5. Great Pond Recommended Plan

The Recommended Plan provides a comprehensive strategy for wastewater and nitrogen management in Great Pond and includes a Preferred Compliance Approach and Contingency Compliance Approach.

The Preferred Compliance Approach integrates multiple nitrogen management strategies for this watershed including centralized sewering, on-site I/A septic systems, shellfish aquaculture, stormwater improvements, permeable reactive barriers, and fertilizer reduction.

The Contingency Compliance Approach provides a conservative estimate of additional centralized wastewater collection and treatment that would be required within the Great Pond watershed if the pilot projects included in the Preferred Compliance Approach did not perform as anticipated.

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

5.1. Preferred Compliance Alternative

The Great Pond TMDL Preferred Compliance Approach (for Planning Flow 1), which integrates traditional wastewater management with pilot nitrogen management strategies, is outlined in Table 5.1. Each compliance component is described in further detail in this section.

Table 5.1. Nitrogen Budget for Great Pond to Achieve Nitrogen TMDL Compliance

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

Notes:

1. Anticipated removal rates provided by the Falmouth WQMC based on the information provided and actions described in Section 5.1.1.
2. Advancements in I/A technology will provide supplementary nitrogen removal if not met through primary alternatives.

5.1.1. Demonstration Projects of Non-Traditional Wastewater and Nitrogen Management Technologies and Approaches

5.1.1.1. Fertilizer Management

The Town of Falmouth adopted a Nitrogen Control Bylaw in 2012 and continues to coordinate a public education and enforcement program for the conditions outlined in the bylaw. The Town conducts an annual mailing to approximately 2,700 properties within 100 feet of all coastal estuaries and requires adherence to the bylaw as a Standard Condition in all Order of Conditions issued by the Falmouth Conservation Commission.

5.1.1.2. Stormwater Best Management Practices

The Town of Falmouth is subject to, and manages, stormwater in accordance with the 2016 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s), issued through the U.S Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Phase II Stormwater Permit Program.

The NPDES permit outlines requirements for discharges to impaired waters with an approved TMDL. These requirements and the Town's actions to meet them are outlined below.

- **Public education and outreach** – The Town of Falmouth distributes seasonal flyers outlining fertilizer use requirements, grass clipping management and leaf litter removal. The Town also distributes informational flyers encouraging proper management of pet waste with all pet registration / renewal applications.
- **Stormwater management in new development and redevelopment** – The Town adopted a Construction and Post-Construction Bylaw on June 28, 2021, which allows the Town to adopt regulations to regulate illicit discharges. In 2021, the Select Board adopted "Stormwater Management Rules and Regulations", which meets the Town's permit requirements providing provisions for investigating and eliminating illicit discharges and for implementing enforcement actions.
- **Good housekeeping and pollution prevention for permittee owned operations** – The Town conducts street sweepings at least twice annually, in accordance with its permit requirements.

5.1.1.3. Shellfish Aquaculture – Uptake and Denitrification

The Town of Falmouth is evaluating the establishment of shellfish aquaculture within Great Pond based on the findings at the other locations currently being evaluated throughout the town.

The Falmouth Department of Marine and Environmental Services (MES) has conducted initial shellfish surveys in Great Pond to determine areas and locations to expand the town's shellfish program to Great Pond. The Town is currently conducting final surveys, which are anticipated to be completed in 2022.

Presuming that 10 acres are available for shellfish aquaculture within the pond, the town is anticipating that the project will remove 1,300 kg-N/yr – 2,100 kg-N/yr through nitrogen uptake and 650 kg-N/yr – 1,050 kg-N/yr through denitrification. Shellfish nitrogen removal estimates are based on measured values from the pilot projects in Falmouth and published values on a per organism basis from Barnstable County (Reitsma et al 2017).

