.

USEPA, 2012. Fact Sheet. EPA Issues 2012 General Permit for Stormwater Discharges from Construction Activities. United States Environmental Protection Agency. February 2012.
Available at http://www.epa.gov/npdes/pubs/cgp2012_short_factsheet.pdf

Wright Pierce, 1998. Draft Combined Sewer Overflow Master Plan for the City of Lebanon, New Hampshire. September 1998.

APPENDIX A: NH TOWNS AND COUNTIES IN THE CT RIVER BASIN

Table A1: Area and Percent of Each County in the Connecticut River Watershed

COUNTY	TOTAL ACRES	ACRES IN CONNECTICUT RIVER WATERSHED	PERCENT IN CONNECTICUT RIVER WATERSHED
Carroll	635,818	29	0.0%
Cheshire	466,514	396,939	85.1%
Coos	1,171,969	673,616	57.5%
Grafton	1,119,743	542,994	48.5%
Hillsborough	571,152	2,359	0.4%
Merrimack	611,148	16,335	2.7%
Sullivan	353,362	326,430	92.4%
TOTAL		1,958,701	Acres
		3,060	Square miles

Table A2: Area and Percent of Each Town in the Connecticut River Watershed

TOWN NAME	COUNTY	TOTAL TOWN AREA (ACRES)	TOWN AREA IN CT RIVER WATERSHED (ACRES)	PERCENT TOWN AREA in CT RIVER WATERSHED
ACWORTH	Sullivan	24998.9	24998.9	100.0
ALSTEAD	Cheshire	25210.9	25210.9	100.0
BATH	Grafton	24684.1	24684.1	100.0
BEANS GRANT	Coos	6182.6	3247.6	52.5
BENTON	Grafton	31201.5	27540.4	88.3
BERLIN	Coos	39805.7	20656.9	51.9
BETHLEHEM	Grafton	58205.9	54916.7	94.4
CANAAN	Grafton	35275.9	35030.5	99.3
CARROLL	Coos	32187.5	31951.8	99.3
CHANDLERS PURCHASE	Coos	1360.7	1181.3	86.8
CHARLESTOWN	Sullivan	24345.4	24344.6	100.0
CHESTERFIELD	Cheshire	30427.8	30427.7	100.0
CLAREMONT	Sullivan	28193.0	28193.0	100.0
CLARKSVILLE	Coos	39915.8	30450.2	76.3
COLEBROOK	Coos	26106.6	25921.1	99.3
COLUMBIA	Coos	39220.1	39220.1	100.0
CORNISH	Sullivan	27269.7	27269.7	100.0
CRAWFORDS PURCHASE	Coos	5242.8	5242.8	100.0
CROYDON	Sullivan	24028.8	24028.8	100.0
DALTON	Coos	18104.3	18104.3	100.0

