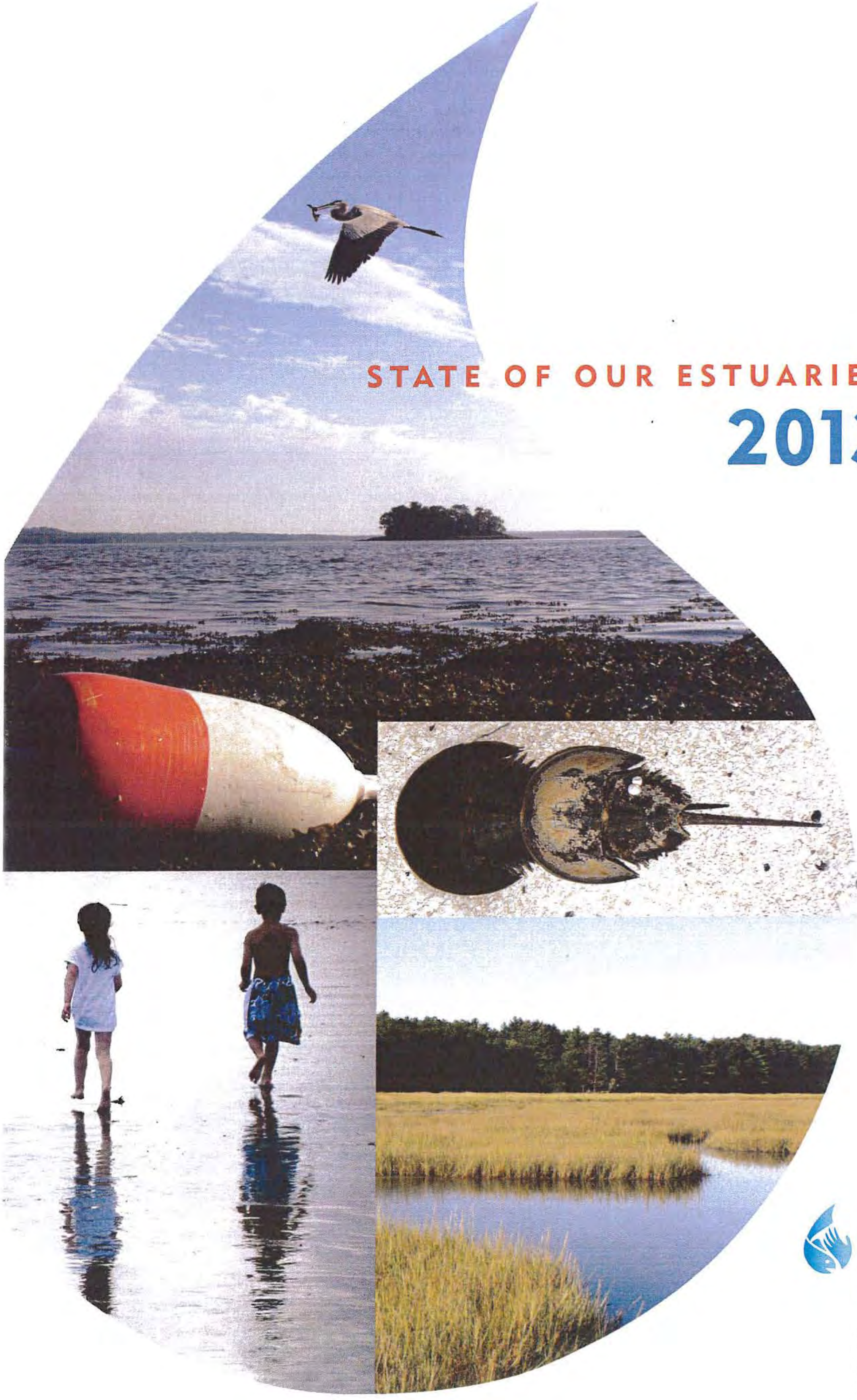
<u>EXHIBIT 6</u>

STATE OF OUR ESTUARIES
2013



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INDICATOR TABLE

Indicator Organization

Indicators are things that we can measure to characterize the pressures on our estuaries, the conditions in our estuaries, and the steps we are taking to respond to challenges in our estuaries. This report is organized with pressure indicators first, followed by condition indicators, and ending with response indicators.

There are many, many more things that are being done to respond to challenges and to restore our estuary. Look for the "Success Stories" and "Case Studies" in the sidebars of the indicator spreads as well as in the "Citizens' Guide to the State of Our Estuaries" to learn more about what's being done and how you can help.

This list of indicators is not exhaustive and does not reflect every pressure, condition, or response that does or could exist for our estuaries. Several important indicators that are missing are harmful algal blooms, fishing pressure, and climate change. However, the list of indicators covers the major issues and provides a reasonably complete picture of the State of Our Estuaries.

Pressure Indicators

Pressure Indicators measure key human stresses on our estuaries

Condition Indicators

Condition indicators monitor the current conditions in our estuaries

Response Indicators

Response indicators track what we are doing to restore our estuaries

- **POSITIVE** Demonstrates good or substantial progress toward the management goal.
- **CAUTIONARY** Demonstrates moderate progress relative to the management goal.
- **NEGATIVE** Demonstrates minimal progress relative to the management goal.

- **POSITIVE** Demonstrates improving or generally good conditions or a positive trend.
- **CAUTIONARY** Demonstrates a possibly deteriorating condition(s) or indicates concern given a negative trend.
- **NEGATIVE** Demonstrates deteriorating conditions or generally poor conditions or indicates concern given a negative trend.
- ↑ **NEGATIVE INCREASE** Statistically significant trend over the full period of record.
- ↓ **NEGATIVE DECREASE** Statistically significant trend over the full period of record.
- ↓ **POSITIVE DECREASE** Statistically significant trend over the full period of record.

