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Project name:
Mill Pond Study

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To:
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From:
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CC:

Date:
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Memo

Subject: Orleans Nitrogen Management in Mill Pond Sub-Watershed: Collection System Connected to Existing WWTF

The Town of Orleans (Town) has identified ten options for reduction of nitrogen load in the Mill Pond sub-watershed (shown in Figure 1), to improve water quality in this sub-watershed.

This memorandum addresses the option to extend the collection system and convey wastewater to the existing municipal wastewater treatment facility (WWTF) on Overland Way to reduce the septic nitrogen load contributions to Mill Pond.

Description

This option involves extending the collection system within the Mill Pond sub-watershed and conveying wastewater to the existing WWTF. Based on preliminary layout review, the collection system would include gravity pipes, possibly low pressure pipes, a pump station, and a force main that discharges into the Phase 2 service area at Great Oak Road.

To understand the relative reduction in nitrogen load, three scenarios have been evaluated, and are described below. Figure 1 shows the infrastructure needed and parcels associated with each scenario. Note that subsequent scenarios are inclusive of prior scenarios. The pump station and force main are required for all scenarios. Contributing parcels identified in the figure are identified based on assumed location of septic systems relative to the estimated area contributing to Mill Pond water quality.

Scenario 1.

Parcels located along Great Oak Road and Brick Hill Road within the Mill Pond/Pochet North Study Area as defined in the Amended Comprehensive Wastewater Management Plan (ACWMP). This scenario represents establishment of the central collection and conveyance pipe for the area and is included as a representative minimum establishment of sewer in the Mill Pond watershed. Figure 1 highlights contributing parcels with blue shading.

Scenario 2.

Parcels included in Scenario 1, plus those along Westwood Drive, Rose Path, Blueberry Lane, Dylan Way, Colony Drive, East Circle Drive, Harbor View Lane, Harbor View East, and Little Cove Lane. These are roads within the Mill Pond/Pochet North Study Area. This scenario represents an expansion of sewers to match those identified in the ACWMP that benefit Mill Pond. Figure 1 highlights the additional contributing parcels with red shading.

Scenario 3.

Parcels included in Scenario 2 plus those along Brick Hill Road, Beginners Lane, and Safe Harbor Lane.

The additional roads complete buildout of the sewer system within the Mill Pond contribution area defined during evaluation of permeable reactive barriers (PRBs). This scenario represents sewering the parcels that would benefit Mill Pond that are proximate to the existing sewer system. Figure 1 highlights the additional contributing parcels with purple shading.

The following sections evaluate these scenarios as a basis for screening to determine which alternative or alternatives are most suitable for additional consideration.

Ownership and Control

Like the implementation of the Downtown and Meetinghouse Pond sewer service areas, the sewer infrastructure would be owned, operated, and maintained by the Town. Easements would be needed in the case of private roads. The connection from the private properties to the Town infrastructure, including grinder pumps if necessary, would be owned by the private property owner.

Performance

Collection systems are a traditional method for managing wastewater. Conveying flows from individual properties to the central treatment plant prevents septic effluent from discharging directly into groundwater. This approach has proven to be reliable for consistently reducing nitrogen levels across a watershed.

Table 1 summarizes nitrogen removal for each scenario. This Study assumes a septic nitrogen load to the groundwater of 5.4 kg/yr/parcel.

Table 1. Nitrogen Removal Estimates for Scenarios 1, 2, and 3

Scenario	Parcels within Contribution Area	Approx. Nitrogen Removal (kg/yr)
1	25	140
2	85	460
3	107	580

The target removal established for comparison purposes for this Study is 750 kg/yr. Scenarios 1, 2, and 3 would achieve 19%, 61%, and 77% of that goal, respectively. It should be noted that the Study goal was established based on the USGS/MEP Mill Pond Subwatershed, which is larger than the contributing area for Mill Pond. Therefore it is not surprising that 100% of the nitrogen removal target would not be met through sewering alone. Sewering can remove relatively high amounts of nitrogen compared to some other nitrogen management alternatives, depending on the number of sewered parcels.

