HIGHLIGHTS OF EDGARTOWN GREAT POND REPORT
MASS ESTUARIES PROJECT

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Edgartown Great Pond Statistics

- The Great Pond is 890 acres (high pond).
- The watershed is 4505 acres.
- The pond is only tidally connected to the Atlantic for short periods of time during man-made breaches, usually three times each year.
- The average time that an inlet is open is 12 days.
- When closed, salinity is typically 10 to 13 parts per thousand (ppt) and,
- When tidal, salinity increases to 21 to 25 ppt.
- Tidal circulation will replace half of the water in the pond every 3.7 days during an opening.

Pond Circulation and Nitrogen Impacts

Water testing of the pond clearly indicates that during summer months, nitrogen is the nutrient that controls the growth of microscopic and larger plants–collectively called biomass. The Pond is categorized as a nitrogen-limited water body. When nitrogen is added to a pond of this type, it is quickly converted into more biomass. Living plants produce oxygen while the sun is shining but at night they take it in and release carbon dioxide. When coupled with the demand for oxygen from decaying plant material, overnight oxygen can be completely removed from the deeper water, which stresses fish and shellfish in the pond. While the fish can swim away, the shellfish die out. As more organic matter is produced over the years, the bottom is no longer suitable habitat for shellfish. Inlets and tidal exchange are clearly a significant way to reduce nitrogen and the resulting crop of microscopic plant material that grows in the water column as a result. For the Great Pond, the desired goal for pond managers is to achieve an average total nitrogen concentration of 0.5 parts per million or less. When this target is reached, the amount of dissolved oxygen and algae will also be acceptable and eelgrass will thrive.

A continuous record of dissolved oxygen and phytoplankton at three locations over a 45-day period following a breach indicated that the Pond contains too much organic matter with algae exceeding desirable levels about half the time. Despite this, dissolved oxygen concentrations were acceptable with only brief periods below the 5 parts per million (ppm) concentration at which aquatic animals are stressed. If inlets can be excavated at 45-day intervals during the summer, the amount of total nitrogen, algae and dissolved oxygen can meet the desired targets (this will need to be combined with nitrogen reduction from the watershed).

Habitat

The marine environment has organisms with different requirements for water quality. Many of these such as oysters and soft-shell clams are not particularly tolerant of poor conditions. A study conducted at 15 stations, indicated that the habitat for organisms living on the bottom is significantly or moderately impaired. The portion of the pond north of Swan Neck is more impaired than that south of the Neck.

Eelgrass provides important habitat for fish and shellfish, but it has nearly disappeared several times in the last 10 years. When excess plant material grows in the eelgrass beds, on their leaves or suspended in the water column, it intercepts light that is necessary for eelgrass growth. Eelgrass responds by thinning out and eventually disappearing. At this time, it has made a slight comeback, however, the coverage is well short of historic coverage.

Habitat Ratings for the Great Pond

Location	Number of Species	Number of species w/ 75 individuals or more	Impairment Rating
COVES			
Jobs Neck	9	8	Moderate
Jane's	16	9	Significant to moderate
Wintucket	8	7	Significant to moderate
Mashacket	7	6	Significant to moderate
Turkeyland	8	8	Moderate
Slough	6	5	Moderate
MAIN BASIN			
Upper	6	6	Significant to moderate
Lower	11	10	Moderate

Modeling

A series of three linked computer models were used to evaluate the Pond's tolerance for nitrogen. One evaluates the land uses in the watershed and determines the nitrogen that is added to the pond from man's activities. Another considers the shape of the pond bottom, the volume of water it holds and the tidal flow to determine how water circulates to the ocean and is replaced by new groundwater. The third model, with data generated by the other two, predicts the likely water quality in the Pond and is validated through water quality testing. The models are calibrated with three years of water quality data and collection of tidal circulation data during an opening to the ocean.

Watershed Delineation and Nitrogen Loading

The watershed area was determined by updating old groundwater contour information with new data. The watershed delineation was divided among twelve sub-watershed areas, each with corresponding nitrogen loads discharging to the coves within the great pond. The watershed area is 4,505 acres, an area five times greater than the 890-acre pond. The watershed is shown in Figure IV-4 below.