PRESSURE INDICATORS: STRESSES ON THE ESTUARY

INDICATOR	STATUS	STATE OF THE INDICATOR	PAGE
Impervious Surfaces	↑ red	In 2010, 9.6% of the land area of the Piscataqua Region watershed was covered by impervious surfaces. Since 1990, the amount of impervious surfaces has increased by 120% while population has grown by 19%.	10
Nutrient Load	yellow	Total nitrogen load to the Great Bay Estuary in 2009-2011 was 1,225 tons per year. There appears to be a relationship between total nitrogen load and rainfall. Although typical nutrient-related problems have been observed, additional research is needed to determine and optimize nitrogen load reduction actions to improve conditions in the estuary.	12

CONDITION INDICATORS: THE CURRENT STATE OF CONDITIONS IN THE ESTUARY

INDICATOR	STATUS	STATE OF THE INDICATOR	PAGE
Nutrient Concentration	↑ red	Between 1974 and 2011 data indicates a significant overall increasing trend for dissolved inorganic nitrogen (DIN) at Adams Point, which is of concern. When examining variability at other monitoring stations with shorter periods of data, no consistent patterns can be found. Recent data considered in the context of long-term data show no pattern or trend.	14
Microalgae	blue	Microalgae (phytoplankton) in the water, as measured by chlorophyll-a concentrations, has not shown a consistent positive or negative trend in Great Bay between 1975-2011.	16
Macroalgae	yellow	Macroalgae, or seaweed, populations have increased, particularly nuisance algae and invasives.	16
Dissolved Oxygen (Bays)	blue	State standards for dissolved oxygen are nearly always met in the large bays and harbors.	18
Dissolved Oxygen (Rivers)	red	State standards for dissolved oxygen in the tidal rivers are not met for periods lasting as long as several weeks each summer.	18
Eelgrass	↓ red	Data indicate a long-term decline in eelgrass since 1996 that is not related to wasting disease. Due to variability even recent gains of new eelgrass still indicate an overall declining trend.	20
Sediment Concentrations	↑ yellow	Suspended sediment concentrations at Adams Point in the Great Bay Estuary have increased significantly between 1976 and 2011.	22
Bacteria	yellow	Between 1989 and 2011, dry weather bacteria concentrations in the Great Bay Estuary have typically fallen by 50 to 92% due to pollution control efforts in most, but not in all, areas.	23
Shellfish Harvest Opportunities	red	Only 36% of estuarine waters are approved for shellfishing and, in these areas, periodic closures limited shellfish harvesting to only 42% of the possible acre-days in 2011. The harvest opportunities have not changed significantly in the last three years.	24
Beach Closures	blue	Poor water quality prompted advisories extremely rarely in 2011. There are no apparent trends.	26
Toxic Contaminants	↓ blue	The vast majority of shellfish tissue samples do not contain toxic contaminant concentrations greater than FDA guidance values. The concentrations of contaminants are mostly declining or not changing.	28
Oysters	red	The number of adult oysters decreased from over 25 million in 1993 to 1.2 million in 2000. The population has increased slowly since 2000 to 2.2 million adult oysters in 2011 (22% of goal).	30
Clams	red	The number of clams in Hampton-Seabrook Harbor is 43% of the recent historical average. Large spat or seed sets may indicate increasing populations in the future.	32
Migratory Fish	yellow	Migratory river herring returns to the Great Bay Estuary generally increased during the 1970-1992 period, remained relatively stable in 1993-2004, and then decreased in recent years.	34

RESPONSE INDICATORS: WHAT WE'RE DOING TO RESTORE THE ESTUARY

INDICATOR	STATUS	STATE OF THE INDICATOR	PAGE
Salt Marsh Restoration	yellow	280.5 acres of salt marsh have been restored since 2000, and 30.6 acres of salt marsh have been enhanced since 2009, which is moderate overall progress towards PREP's goals.	35
Conservation Lands (General)	blue	At the end of 2011, 88,747 acres in the Piscataqua Region watershed were conserved which amounted to 13.5% of the land area. At this pace, the goal of conserving 20% of the watershed by 2020 is likely to be reached.	36
Conservation Lands (Priority)	red	In 2011, 28% of the core priority areas in New Hampshire and Maine were conserved. At this pace, the goal of conserving 75% of these lands by 2025 is unlikely to be reached.	38
Oyster Restoration	blue	A total of 12.3 acres of oyster beds have been created in the Great Bay Estuary, which is 61% of the goal. Mortality due to oyster diseases is a major impediment to oyster restoration.	40
Eelgrass Restoration	red	A total of 8.5 acres of eelgrass beds have been restored which is only 17% of the goal. Poor water quality is often the limiting factor for eelgrass transplant survival.	41
Migratory Fish Restoration	blue	River herring access has been restored to 42% of their historical distribution within the mainstems of the major rivers in the Piscataqua Region. This represents substantial progress in meeting PREP's goal of restoring 50% of the historical distribution of river herring by 2020.	42

Nutrient Load

How much nitrogen is coming into the Great Bay Estuary and have nutrient-related problems been observed?

Sagamore Creek Panne, Portsmouth. Photo by D. Kellam

Total nitrogen load to the Great Bay Estuary in 2009-2011 was 1,225 tons per year. There appears to be a relationship between total nitrogen load and rainfall. Although typical nutrient-related problems have been observed, additional research is needed to determine and optimize nitrogen load reduction actions to improve conditions in the estuary.

EXPLANATION The load of all forms of nitrogen into the Great Bay Estuary in 2009-2011 was 1,225 tons per year (Figure 2.1). Nitrogen loads to the bay tend to be higher in years with more rainfall. Since 2003, when nitrogen loads began to be measured, the total nitrogen load to the bay was highest in 2005-2006. The increase appeared to be driven by higher amounts of nitrogen carried into the bay by rain runoff and river flow during years with heavy rainfall, especially 2005 and 2006 (Figure 2.2). In more recent years load has decreased, which again may be related to drier years with less rainfall. It is due to these fluctuations in data that no long or short term trends can be determined.

One important component of nitrogen needing consideration is the most reactive type called dissolved inorganic nitrogen (DIN). This type is known to cause faster plant and algae growth than other forms of nitrogen. Between 2009-2011, 597 of the 1,225 tons of nitrogen entering the bay was DIN.