5.1.1.4. Shorewood Drive Permeable Reactive Barrier

The Town of Falmouth is evaluating the installation of a 300-foot permeable reactive barrier (PRB) on a site located off Shorewood drive. It is anticipated that the project has the potential to remove up to 1,325 kg-N/yr based on the US Environmental Protection Agency (USEPA estimated nitrogen mass flux). A pilot PRB was installed at this site in 2019 and is currently being monitored to verify performance assumptions.

5.1.2. Traditional Wastewater Management

5.1.2.1. Service Area and Nitrogen Removal

Septic nitrogen load will be removed from the Great Pond watershed through two collection system extensions (the existing LPSA extensions and the proposed TASA extension).

The existing Little Pond Sewer Service Area (which was sewered in 2017) includes 253 parcels in the Great Pond watershed. The nitrogen load removal from Great Pond through sewering of these parcels is estimated to be 1,000 kg/yr.

The proposed TASA collection system (Phases 1 & 2) is anticipated to collect wastewater from 1,289 parcels in the Great Pond watershed on the Maravista, Acapesket, and Teaticket peninsulas. The anticipated load removal from this collection system is 6,188 kg/yr.

Anticipated septic nitrogen load removals from both collection system extensions in the Great Pond watershed are summarized in Table 5.2.

Table 5.2. Anticipated Septic Nitrogen Load Removals in the Great Pond Watershed

	Number of Sewered Parcels in the Great Pond Watershed	Anticipated Septic Nitrogen Load Removal from the Great Pond Watershed (kg/yr)
Little Pond Sewer Service Area (LPSSA)	253	1,000
Proposed Teaticket Acapesket Study Area (TASA)	1,289	6,188[1]

Notes:

1. 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 sewering to the current septic nitrogen load that needs to be removed from the watershed to meet the TMDL. The centralized system and treatment facility will be sized to convey and treat anticipated future flows from the identified sewershed.

5.1.2.2. Collection and Transmission System Layout

Septic nitrogen load will be removed from the Great Pond watershed through the existing LPSA sewer extension and the proposed TASA sewer extension. The portions of both collection systems within the Great Pond watershed are outlined in Figure 5-1 (see Attachments). As outlined in Figure 4-3 (see Attachments), flow collected through TASA will be conveyed to the Falmouth WWTF through a force main system and two existing lift stations serving LPSA.

The conceptual layout for the TASA collection system is outlined in Table 5.3. The Town is currently working to secure proposed lift station locations and sewer easements. As both are finalized the conceptual layout and preliminary capital cost estimates for the project will be adjusted accordingly.

Table 5.3. TASA Collection System Conceptual Layout

Component	Estimated Quantities[1,2] - TASA Phase 1	Estimated Quantities[1,2] - TASA Phase 2
Gravity Mains (miles)	4.8	11.5
Low Pressure Sewer (miles)	3.2	0.8
Force Main (miles)	5.0	2.8
Gravity Manholes	140	250
Gravity Connections[3,4]	447	1,137
Grinder Pumps[3,4]	231	52
Connection to Existing Lift Stations	2	0
New Lift Stations	2	4

Notes:

1. Estimated quantities were based on a SewerCAD model developed for the service area. No surveys have been conducted as part of this project. All values are considered approximate and are provided for calculating costs and for general comparison purposes of alternatives. TASA Phase 1 conceptual layout assumes four sewer easements are obtained on the Teaticket Peninsula.
2. Linear pipe quantities have been rounded to the nearest hundred. Quantities for manholes were rounded to the nearest tens.
3. Houses that are adjacent to a gravity sewer but are located at a lower elevation than the sewer will require a small pump and a small diameter force main to connect to the system and are not counted in the quantity of grinder pumps.
4. Approximate number of connections is on a per parcel basis and includes 19 additional connections in Cedar Meadows, one additional connection in Tea Garden and 56 additional connections in Falmouthport.