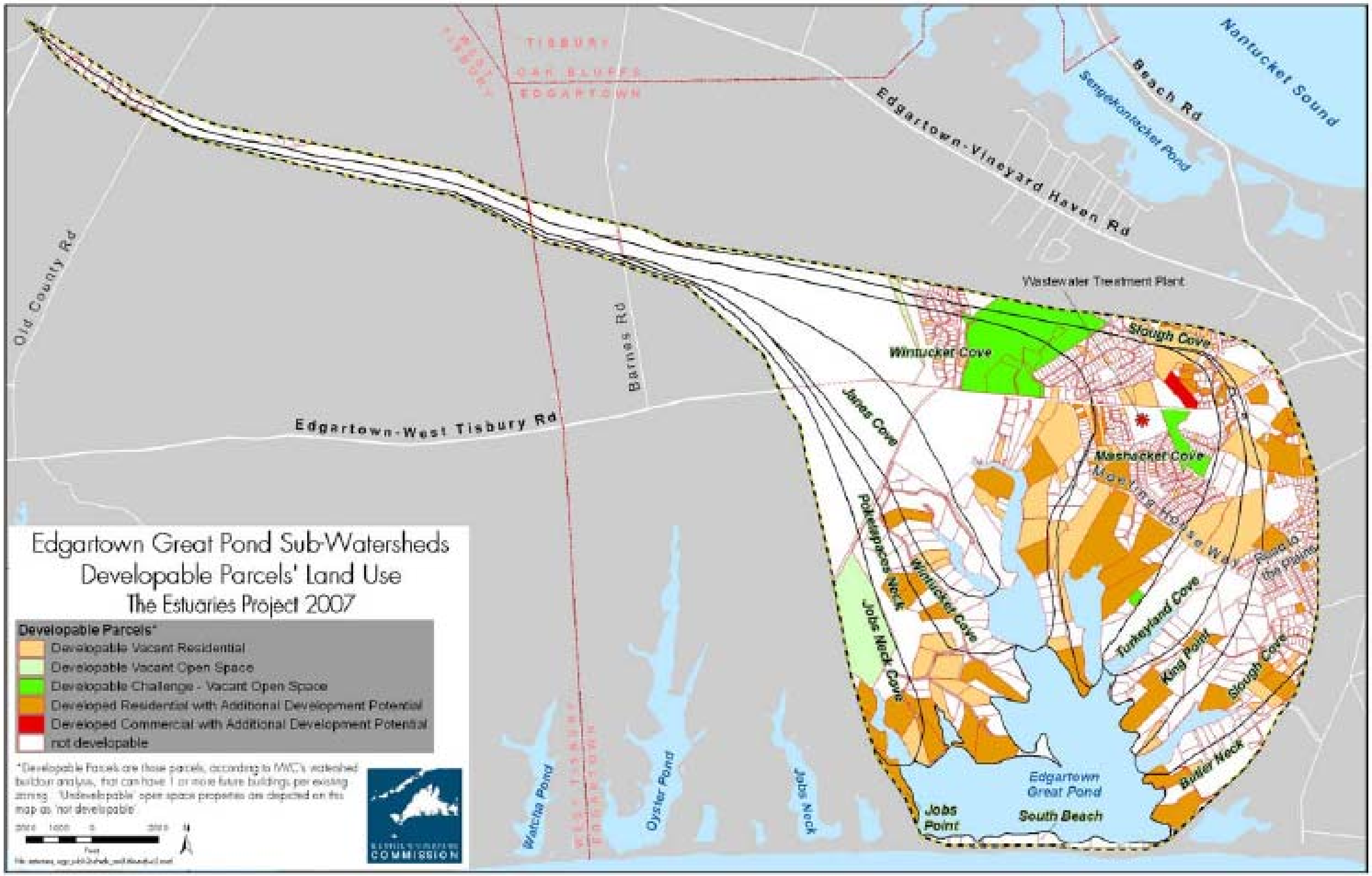

Figure IV-4. Parcels, Parcelized Watersheds, and Developable Parcels in the Edgartown Great Pond system watershed and sub-watersheds.

