

2. Great Pond TWMP Planning Basis

The Great Pond System watershed is divided into 24 sub-watersheds. The ‘Final Great, Green and Bourne Pond Embayment Systems Total Maximum Daily Loads (TMDL) for Total Nitrogen (Report #96-TMLD-6 Control #181.0)’ outlines target threshold watershed loads for two waterbodies in the Great Pond System – Great Pond and Perch Pond. The TMDL Report outlines the maximum nitrogen loading that each waterbody may receive while maintaining its water quality standards and designated uses. Table 2.1 outlines the nitrogen TMDLs for the two waterbodies.

Table 2.1. Great Pond and Perch Pond TMDLs

Major Watershed	Waterbody Segment	Description ¹	Nitrogen TMDL (kg/d) ²
Great Pond System	Great Pond	From the inlet of Coonamessett River to Vineyard Sound (excluding Perch Pond), Falmouth	22.50 (8213 kg/yr)
	Perch Pond	Connects to northwest end of Great Pond, west of Keechipam Way, Falmouth	0.59 (215 kg/yr)
Sources:			
<ol style="list-style-type: none"> 1. Massachusetts Year 2016 Integrated List of Waters. 2. ‘Table 5 – the Total Maximum Daily Loads (TMDL) for the Great, Green and Bourne Pond Embayment Systems, represented as the sum of the calculated target threshold loads (from controllable watershed sources), atmospheric deposition, and sediment sources (benthic flux)’ of the ‘Final Great, Green and Bourne Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen’ (Report #96-TMDL-6 Control #181.0), dated April 6, 2006. 			

The largest source of controllable nitrogen for both watersheds is on-site septic systems. Nitrogen from septic systems enters the waterbody in two ways:

- Direct groundwater discharge into the watershed (groundwater load) – this represents septic system loads that flow directly through groundwater to the main embayment waterbody.
- Surface water discharge (surface water load) – this represents septic system loads from up-gradient watersheds that enters a stream (in this case the Coonamessett River) and/or pond via groundwater before discharging into the main embayment waterbody. During the development of the MEP Report, flow and nitrogen concentration measurements were taken at a stream gauge in the Coonamessett River at Route 28 to quantify surface water discharge loads into Great Pond. Surface water loads are represented as a point discharge from an upper watershed into the main waterbody.

Other sources of nitrogen to the watersheds include natural background, land use (stormwater runoff and fertilizers), atmospheric deposition, and the Massachusetts Military Reservation Wastewater Treatment Facility (WWTF) plume and nutrient-rich embayment sediments. Of these sources, land use, septic system, and WWTF sources are typically considered “controllable” sources of nitrogen.

The Falmouth WQMC established a nitrogen removal goal (Table 2.2) to meet the Great Pond TMDL based on the difference between the present attenuated nitrogen load from septic systems, runoff, and fertilizer (based on data provided by the MEP Report), and the threshold nitrogen load (based on data provided by the MEP Report).

Table 2.2. Great Pond TMDL Nitrogen Removal Goal

Subembayment / Surface Water Source	Present Nitrogen Load (kg/yr) ¹	Threshold Nitrogen Load (kg/yr) ^{1,2}	Nitrogen Reduction Required (kg/yr)
Great Pond	9,125	1,358	7,767
Perch Pond	1,964	329	1,635
Coonamessett River	8,260	5,508	2,752
Total Great Pond System	19,349	7,195	12,154

Notes:

1. Data from 'Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Great/Perch Pond, Green Pond, and Bourne Pond, Falmouth, Massachusetts – Final Report – April 2005 Table VIII-3: Comparison of subembayment total attenuated watershed loads (including septic, runoff, and fertilizer) used for modeling of present and threshold loading scenarios of the Ashumet Valley systems. These loads do not include direct atmospheric deposition (onto the sub-embayment surface) or benthic flux loading terms.' Data converted from kg/day to kg/yr.
2. Data from 'Final Great, Green and Bourne Pond Embayment Systems Total Maximum Daily Loads for Total Nitrogen (Report +96-TMDL-5 Control #181.0) Table 5: The Total Maximum Daily Load (TMDL) for the Great, Green, and Bourne, Pond Embayment Systems, represented as the sum of the calculated target threshold loads (from controllable watershed sources), atmospheric deposition, and sediment sources (benthic flux).