Nitrogen enters the bay primarily in two ways. First, nitrogen from fertilizers from lawns and farms, septic systems, animal wastes, and air pollution from the whole watershed is carried into the bay through rain and snowmelt runoff, river flow, and groundwater flow. These sources account for 68% of the nitrogen entering our system (Figure 2.1). Second, there are 18 municipal sewer treatment plants that discharge treated wastewater out through pipes either into the bay or into rivers that flow into the bay. Wastewater discharges are concentrated sources of nitrogen, primarily in the reactive DIN form (Figure 2.1).

Regardless of the particular sources, the major contributors of nitrogen to the bay are related to population growth and associated building and development patterns. The PREP goal is to reduce nutrient loads to the estuaries and the ocean so that adverse, nutrient-related effects do not occur. At this time the Great Bay Estuary exhibits many of the classic symptoms of too much nitrogen: low dissolved oxygen in tidal rivers, increased macroalgae growth, and declining eelgrass. Although the specific causal links between nitrogen load and these concerning symptoms have not yet been fully determined for Great Bay, global, national and local trends all point to the need to reduce nitrogen loads to the estuary.[3] Additional data collection and research is critical to a better understanding of these links and where the most effective reductions can be targeted.

Why This Matters

Nitrogen is a nutrient that is essential to life in the estuaries. However, scientific understanding of estuaries is that high levels of nitrogen may cause problems like the excessive growth of plants and algae.[1] When the plants die, oxygen needed by fish is pulled out of the water and can cause fish to suffocate. The rapid plant growth can also shade or smother underwater eelgrass meadows and other important habitats, limiting important functions such as providing food and shelter and cleaning the water. Excess nitrogen is a problem across the US and around the world.[2]

PREP GOAL **Reduce nutrient loads to the estuaries and the ocean so that adverse, nutrient-related effects do not occur.**

Non-point sources of nitrogen include lawn fertilizers, septic systems, animal wastes, and atmospheric deposition on to land.

FIGURE 2.1 Nitrogen loads to the Great Bay Estuary from different sources, 2009-2011

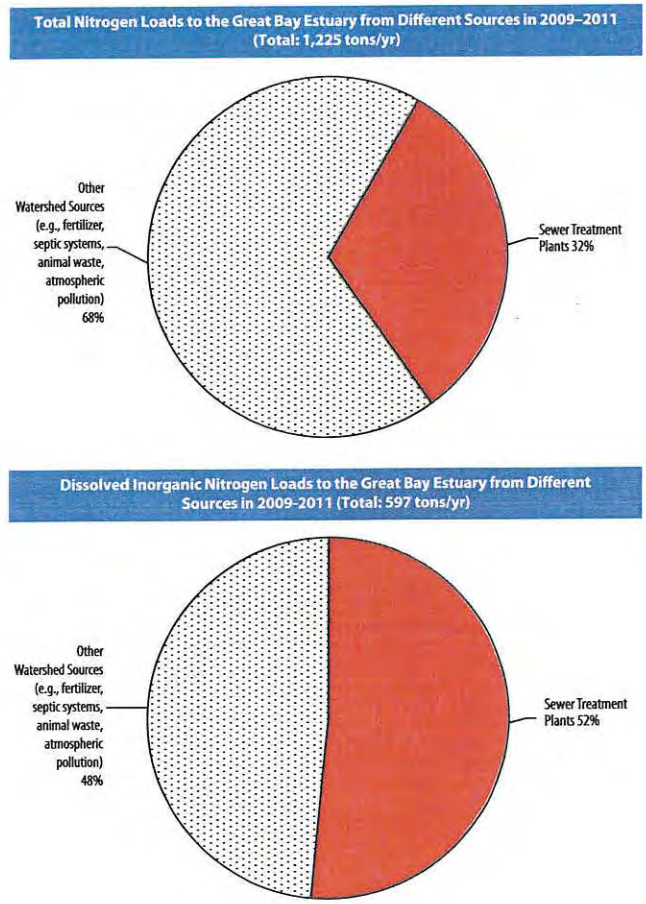


FIGURE 2.2 Trends in nitrogen loads and precipitation, 2003-2011

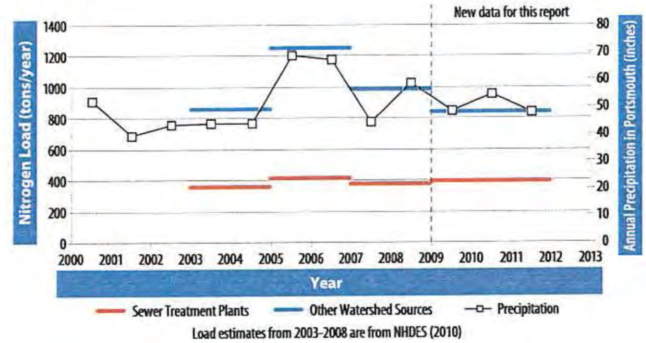
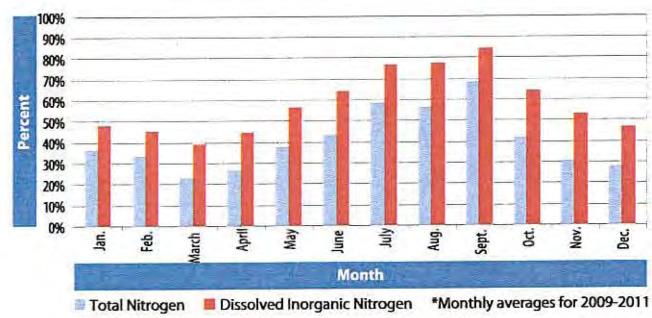


FIGURE 2.3 Percent of nitrogen load to the Great Bay Estuary from sewer treatment plants by month



The percent of the nitrogen load to the estuary from sewer treatment plants varies month-to-month over the course of the year. Sewer treatment plants contribute the majority of the nitrogen load during the warmer months when algae growth typically occurs.