5.1.2.3. Wastewater Treatment at the Falmouth WWTF

The Town of Falmouth is currently in the design phase of the Falmouth WWTF TASA Improvements Project, which will provide capacity to treat anticipated flows from TASA and ESRA (Planning Flow 1). Future upgrades will be required to treat Planning Flow 2 and 3 at the Falmouth WWTF. Design flows and loads for the TASA Improvements project are outlined in Tables 5.4 and 5.5 for Planning Flow 1.

Table 5.4. Falmouth WWTF TASA Improvements Project – Design Flow[1]

Parameter	WWTF Pre-LPSA (mgd)	LPSA (mgd)	TASA (mgd)[1]	ESRA (mgd)	Total Future Flow (mgd)
Average Day	0.45	0.26	0.36	0.14	1.21
Maximum Month	0.81	0.47	0.65	0.25	2.18
Maximum Day	0.86	0.49	0.68	0.27	2.30
Peak Hour	1.53	0.88	1.22	0.48	4.11

Notes:

1. 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.

Table 5.5. Falmouth WWTF TASA Improvement Project – Design Loads

Influent Characteristic	WWTF Pre-LPSA (lb/d)	LPSA (lb/d)	TASA (lb/d)[1]	ESRA (lb/d)	Total Future Load (lb/d)
BOD	670	630	680	210	2,190
TSS	700	740	800	220	2,460
TN	110	150	160	30	450
TP	20	20	20	10	70

Notes:
1. 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.

5.1.2.4. Effluent Discharge

The WQMC recommendations for effluent discharge based on the findings presented in Section 4 are summarized below:

1. Design existing Open Sand Beds 14 & 15 as the preferred treated effluent discharge site for the projected ESRA / TASA flows in the short-term contingent on the MEP report results for Herring Brook (which the Town is anticipating receiving in 2023). Additional flow is anticipated to be accommodated at this site through a combination of expanding the existing open sand bed area and an increase in hydraulic loading rate to 11 gpd/ sf for the expanded footprint. Groundwater modeling simulations will need to be conducted of the conceptual layout to establish the maximum allowable flow to these beds.
2. Consider ocean outfall options in Buzzards Bay and Vineyard Sound, along with land-based options at the Allen and Augusta parcels, for projected mid-term (Planning Flow 2) and long-term (Planning Flow 3) wastewater flows.

5.1.2.5. Estimated Costs and Anticipated Implementation Schedule

Capital costs for the wastewater management facilities component of the TWMP are summarized in Table 5.6. The implementation schedule for the wastewater management facilities is outlined in Table 5.7.

Table 5.6. Capital Costs for Recommended Wastewater Facilities

Infrastructure	Planned Appropriation Date	Capital Costs (Adjusted for Mid-Point of Construction Dollars for Each Project)
TASA Improvements Falmouth WWTF Upgrade	April 2022 - complete	$24.0 M (2024$)
TASA Collection System Phase 1[1]	April 2024	$39.9 M (2026$)
Recharge Facilities for TASA / ESRA Flows	April 2024	$1.4 M (2026$)
TASA Collection System Phase 2[2]	April 2026	$49.4 M (2026$)

Notes:
1. Phase 1 costs based on Alternative Number 2 Subarea 1 outlined in GP TM-1, which assumes two new lift stations locations and one sewer easement is obtained for sewershed. This planning number will be refined as the Town finalizes available lift station and sewer easement locations. The cost estimate assumes a single force main system from TASA to the Falmouth WWTF and a grinder pump allowance.
2. Phase 2 costs based on Alternative TASA TM7 Subarea 2 outlined in GP TM-1, which assumes four new lift stations locations are obtained for sewershed. This planning number will be refined as the Town finalizes available lift station and sewer easement locations. The cost estimate assumes a single force main system from TASA to the Falmouth WWTF and a grinder pump allowance.