TOWN NAME	COUNTY	TOTAL TOWN AREA (ACRES)	TOWN AREA IN CT RIVER WATERSHED (ACRES)	PERCENT TOWN AREA in CT RIVER WATERSHED
DIXVILLE	Coos	31455.3	5006.2	15.9
DORCHESTER	Grafton	28889.9	14593.8	50.5
DUBLIN	Cheshire	18553.0	8587.8	46.3
DUMMER	Coos	31461.4	8393.6	26.7
EASTON	Grafton	19934.0	19934.0	100.0
ENFIELD	Grafton	27615.6	27615.6	100.0
ERVINGS LOCATION	Coos	2401.7	2233.1	93.0
FITZWILLIAM	Cheshire	23059.8	23059.8	100.0
FRANCONIA	Grafton	42124.1	27154.3	64.5
GILSUM	Cheshire	10681.9	10681.9	100.0
GOSHEN	Sullivan	14420.0	14201.9	98.5
GRAFTON	Grafton	27139.0	6306.6	23.2
GRANTHAM	Sullivan	17950.9	17950.9	100.0
HANOVER	Grafton	32087.1	32087.0	100.0
HARRISVILLE	Cheshire	12945.5	5339.4	41.3
HART'S LOCATION	Carroll	12302.5	28.5	0.2
HAVERHILL	Grafton	33509.8	33509.8	100.0
HINSDALE	Cheshire	14497.2	14497.2	100.0
JAFFREY	Cheshire	25708.5	5976.3	23.3
JEFFERSON	Coos	32206.6	32206.6	100.0
KEENE	Cheshire	23867.4	23867.4	100.0
KILKENNY	Coos	16444.2	16444.2	100.0
LANCASTER	Coos	32763.6	32763.6	100.0
LANDAFF	Grafton	18223.6	18223.6	100.0
LANGDON	Sullivan	10446.1	10446.1	100.0
LEBANON	Grafton	26415.2	26415.2	100.0
LEMPSTER	Sullivan	20956.2	20956.2	100.0
LINCOLN	Grafton	83843.7	2701.6	3.2
LISBON	Grafton	17065.6	17065.6	100.0
LITTLETON	Grafton	34555.3	34555.3	100.0
LOW & BURBANKS	Coos	16728.2	14165.6	84.7
LYMAN	Grafton	18355.9	18355.9	100.0
LYME	Grafton	35215.8	35187.0	99.9
MARLBOROUGH	Cheshire	13212.1	13212.1	100.0
MARLOW	Cheshire	16921.6	16921.6	100.0
MILAN	Coos	41247.1	19822.3	48.1
MILLSFIELD	Coos	28937.8	5599.9	19.4
MONROE	Grafton	15248.9	15246.8	100.0
NELSON	Cheshire	14898.2	9133.0	61.3

TOWN NAME	COUNTY	TOTAL TOWN AREA (ACRES)	TOWN AREA IN CT RIVER WATERSHED (ACRES)	PERCENT TOWN AREA in CT RIVER WATERSHED
NEW IPSWICH	Hillsborough	21149.1	2359.0	11.2
NEW LONDON	Merrimack	16267.9	5331.4	32.8
NEWBURY	Merrimack	24382.6	10249.2	42.0
NEWPORT	Sullivan	27930.3	27930.3	100.0
NORTHUMBERLAND	Coos	23558.9	23558.9	100.0
ODELL	Coos	28806.8	28806.8	100.0
ORANGE	Grafton	14799.7	6907.2	46.7
ORFORD	Grafton	30577.8	25312.9	82.8
PIERMONT	Grafton	25582.2	22101.0	86.4
PITTSBURG	Coos	186430.5	147918.7	79.3
PLAINFIELD	Sullivan	33914.3	33914.1	100.0
RANDOLPH	Coos	30142.3	15605.4	51.8
RICHMOND	Cheshire	24152.3	24152.3	100.0
RINDGE	Cheshire	25468.9	18090.0	71.0
ROXBURY	Cheshire	7844.8	7844.8	100.0
SARGENTS PURCHASE	Coos	16559.6	2064.7	12.5
SPRINGFIELD	Sullivan	28478.8	21395.8	75.1
STARK	Coos	38221.8	38221.8	100.0
STEWARTSTOWN	Coos	30019.1	27824.3	92.7
STODDARD	Cheshire	33949.9	14822.2	43.7
STRATFORD	Coos	51231.5	51231.3	100.0
SUGAR HILL	Grafton	11027.6	11027.6	100.0
SULLIVAN	Cheshire	11984.9	11984.9	100.0
SUNAPEE	Sullivan	16099.1	16099.1	100.0
SURRY	Cheshire	10240.9	10240.9	100.0
SUTTON	Merrimack	27734.8	754.7	2.7
SWANZEY	Cheshire	29011.7	29011.7	100.0
THOMPSON & MESERVE	Coos	11848.9	3540.5	29.9
TROY	Cheshire	11274.2	11274.2	100.0
UNITY	Sullivan	23806.3	23806.3	100.0
WALPOLE	Cheshire	23469.5	23469.5	100.0
WARREN	Grafton	31356.0	3609.3	11.5
WASHINGTON	Sullivan	30524.0	10894.6	35.7
WENTWORTH	Grafton	26963.8	721.8	2.7
WESTMORELAND	Cheshire	23577.5	23577.5	100.0
WHITEFIELD	Coos	22231.9	22231.9	100.0
WINCHESTER	Cheshire	35555.7	35555.7	100.0
WOODSTOCK	Grafton	37752.1	2190.4	5.8
TOTAL		**2590186.3**	**1958701.4**	

