



The Problem

The Massachusetts Estuaries Program (MEP) technical report (available at www.oceanscience.net/estuaries/) indicates the Popponeset Bay system exceeds its critical threshold for nitrogen, resulting in impaired water quality. Popponeset Bay is one of the first to have received a MEP technical report. A nutrient Total Maximum Daily Load (TMDL) has been established by MassDEP and US EPA.

- **MEP TECHNICAL REPORT STATUS:** Final
- **TMDL STATUS:** Final TMDL
- **TOTAL WASTEWATER FLOW:** 456 MGY (million gal per year)
 - Treated WW Flow: 61 MGY
 - Septic Flow: 395 MGY
- **UNATTENUATED TOTAL NITROGEN LOAD (MEP):** 41,628 kg/Y (kilograms per year)
- **ATTENUATED TOTAL NITROGEN LOAD (MEP):** 27,611 kg/Y
- **SOURCES OF CONTROLLABLE NITROGEN (MEP):**
 - 82% Septic Systems
 - 10% Lawn Fertilizer
 - 7% Stormwater From Impervious Surfaces
 - 1% Wastewater Treatment Facilities

CONTRIBUTING TOWNS

- **MASHPEE**
- **SANDWICH**
- **BARNSTABLE**
- **DISCUSSION:** A portion of the land area in Sandwich and Mashpee is not in the control of the town as it is part of Joint Base Cape Cod (JBCC), which is served by a wastewater treatment facility and discharged outside of the watershed.

THE MEP RESTORATION SCENARIO

- **WATERSHED TOTAL NITROGEN REDUCTION TARGET:** 45%
- **WATERSHED SEPTIC REDUCTION TARGET:** 61%
(The scenario represents the aggregated sub-embayment percent removal targets from the MEP technical report)

POPPONESSET BAY ESTUARY

- **EMBAYMENT AREA:** 720 acres
- **EMBAYMENT VOLUME:** 119 million cubic feet
- **2012 INTEGRATED LIST STATUS:** Category 4a for estuarine bioassessments and fecal coliform
 - Category 4a: TMDL is complete
 - www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

The Popponeset Bay estuary is located in the Towns of Mashpee and Barnstable. It is a large shallow embayment that extends from Nantucket Sound nearly three miles to its groundwater fed headwaters. The embayment includes four distinct sub-systems - Shoestring Bay, the Mashpee River, Ocway Bay and Popponeset Creek. The estuary supports a variety of recreational uses including boating, swimming, shell fishing and fin fishing.

POPPONESSET BAY WATERSHED

- **ACRES:** 13,082
- **PARCELS:** 7,979
- **% DEVELOPED RESIDENTIAL PARCELS:** 78%
- **PARCEL DENSITY:** 1.6 acres per parcel (approx.)
- **WASTEWATER TREATMENT FACILITIES:** 6
 - Stratford Ponds: 35,500 gallons per day (GPD)
 - Willowbend: 113,000 GPD
 - Cotuit Meadows: 59,000 GPD
 - Windchime: 40,000 GPD
 - Mashpee Commons: 180,000 GPD
 - South Cape Village: 24,000 GPD

Freshwater Sources

PONDS

- **IDENTIFIED SURFACE WATERS:** 40
- **NUMBER OF NAMED FRESHWATER PONDS:** 13
- **PONDS WITH PRELIMINARY TROPHIC CHARACTERIZATION:** 5
(Listed In Appendix 4C, Ponds With Water Quality Data)
- **2012 INTEGRATED LIST STATUS:** 4 listed
- **DISCUSSION:** Mashpee recently conducted a pond assessment and installed Solar Bees in Santuit Pond in efforts to restore water quality.

LOCAL PROGRESS

BARNSTABLE

Barnstable contributes approximately 14% of the attenuated wastewater nitrogen load to Popponeset Bay. The Town of Barnstable submitted a draft Comprehensive Wastewater Management Plan (CWMP) in 2012, which characterized the wastewater needs of the Popponeset Bay watershed in terms of required nitrogen reduction, according to the Massachusetts Estuaries Project (MEP) technical report and the Total Maximum Daily Load (TMDL). The earlier 2007 CWMP and its predecessor, the 1993 Needs Assessment, identified other wastewater needs according to Title 5 conditions.

MASHPEE

The Town of Mashpee contributes approximately 77% of the attenuated wastewater nitrogen load to Popponeset Bay. The Town has been engaged in wastewater planning since 2001. The draft Needs Assessment and Technologies Screening Report, completed in 2007, address nitrogen loading to the eastern portion of Waquoit Bay and documents the significant level of effort that had gone into addressing coastal water quality over the previous six years. The Alternatives Assessment, completed in 2008, evaluates 4 options that consider an array of wastewater management scenarios that involve use of, and potential expansion of, existing wastewater treatment facilities, new sewerage and use of denitrifying on-site septic systems.

In 2013, the town filed its Final Needs Assessment, which considers 8 computer simulations run by the MEP to evaluate TMDL compliance. The final report includes adjustments to previous scenarios, incorporates decentralized wastewater treatment and non-traditional nitrogen reduction approaches, such as aquaculture and stormwater Best Management Practices (BMPs).

SANDWICH

Sandwich contributes approximately 9% of the attenuated wastewater nitrogen load to Popponeset Bay. Much of the nitrogen load from Sandwich is naturally attenuated by the intervening ponds and streams. Sandwich has completed a CWMP Needs Assessment and is presently working on public private partnerships for wastewater infrastructure in South Sandwich Village, which is partially in the Popponeset watershed.