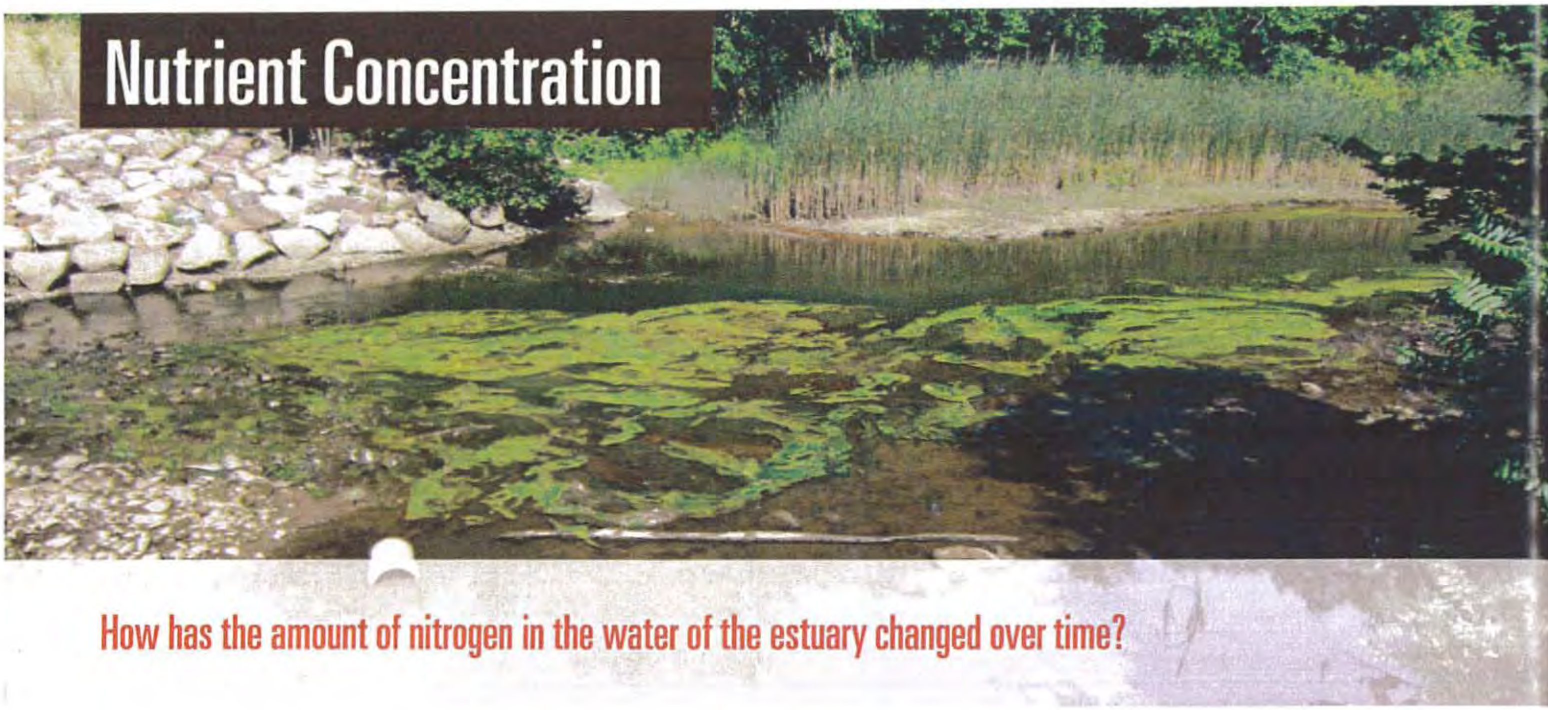
Success Story

York's Lawns to Lobsters

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

Photo by PREP

Nutrient Concentration



How has the amount of nitrogen in the water of the estuary changed over time?

Algae growth in the Winnicut River below the fish ladder, Greenland, NH. Photo by S. Demers

Between 1974 and 2011 data indicates a significant overall increasing trend for dissolved inorganic nitrogen (DIN) at Adams Point, which is of concern. When examining variability at other monitoring stations with shorter periods of data, no consistent patterns can be found. Recent data considered in the context of long-term data show no pattern or trend.

EXPLANATION Total nitrogen measures all of the nitrogen in the water, both the nitrogen dissolved in the water and the nitrogen in floating algae. Total nitrogen concentrations in Great Bay have been monitored since 2003, but have not shown any consistent trends (Figure 3.1). The average concentration of total nitrogen in Great Bay in 2009-2011 was 0.38 mg/L.

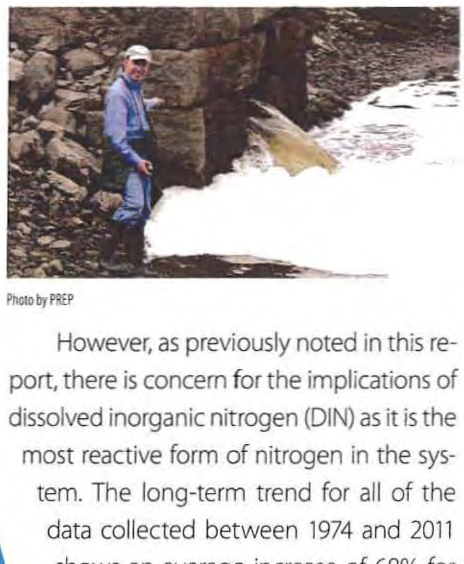


Photo by PREP

However, as previously noted in this report, there is concern for the implications of dissolved inorganic nitrogen (DIN) as it is the most reactive form of nitrogen in the system. The long-term trend for all of the data collected between 1974 and 2011 shows an average increase of 68% for DIN (Figure 3.2). The DIN concentrations in the last three years fell below the average trend line to 0.116 mg/L. These levels are comparable to the DIN concentrations that were measured for some of the years in the 1970s.

The apparent conflict between the long-term increasing trend for DIN at Adams Point and recent overall low concentrations for DIN may be explained by the fact that DIN is highly variable. It is rapidly taken up into plants and removed from the water or converted to other forms of nitrogen. Total nitrogen concentrations are a better measure of overall nitrogen availability in the estuary.