Proper management of water quality and habitat health requires determination of the amount of nitrogen transported by groundwater from the watershed to the pond. This is done through the quantification of nitrogen sources. In addition, the amount of nitrogen from direct atmospheric deposition, as well as that from nitrogen regeneration from pond sediment must be determined to gain a full picture. Ultimately, pond managers will be able to identify the need for nitrogen reduction within sub-watershed areas or the watershed as a whole to improve water quality. The suggested goal of pond management is to restore eelgrass to the south half of the Pond system.

As mentioned above, a model based upon watershed specific land uses and pre-determined nitrogen loading rates is used to quantify the amount of nitrogen in the watershed. Regional loading factors for southeastern Massachusetts and local specific watershed data, such as average water use, were used for this assessment. Nitrogen loading from atmospheric deposition utilized regional data sources. Nitrogen regeneration from sediment was determined through in-depth field analysis of the sediment in the great pond.

2007 Loading Conditions to Edgartown Great Pond in kilograms/year			
	Watershed Load	Acid rain	Sediment release
	9347	4068	6619

NOTE: A kilogram is about 2.2 pounds.

Sources of Nitrogen

Present day sources of nitrogen are shown graphically below. The chart titled "Overall Load" shows all sources- both those we can change at the local level and those that require state or national response. For example, septic systems loading can be controlled at the town level and it accounts for the largest volume of nitrogen to the pond. It is 37% of the Overall Load but 54% of the Local Control Load. Acid rain deposition (Water Body Surface Area) contributes 27% of the overall load, but must be controlled at state and national levels.

OVERALL LOAD **LOCAL CONTROL LOAD**

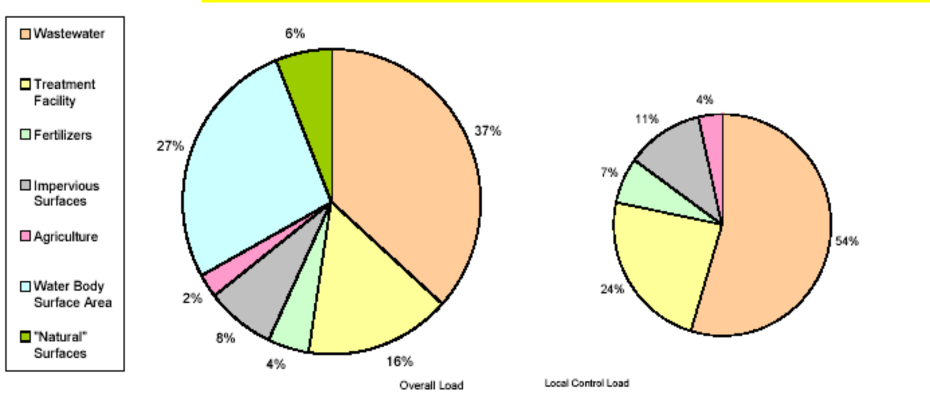

Figure IV-5. Land use-specific unattenuated nitrogen load (by percent) to the overall Edgartown Great Pond System watershed. "Overall Load" is the total nitrogen input within the watershed, while the "Local Control Load" represents only those nitrogen sources that could potentially be under local regulatory control.

Wastewater

A water-use approach is used to calculate the nitrogen load from septic systems. A well-established nitrogen concentration in wastewater is used to convert water use to nitrogen loading. Septic systems in the watershed contribute 5536 kilograms per year (kg/yr)

The Edgartown Wastewater Treatment Facility produced an annual nitrogen load of 2,404 kg/yr prior to an upgrade of the facility in1996. Since then, nitrogen loading has been reduced to 696 kg. Based on the distance from the treatment plant discharge to the pond and a groundwater flow of 1 foot per day, the plume with reduced nitrogen should take 10-12 years to reach the pond. Review of available water quality data suggests that the results of the upgrade have not reached the pond, but should be arriving within the next two years. Current conditions include an annual load of 2,404 kg/yr, but a reduction of about 1700 kilograms from this source is very near

Fertilizer

Fertilizer from residential lawns, a golf club and agriculture represents 6% of the overall contribution of nitrogen. This is based on established loading rates, lawn size and acres of measured golf turf and agricultural fields. A leaching rate to groundwater of 20% is used. Agriculture contributes 369 kg/yr and the golf club and residential lawns contribute 659 kg/yr.