TOWN NAME	COUNTY	TOTAL TOWN AREA (ACRES)	TOWN AREA IN CT RIVER WATERSHED (ACRES)	PERCENT TOWN AREA in CT RIVER WATERSHED
TOTAL NUMBER OF TOWNS = 98				
NUMBER OF TOWNS 100% IN WATERSHED = 52				

APPENDIX B: METADATA FOR POPULATION AND LAND COVER MAPS

Metadata for Figure 7: Population Change in NH in the CT River Basin (1990 - 2010)

Population: US Census Bureau blocks, selected by centroid inclusion method
HUC12 watersheds: NRCS, 1:24,000
Rivers: USGS, 1:2,000,000
Base map © 2010 Microsoft Corp. and its data suppliers

US EPA Region 1 GIS Center Map #8628_PCNH, 3/29/2013

Metadata for Figure 8: Change in Disturbed Land in NH (2001-2006)

MRLC 2001 / 2006 Developed Land Cover Classes (http://www.mrlc.gov):
- Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. (Class 21)
- Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units. (22)
- Developed, Medium Intensity – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units. (23)
- Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover. (24)

Metadata for
Figure 10: Agricultural Land Cover Change in NH (2001-2006)

MRLC 2001 / 2006 Agricultural Land Cover Classes (http://www.mrlc.gov):
- Pasture/Hay – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation. (Class 81)
- Cultivated Crops – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled. (82)

Metadata for

Figure 9: Change in Impervious Cover in NH (2001-2006)

*Because the four NLCD developed classes are derived from a percent imperviousness mapping product, an overview of steps required to update the NLCD 2001 imperviousness to reflect urban growth captured in 2006 era Landsat imagery is provided here (Xian, et al., 2010). First, 2001 nighttime lights imagery from the NOAA Defense Meteorological Satellite Program (DMSP) was imposed on the NLCD 2001 impervious surface product to exclude low density imperviousness outside urban and suburban centers so that only imperviousness in urban core areas would be used in the training dataset. Two training datasets, one having a relatively larger urban extent and one having a smaller extent, were produced through imposing two different thresholds on city light imagery. Second, each of the two training datasets combined with 2001 Landsat imagery was separately applied using a regression tree (RT) algorithm to build up RT models. Two sets of RT models were then used to estimate percent imperviousness and to produce two 2001 synthetic impervious surfaces. Similarly, the same two training datasets were used with 2006 Landsat imagery to create two sets of RT models that produce two 2006 synthetic impervious surfaces. Third, the 2001 and 2006 synthetic impervious surface pairs were compared using both 2001 impervious surface products to retain 2001 impervious surface area (ISA) in the unchanged areas. The 2006 DMSP nighttime lights imagery was then employed to ensure that non-imperviousness areas were not included and that new impervious surfaces emerged in the city light extent. After this step, two 2006 intermediate impervious surfaces were produced. Finally, the two intermediate products and 2001 imperviousness were compared to remove false estimates in non-urban areas and generate a 2006 impervious surface estimate. Imperviousness threshold values used to derive the NLCD developed classes are:
(1) developed open space (imperviousness < 20%)
(2) low-intensity developed (imperviousness from 20 - 49%)
(3) medium intensity developed (imperviousness from 50 -79%)
(4) high-intensity developed (imperviousness > 79%)
During this process, inconsistencies in the NLCD 2001 Percent Developed Imperviousness product were corrected with the new product, NLCD 2001 Percent Developed Imperviousness Version 2.0, included as part of the NLCD 2006 product release.
http://www.mrlc.gov