In other areas of the estuary besides Great Bay, some trends for total nitrogen and other forms of nitrogen have been observed. Increasing trends for total nitrogen and total dissolved nitrogen were apparent in the Squamscott River, while decreasing trends for DIN were observed in the Oyster River.

The variety of results highlights the complexity of nitrogen cycling in the estuary. More data and study is needed to better understand these relationships.

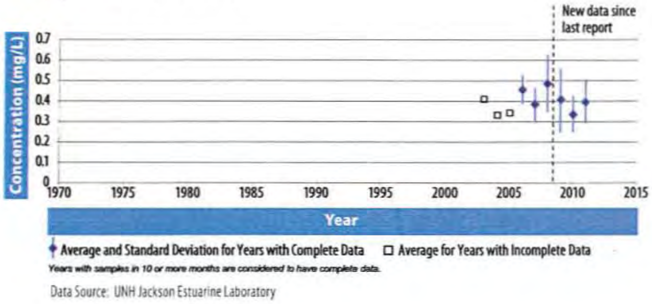
Why This Matters

Nitrogen is an essential nutrient to life in the estuaries. However, scientific understanding of estuaries is that high levels of nitrogen may cause problems from the excessive growth of plants and algae. The amount of nitrogen present in the water (the nitrogen "concentration") is an important indicator of nutrient availability for plants and algae' growth in the estuary. However, because nitrogen is rapidly removed from the water by plants, the nitrogen concentration in the water does not always reflect the amount of nitrogen that has been loaded into the estuary.

PREP GOAL **No increasing trends for any nitrogen or phosphorus species.**

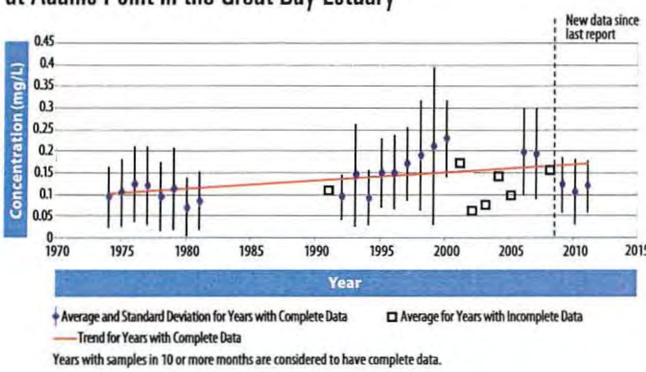
The long-term trend for all of the data collected between 1974 and 2011 shows an average nutrient concentration increase of 68%.

FIGURE 3.1 Total nitrogen concentration trends at Adams Point in the Great Bay Estuary

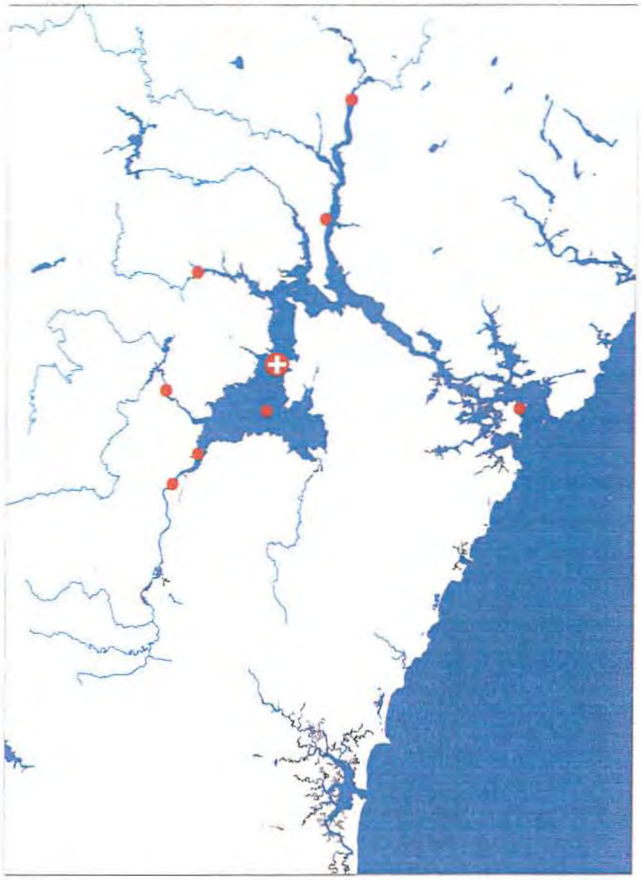


Data Source: UNH Jackson Estuarine Laboratory

FIGURE 3.2 Dissolved inorganic nitrogen concentration trends at Adams Point in the Great Bay Estuary