To meet the Great Pond TMDL, the Town of Falmouth has developed a nitrogen TMDL Compliance Preferred Alternative for Great Pond which integrates multiple nitrogen management strategies for this watershed including centralized sewerage, on-site innovative and alternative septic systems (I/A systems), shellfish aquaculture, stormwater improvements, permeable reactive barriers, and fertilizer reductions. The portion of the Great Pond watershed to be sewerage under the Preferred Alternative (Teaticket Acapesket Sewer Areas 1 and 2) is shown on Figure 2-1 (see Attachments).

The Town has also developed a TMDL Compliance Contingency Alternative, which provides a conservative estimate of additional centralized wastewater collection and treatment that would be required if the pilot projects included in the Preferred Compliance Approach did not perform as anticipated.

The Town has implemented a robust monitoring program for pilot projects and will continue to monitor pilot project performance through its adaptive management program. The Town will adjust its TMDL Compliance Approach if/as needed through a MEPA Notice of Project Change, based on program findings.

The Great Pond TMDL Compliance Plan for both the Preferred Alternative and Contingency Alternative is summarized in Table 2.3.

Table 2.3. Great Pond Nitrogen TMDL Compliance Plan

Compliance Component – Nitrogen Removal Approach	Estimated Nitrogen Loading Reduction (kg-N/year) ⁴	
	Preferred Alternative	Contingency Alternative
Fertilizer Bylaw (25% of fertilizer load) ^{1,2}	425	0
Stormwater Best Management Practices (25% of impervious load) ^{1,2}	580	0
Shellfish Aquaculture (uptake) ^{1,2}	1,300 – 2,100	0
Shellfish Aquaculture (denitrification) ^{1,2}	650 – 1,050	0
Permeable Reactive Barrier at Shorewood Drive (300 feet) ^{1,2}	1,325	0
Sewer Extension – Little Pond Sewer Area (Great Pond)	1,000	1,000
Sewer Extension – Teaticket Acapesket Sewer Area 1 ³	2,890	2,890
Sewer Extension – Teaticket Acapesket Sewer Area 2 ³	3,298	3,298
Sewer Extensions – Contingency	0	4,966
Total Estimated Reduction	11,468 – 12,668	12,154
Nitrogen Removal TMDL Goal	12,154	12,154

Notes:

1. Anticipated removal rates provided by the Falmouth WQMC. See Section 3 for background.
2. Advancements in I/A technology will provide supplementary nitrogen removal if not met through primary alternatives.
3. Estimated wastewater flows developed using water use data from 2014, 2015 and 2016 and a 20% allocation to account for undesignated redevelopment and potential development of currently un-developable parcels.
4. If a treated effluent site is selected within the Great Pond watershed additional nitrogen loading reduction will be required to offset the nitrogen load returned to the watershed through treated effluent discharge.

2.1. Projected Wastewater Flows and Nitrogen Loads

The Town of Falmouth operates the Falmouth Wastewater Treatment Facility (WWTF), located at Blacksmith Shop Road. The WWTF currently operates under Groundwater Discharge Permit No. 168-6, effective date February 5, 2021 (2021 Permit) and has a permitted average annual effluent flow of 0.71 mgd.

The WWTF has 15 treated effluent disposal open sand beds. The Town of Falmouth has allocated all its permitted treated effluent discharge capacity at the existing open sand beds for existing sewer service areas.

An alternatives analysis was conducted to identify a preferred treated effluent discharge site for future wastewater flow. Three planning horizons (with associated wastewater flow rates) were established for the analysis, to allow each site to be evaluated for both near-term and longer-term treated effluent discharge scenarios. The planning flows are outlined in Table 2.4 and described below.