Sources of Nitrogen Loading to the Great Pond in kilograms per year

Sources of Nitrogen	Amount Today (kilograms)	Amount Buildout (kilograms)
Septic systems	5536	12469
Wastewater facility	2404	1707
Fertilizer application	659	979
Runoff	1157	1511
Agriculture	368	313
Acid rain	4068	4068
Background in groundwater	931	931
Sediment release	6619	10772
TOTAL	21742	32750

Acid Deposition

Acid rain deposition represents 27% (4068kg/yr) of the nitrogen load to the great pond. While this is a very significant contribution, it is also the most difficult nitrogen source to remediate because it cannot be controlled through local management techniques. Most of this nitrogen is produced in areas well outside the watershed, beyond state boundaries, and is blown eastward.

Threshold Nitrogen Concentration/Target Nitrogen Load

While it is certain that eelgrass habitat over 50 years ago was of better quality than at present, it was likely not of high quality due to the system's periodic tidal exchange and the naturally nitrogen enriched condition at that time. Opening of the great pond was initiated in the 1940's and would have been required then as well as today for shellfish, alewives and water quality. Habitat restoration in this nutrient enriched system should focus on improving eelgrass habitat within the lower main basin and on full restoration of infaunal (animals living in the bottom sediment) habitat quality pond-wide. This change should approximate historical conditions in the great pond.

A healthy infaunal habitat can clearly be achieved at an average total nitrogen level below 0.5 ppm in the pond. This is the critical nitrogen threshold that pond managers need to achieve in order to have a healthy system supporting shellfish and eelgrass.

This threshold level can be achieved through a reduction in total nitrogen loading of about 18% coupled with an additional mid-summer breach of the pond. The most direct way to reach the loading target is through a 30% reduction in the load from septic system wastewater, the loading from the upgraded sewage treatment plant and a productive mid-summer breach.

The model prediction for total nitrogen concentration buildup before an inlet and the decrease that occurs as pond water leaves the system and is replaced by cleaner Ocean water is shown in Figure Viii-1.

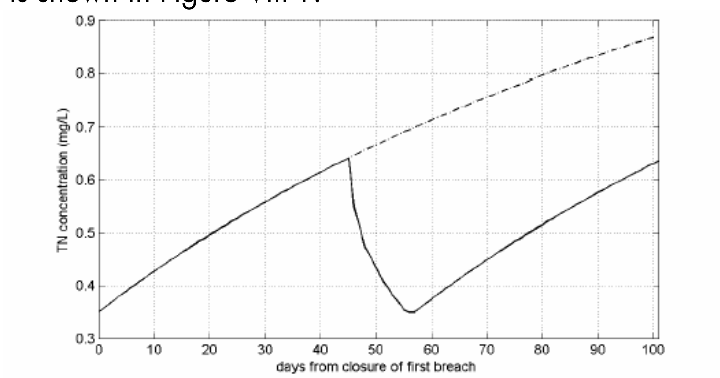

Figure VIII-1. Comparison of modeled pond-averaged TN concentrations for case where the pond is breached only in the early summer (thick black dot-dashed line) and also when it is breached an additional time mid-summer.

Buildout

Analysis for reaching the appropriate nitrogen concentration is based upon existing conditions. However, it is also critical to ensure that potential nitrogen loading from future development is mitigated to protect the long-term health of the pond. Based upon current zoning and other land-use measures that provide for the sub-division of land, nitrogen loading from the watershed will be increased by 62% at buildout. Consideration of this future load must be part of the management program for the great pond.

2007 Loading Conditions to Edgartown Great Pond in kilograms/year			
	Watershed Load	Acid rain	Sediment release
TODAY	9347	4068	6619
BUILDOUT	17763	4068	10772