Data Source: UNH Jackson Estuarine Laboratory

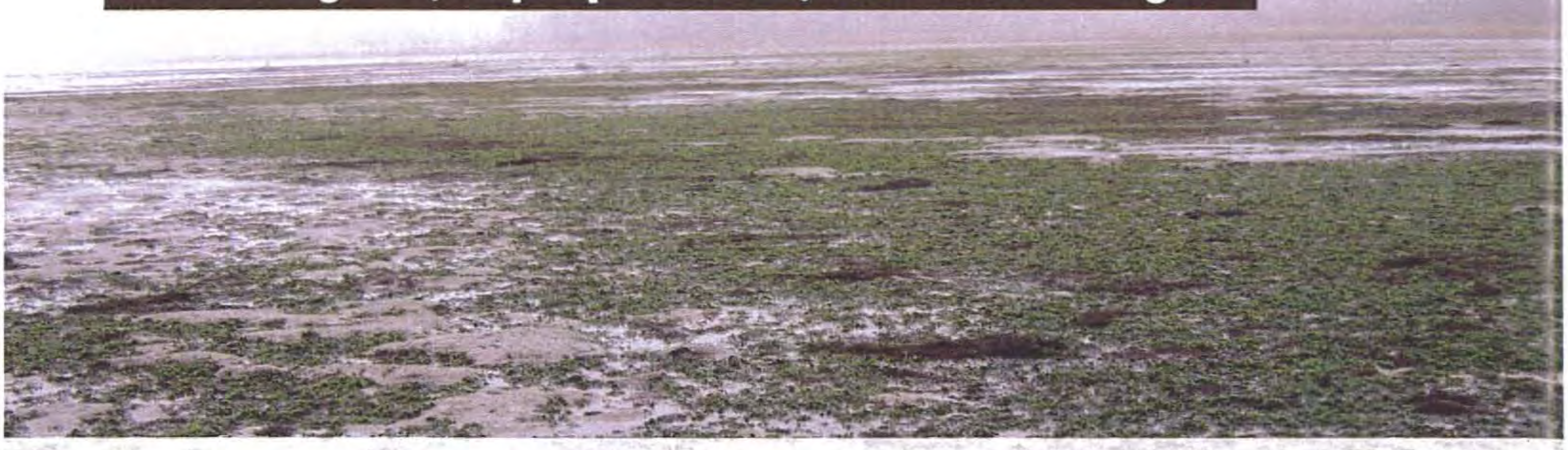


Monitoring location for Fig. 3.1 & 3.2 is marked by a red circle with a white plus sign. Other red dots indicate additional water quality monitoring locations.

Flooding in Newmarket, NH. Photo by PREP

Climatic trends, including extreme rain and snow events, can affect the delivery of nitrogen loads to our estuaries. The highest nitrogen loads calculated for the Great Bay Estuary appear to correlate with years of high annual precipitation (Figure 2.2). It appears that more nitrogen is "flushed" from the landscape during wet periods. New England is experiencing more frequent higher intensity rain storms, and this trend is anticipated to continue. Therefore additional research on how climate and weather affect the amount and timing of nitrogen delivery to the estuary is needed.

Microalgae (Phytoplankton) and Macroalgae



How has the amount of algae in the estuary changed over time?

Ulva Lactuca in Great Bay off of Portsmouth Country Club, Greenland,NH. Photo by J. Nettleton

Microalgae (phytoplankton) in the water, as measured by chlorophyll-a concentrations, has not shown a consistent positive or negative trend in Great Bay between 1975-2011.

Macroalgae, or seaweed, populations have increased, particularly nuisance algae and invasives.

EXPLANATION This is a new indicator for this year's report because of its known relationship to nutrients and the role algae plays in an estuarine system. Plant growth can take many forms in estuaries. There can be microscopic plants, called phytoplankton, that float in the water. The amount of chlorophyll-a present in the water is a measure of these microscopic plants. In addition, there can be larger rooted and un-rooted seaweeds, called macroalgae, that grow in the estuary. Of particular concern are certain types of nuisance macroalgae that grow quickly in high nutrient environments and crowd out or smother the slower growing eelgrass populations.[5]

Measurements of chlorophyll-a in the water in Great Bay since 1975 have not shown any consistent long-term trends, nor were there any short term changes in the last three years (Figure 4.1). Blooms of microscopic plants are episodic and variable in size depending on factors such as weather. As a result, it can be difficult to detect trends in chlorophyll-a based on a monthly monitoring program which is how monitoring is currently conducted.

For nuisance macroalgae, there is evidence that populations have increased. Baseline measurements of some macroalgae species at some locations were made by UNH researchers between 1972 and 1980.[7] In 2008-2010, these field studies were repeated using the same methods to document changes in populations.[7] The report concluded that "Great increases in both mean and peak *Ulva* and *Gracilaria* biomass and percent cover have occurred in the Great Bay Estuarine System."[8] For example, at a site in Lubberland Creek in the Great Bay, the mean percent cover of a common macroalgae, *Ulva lactuca*, had increased from 0.8% of the area covered in 1979-1980 to 39% of the area covered in 2008-2010. (Figure 4.2) Increases in macroalgae cover of up to 90% have been measured at some sites in the Great Bay Estuary on some dates. In 2007, another UNH field study[9] documented that there were 137 acres of macroalgae mats in the Great Bay in August 2007, which amounted to over 3% of the entire bay surface (Figure 4.3) and occupying areas formerly covered with eelgrass. Due to the variable nature of algae, more data collection and study is needed to gain a better understanding of the extent and causes of these increases.

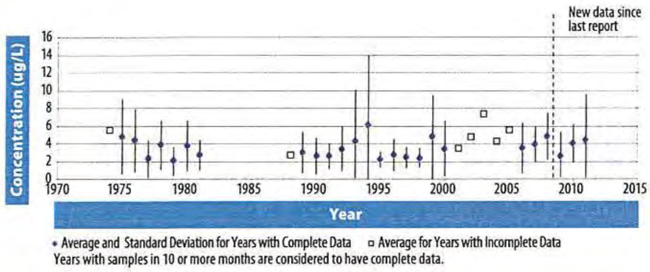
Why This Matters

Increasing nitrogen inputs to estuaries can stimulate plant growth. Excessive algae growth in the water and on the bottom can make the water cloudy, deplete dissolved oxygen in the water, or can entangle, smother and cause the death of important eelgrass habitat.[4]

PREP GOAL **No increasing trends for algae.**

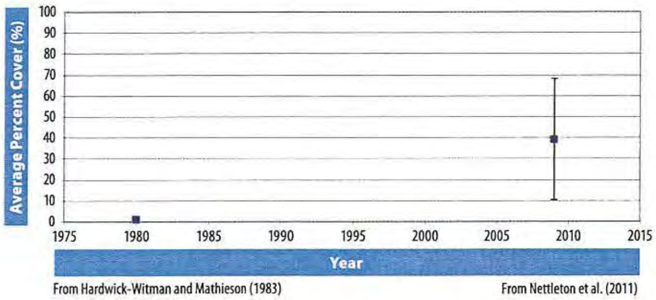
Nuisance macroalgae can grow quickly in high nutrient environments and crowd out the slower growing eelgrass populations.