- **Planning Flow 1 (short-term planning flow)** represents anticipated average annual wastewater flow for the Great Pond Preferred Alternative. Planning Flow 1 includes flow allocations for existing permitted flow (2021 Permit), an Existing Sewer Area Redevelopment Allocation (ESRA) and the estimated Teaticket / Acapesket Sewer Area future flow (TASA).
- **Planning Flow 2 (medium-term planning flow)** represents anticipated average annual wastewater flow for the South Coast Preferred Alternative. Planning Flow 2 includes Planning Flow 1 and an allocation for potential future sewer service areas outlined by the Town of Falmouth WQMC in the South Coast estuaries in Seacoast Shores (Waquoit Bay watershed), Antler Shores (Waquoit Bay watershed), Seapit (Waquoit Bay watershed), Fishermans Cove (Bournes Pond watershed) and Oyster Pond (Oyster Pond watershed).

- **Planning Flow 3 (long-term / contingency planning flow)** represents anticipated average annual wastewater flow for the Great Pond Contingency Alternative. Planning Flow 3 includes Planning Flow 1, Planning Flow 2, and an allocation for contingency sewerage in the Great Pond watershed if pilot nitrogen management strategies do not perform as anticipated.

Table 2.4. Centralized Wastewater Management Alternatives Analysis Planning Flows 1 through 3

Planning Flow	Flow Components	Average Wastewater Flow (mgd)	Average Current Septic Nitrogen Load Removed from Great Pond Watershed (kg/yr) ^{7,8}
Planning Flow 1: Great Pond Preferred Alternative	Existing Permitted Flow ¹	0.71	1,000 ⁶
	Existing Sewer Area Redevelopment Allocation (ESRA) ²	0.14	0
	Teaticket / Acapesket Sewer Area (TASA) ³	0.36 ⁷	6,188 ⁸
Planning Flow 2: South Coast Preferred Alternative	Potential Bournes Pond and Waquoit Bay Sewer Area ^{3,4}	0.34	0 ⁹
Planning Flow 3: Great Pond Contingency Alternative	Great Pond Contingency Sewering ⁵	0.19	4,966
Planning Flow 1 Total		1.21	7,188
Planning Flow 2 Total		1.55	7,188⁹
Planning Flow 3 Total		1.74	12,154⁹
Notes:			
<ol style="list-style-type: none"> 1. Groundwater Discharge Permit No. 168-6, effective date February 5, 2021 (2021 Permit). 2. For this analysis the ESRA was estimated as 20% of existing permitted flow. 3. Flow includes WQMC allowance for infiltration / inflow (I/I) in a gravity system. Estimated I/I is not included in nitrogen load calculations 4. Potential future sewer area outlined by the WQMC which includes Seacoast Shores, Antler Shores, Seapit, Fishermans Cove, and Oyster Pond. WQMC analysis is based on the MVP tool future projections for these areas. These areas are all located outside of the Great Pond watershed. 5. Great Pond Contingency sewerage provides an estimate of additional sewerage to meet TMDL if load removal targets are not met by proposed pilot technologies. 6. Estimated septic nitrogen load removal from the portion of the LPSA located in the Great Pond watershed. 7. Estimated wastewater flows for TASA were developed using water use data from 2014-2016 and a 20% wastewater allocation to account for undesignated redevelopment and potential development of currently un-developable parcels. The future allocation in this flow estimate is not included in the nitrogen load estimate to allow for a comparison of anticipated current septic nitrogen load removed through sewerage to the current septic nitrogen load that needs to be removed from the watershed to meet the TMDL. The collection system and treatment facility will be sized to convey and treat anticipated future flows from the identified sewerage. 8. Estimated existing septic nitrogen load removal from the portion of the TASA located in the Great Pond watershed. 9. All wastewater flow in Planning Flow 2 is anticipated to be collected outside of the Great Pond watershed. 			