STREAMS

- **SIGNIFICANT FRESHWATER STREAM OUTLETS: 2**
 Mashpee River:
 - Average Flow: 26,223 cubic meters per day (m3/d)
 - Average Nitrate Concentrations: .318 milligrams per liter (mg/L)
 Santuit River:
 - Average Flow: 13,164 m3/d
 - Average Nitrate Concentrations: 0.702 mg/L
- **DISCUSSION:** Characterization of fresh water streams like these is a regular part of the MEP technical reports. These concentrations are higher than areas of the aquifer with less than 0.05 mg/L background concentrations that are evident in public supply wells located in pristine areas. This provides evidence of the impact of non-point source nitrogen pollution from residential areas on the aquifer and receiving coastal waters.

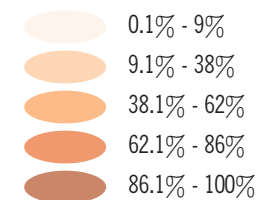
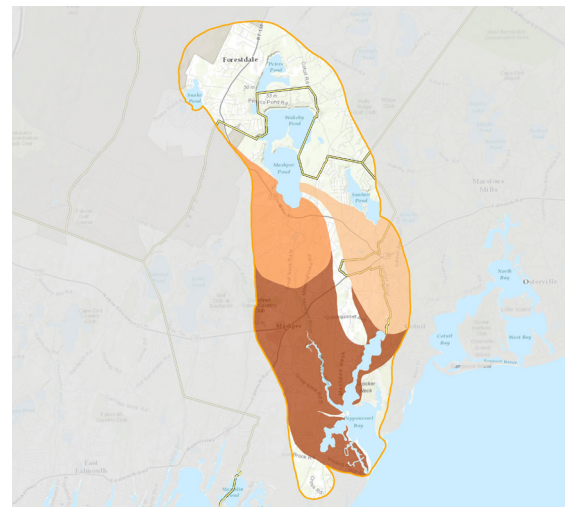
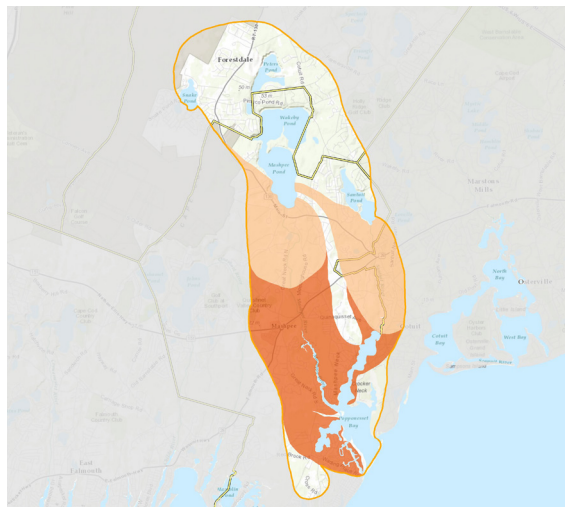
DRINKING WATER SOURCES

- **WATER DISTRICTS: 3**
 - Sandwich Water District
 - Cotuit Water District
 - Mashpee Water District
- **GRAVEL PACKED WELLS: 9**
 - 2 have nitrate concentrations between 0 and 0.5 mg/L
 - 1 have nitrate concentrations between 0.5 and 1 mg/L
 - 3 have nitrate concentrations between 1 and 2.5 mg/L
 - 1 have nitrate concentrations between 2.5 and 5 mg/L
 - 2 have no nitrate concentration data
- **SMALL VOLUME WELLS: 2**
- **DISCUSSION:** The MEP includes contributing areas to the Rock Landing community water supply wells in its watershed map. These wells are located outside the Popponesset Bay watershed.

Degree of Impairment and Areas of Need

For the purposes of the §208 Plan Update areas of need are primarily defined by the amount of nitrogen reduction required as defined by the TMDL and/or MEP technical report. These were referred to above as a 61% reduction in septic nitrogen and a 45% reduction in total nitrogen. More specifically, the MEP provides a targeted amount of nitrogen reduction required by subwatershed, as shown in Figure 4-1 POB Subwatersheds with Total Nitrogen Removal Targets and Figure 4-2 POB Subwatersheds with Septic Nitrogen Removal Targets.

The nitrogen load from the watershed exceeds the threshold or TMDL for Popponesset Bay, resulting in impaired water quality. The ecological health of a water body is determined from water quality, extent of eelgrass, assortment of benthic fauna, and dissolved oxygen and ranges from 1-severe degradation, 2-significantly impaired, 3-moderately impaired,



Subwatersheds with Total Nitrogen Removal Targets

Figure 4-1 POB

Subwatersheds with Septic Nitrogen Removal Targets

Figure 4-2 POB

4- healthy habitat conditions

MEP ECOLOGICAL CHARACTERISTICS AND WATER QUALITY

- **OVERALL ECOLOGIC CONDITION:** Healthy to Severely Degraded
- **LOWER POPPONNESSET BAY:** Healthy to Moderately Impaired
- **OCKWAY BAY:** Significantly Impaired to Severely Degraded
- **MASHPEE RIVER:** significantly Impaired to Severely Degraded
- **SENTINEL STATIONS:**
 - Total Nitrogen Concentration Threshold: 0.38 mg/L
 - Total Nitrogen Concentration Existing: 0.45 mg/L
(As reported at the MEP sentinel water-quality monitoring stations)