FIGURE 4.1 Chlorophyll-a trends at Adams Point in the Great Bay Estuary



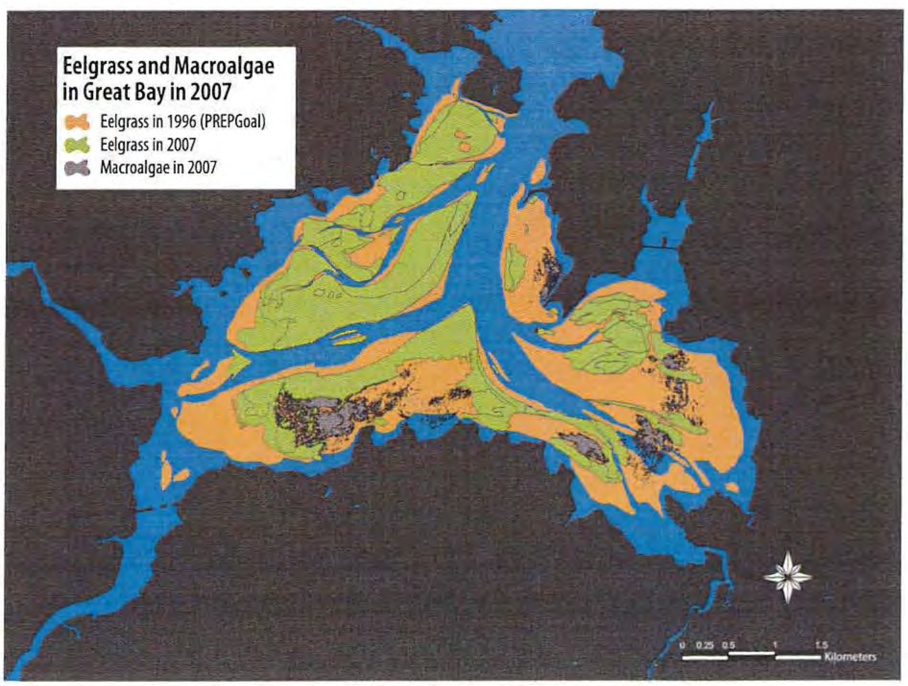
Data Source: UNH Jackson Estuarine Laboratory

FIGURE 4.2 Macroalgae percent cover at the Lubberland Creek site in Great Bay in 1979-1980 and 2008-2010



Monitoring location for Fig. 4.1 is marked by a red circle with a white plus sign. Monitoring location for Fig. 4.2 is marked by a yellow circle with a white plus sign. Other red dots indicate water quality monitoring locations.

FIGURE 4.3 Eelgrass and macroalgae in Great Bay in 2007



Data Source: Eelgrass data provided by UNH Seagrass Ecology Laboratory Macroalgae data from Pe'eri et al. (2008)

Eelgrass

How much eelgrass habitat is in the Great Bay Estuary and how has it changed over time?

Eelgrass on the bottom of Little Bay. Photo by J. Carroll

Data indicate a long-term decline in eelgrass since 1996 that is not related to wasting disease. Due to variability even recent gains of new eelgrass still indicate an overall declining trend.

EXPLANATION The total eelgrass cover in the entire Great Bay Estuary for years with complete data is plotted in Figure 6.1. In 2011, the total eelgrass cover in the estuary was 1,891 acres, 35% below the PREP goal of 2,900 acres derived from the 1996 eelgrass maps. The total acreage has been relatively steady for the past three years and higher than the previous three years (2006-2008), which were 44 to 48% below the goal. There are also indications, based on estimates of the density of the eelgrass beds, that the remaining beds contain fewer plants and, therefore, provide less habitat.

The majority of the eelgrass in the estuary is in the Great Bay itself. Eelgrass in this important area has been mapped each year. The data show that, since 1990, there has been a statistically significant, 38% decline of eelgrass in Great Bay (Figure 6.2). Statistically significant declines of eelgrass have also been observed in other sections of the estuary: the Winnicut River, Little Harbor, Portsmouth Harbor, and the Piscataqua River. However, the total amount of eelgrass lost in these areas is much smaller than the losses in Great Bay.

The actual location and connectivity of the remaining eelgrass in the estuary is important. Figures 6.3, 6.4, and 6.5 show the 2011 eelgrass maps relative to the 1996 eelgrass maps. These figures show that: (1) the loss of eelgrass in the Piscataqua River disrupts the connectivity of eelgrass between Portsmouth Harbor and Great Bay, (2) eelgrass is absent from the tidal rivers, and (3) the new eelgrass bed in Little Bay is larger than the one that was mapped in 1996.

The new eelgrass bed in Little Bay may be a positive sign. Starting in 1996, eelgrass had declined in this area over time and was essentially absent from 2007 through 2010. However, in 2011, a 48-acre eelgrass bed was observed in this area. The large variance in eelgrass cover in this area shows the variability of eelgrass recovery. Data from 2012 and future years are needed to determine if this bed will persist showing an improving trend in Little Bay.

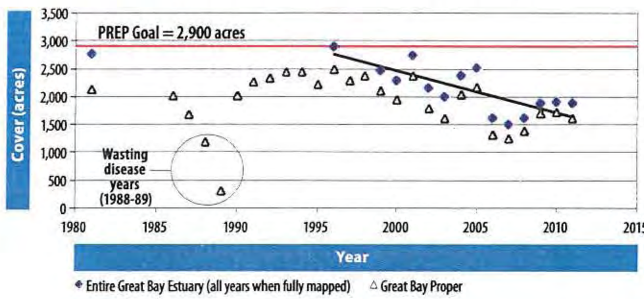
Why This Matters

Eelgrass (*Zostera marina*) is at the base of the estuarine food web in the Great Bay Estuary. Healthy eelgrass beds filter water and stabilize sediments[14] and provide habitat for fish and shellfish.[15] While eelgrass is only one species in the estuarine community, the presence of eelgrass is critical for the survival of many species.