Table 5.7. Great Pond TWMP Implementation Schedule

Activity	2022	2023	2024	2025	2026	2027	2028
Falmouth WWTF TASA Improvements Project Construction							
Town Meeting – Vote to Establish TASA Betterment Percentage							
TASA Collection System (Phases 1 & 2) and Recharge Facilities Design Appropriation and Ballot Vote							
TASA Collection System and Recharge Facilities Construction Appropriation and Ballot Vote							
TASA Collection System and Recharge Facilities Construction							

5.1.2.6. Expected Impact of Great Pond Sewering on Green Pond Nitrogen Removal

Although not a primary goal of the Great Pond TWMP, the TASA collection system will collect wastewater from 502 parcels in the Green Pond watershed. The nitrogen load removal in Green Pond through TASA sewering (of Phase 2 area) is estimated at 2,410 kg-N/yr.

This sewer extension will significantly reduce the nitrogen loading to Green Pond and will be augmented by additional removals provided by the non-traditional nitrogen mitigation strategies. Green Pond will be addressed through a future targeted watershed management plan.

5.2. Contingency Compliance Alternative

The Great Pond TMDL Contingency Compliance Alternative provides a conservative estimate of additional centralized wastewater collection and treatment that would be required if none of the pilot projects included in the preferred alternative did perform as anticipated (Table 5.8).

Table 5.8. Nitrogen Budget for Great Pond to Achieve Nitrogen TMDL Compliance

	Estimated Nitrogen Loading Reduction (kg-N/year) - Contingency Alternative
Fertilizer Bylaw (25% of fertilizer load)[1]	0
Stormwater Best Management Practices (25% of impervious load)[1]	0
Shellfish Aquaculture (uptake)[1]	0
Shellfish Aquaculture (denitrification)[1]	0
Permeable Reactive Barrier at Shorewood Drive (300 feet)[1]	0
Sewer Extension – Little Pond Sewer Service Area (Great Pond)	1,000
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 1	2,890
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 2	3,298
Sewer Extensions – Contingency	4,966
Total Estimated Reduction	**12,154**
Nitrogen Removal TMDL Goal	**12,154**

Removal of an additional 4,966 kg-N/year through sewering would require the sewering of approximately 1,232 single family residential properties sewered in the Great Pond watershed north of Route 28 (based on an average nitrogen removal of 4.6 kg-N/year unattenuated N load per single family home).

5.3. No Action Alternative

As part of the development of the Recommended Plan a No Action Alternative was considered to establish an initial baseline for the project and summarize potential impacts if the Town were to proceed without implementing any recommended improvements to addresses its nitrogen reduction needs in Great Pond through an approved TWMP.

The impact of excessive nitrogen impact on coastal waters and other natural resources is well documented. Without addressing these identified needs Falmouth would continue to lose natural and economic resources, including declines in finfishing and shellfishing habitats, decline in property values, continued algal blooms in coastal embayments, beach and shellfish closures, and potential declines in tourism as the aesthetic impacts of excessive nitrogen loading continue to impair the Town's water resources.

Financial impacts of the No Action Alternatives may include:

- Reduced property values and revenues
- MassDEP issuance of Consent Order to achieve the TMDLs and associated fines for not doing so in a timely manner
- Reduced commercial shellfish / fin-fish income
- Potential litigation
- Reduced income to local businesses due to the reduced attractiveness of the town to tourists and seasonal residents and retirees with accompanying loss of jobs.
- Loss of future funding for projects through the State Revolving Fund (SRF) or other means

5.4. Adaptive Management and Monitoring

The Town of Falmouth's CWMP includes the implementation of an adaptive management process to incorporate cost effective non-traditional methods into the plan once they demonstrate feasibility. The adaptive management process will involve ongoing water quality monitoring to monitor and respond to the results of the implementation of the preferred compliance plan

This adaptive management approach will enable the CWMP to be adjusted based on the monitoring results of the environmental and economic impacts associated with the construction of sewers and implementation of non-traditional projects in Falmouth. Coordination with MassDEP and CCC will also be conducted, and key factors incorporated into the adaptive management plan.