PREP GOAL **Increase the aerial extent of eelgrass cover to 2,900 acres and restore connectivity of eelgrass beds throughout the Great Bay Estuary by 2020.**

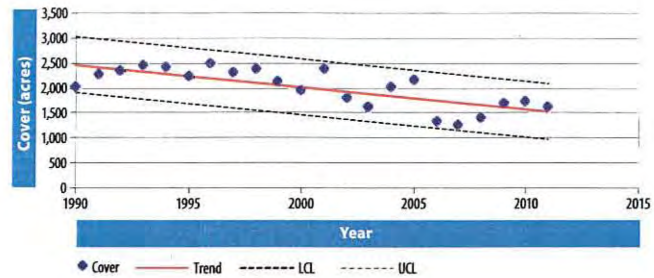
There are indications that remaining beds contain fewer plants and, therefore, provide less habitat.

FIGURE 6.1 Eelgrass Cover in the Great Bay Estuary



Data Source: UNH Seagrass Ecology Laboratory

FIGURE 6.2 Eelgrass cover in Great Bay proper



Data Source: UNH Seagrass Ecology Laboratory Statistically significant trend

FIGURE 6.3 Eelgrass cover in Great Bay and its tributaries in 1996 and 2011

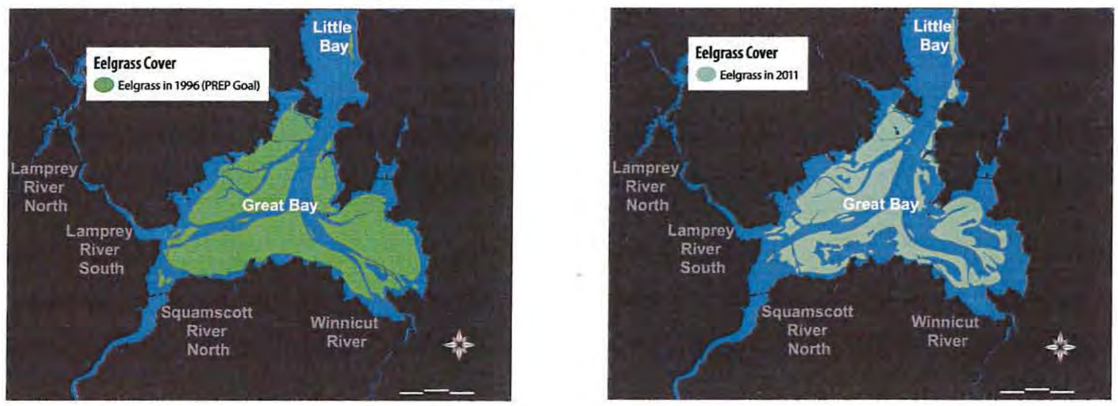


FIGURE 6.4 Eelgrass cover in Little Bay and its tributaries in 1996 and 2011

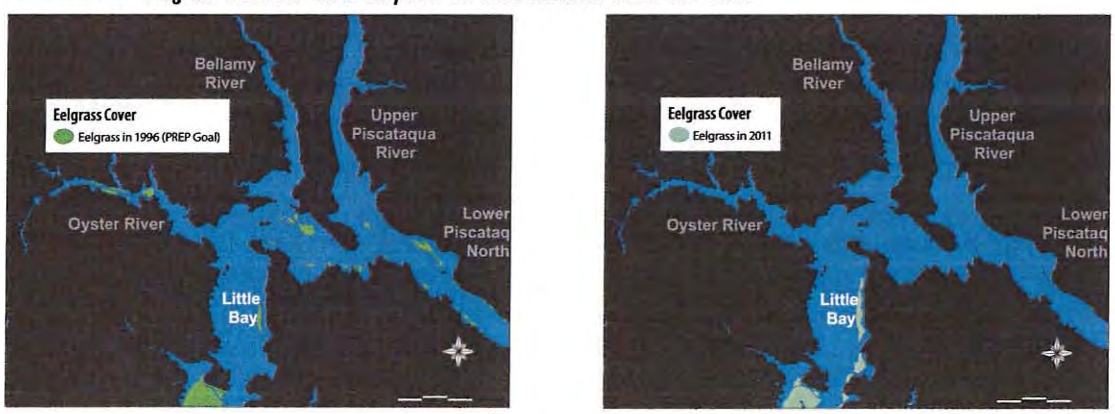
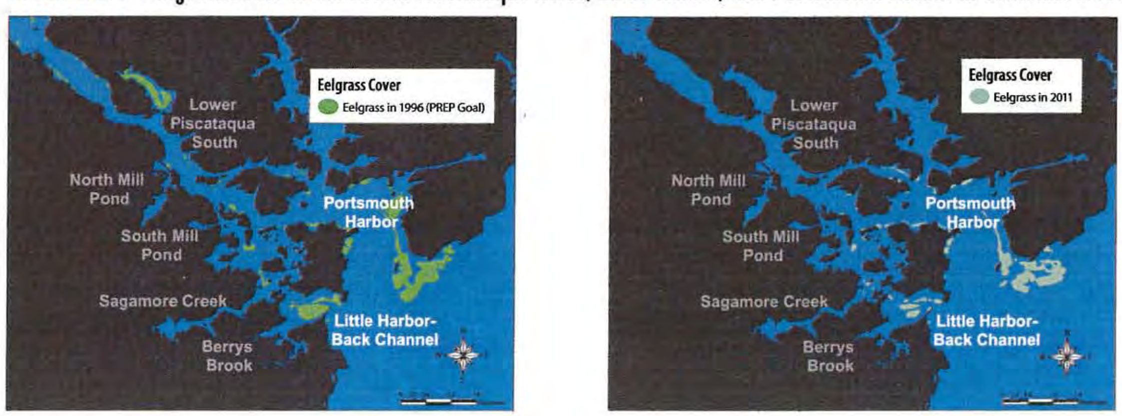


FIGURE 6.5 Eelgrass cover in the Lower Pisctataqua River, Little Harbor, and Portsmouth Harbor in 1996 and 2011



Data Source: UNH Seagrass Ecology Laboratory

EELGRASS