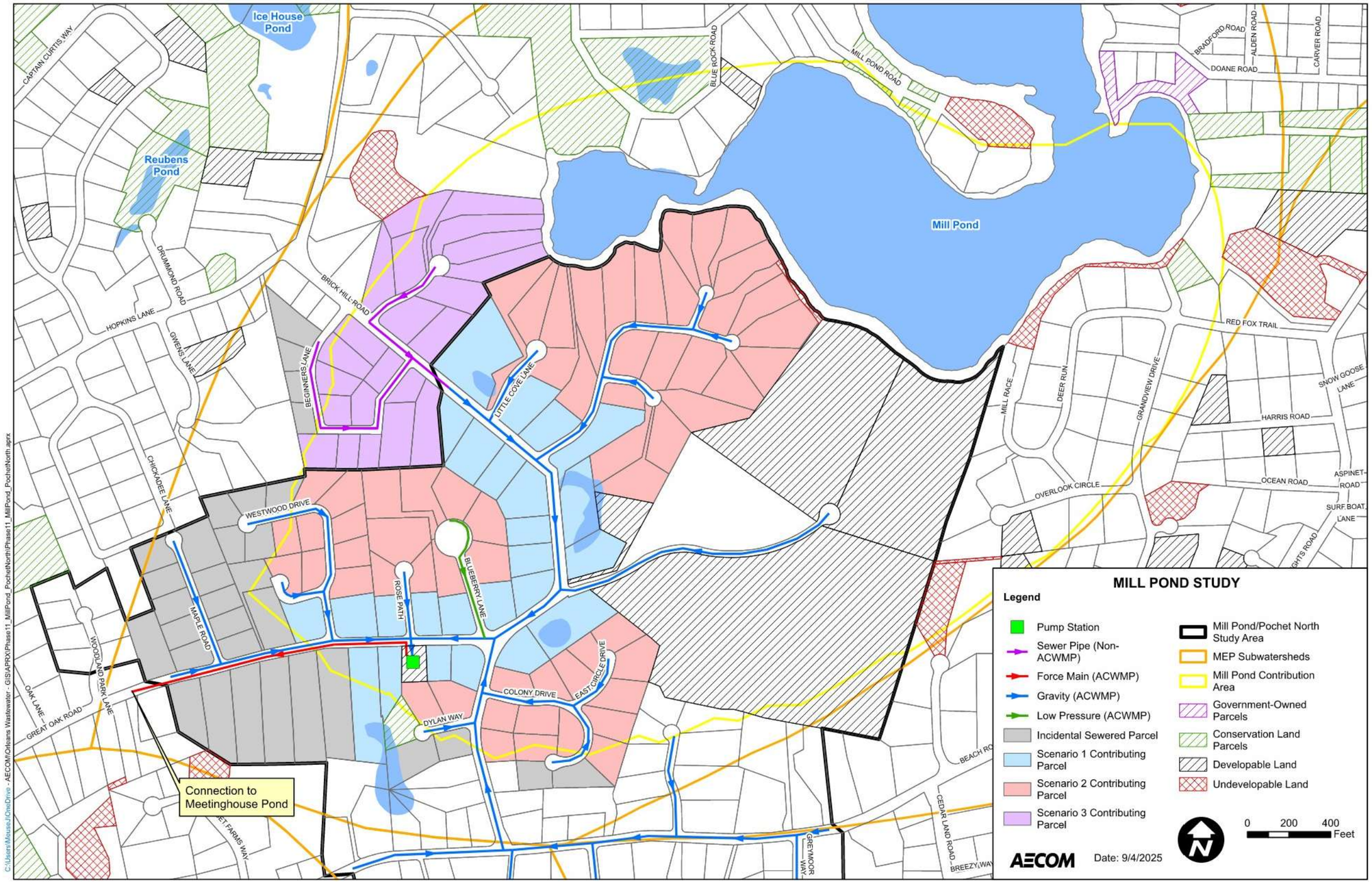

Figure 1: Assumed Contributing Parcels for Scenarios 1, 2, and 3

Costs

Due to the significant material, equipment, and installation costs, the cost of this alternative has a relatively high capital cost. Operations and maintenance costs are also higher than many of the other alternatives due to the amount of public infrastructure and power requirements for the pump station.

If this alternative is implemented ahead of the WWTF expansion it would use capacity that would otherwise be available for other service areas, leading to accelerated expansion and earlier associated costs. Sewering of this general area was anticipated at the time of the ACWMP so implementation of this alternative would not impact post-expansion WWTF capacity.

Speed of Water Quality Improvement

The speed of water quality improvement depends on how far from the water body the nitrogen is being removed. Sewer removes the septic load at the source but does not address the legacy nitrogen, meaning that the septic nitrogen load introduced to the groundwater prior to sewering will still impact the water body. Scenario 2 is anticipated to have a shorter time than Scenario 1 to incremental water quality improvement as it includes parcels closer to the water body. The benefit associated with sewering the closest parcels to the pond could be on the order of a few years while the full benefit at Mill Pond of sewering could take decades to realize.

Predictability of Performance

Nitrogen removal through sewering is predictable at a property scale and measurable at a regional scale. Nitrogen concentration at the WWTF influent and effluent is measured and the difference is the nitrogen removed. Sewering does not take advantage of the attenuation that occurs within a septic system which should be considered when comparing load removal.

Reliability

Sewering is considered to be a very reliable method for removal of septic nitrogen load. The performance of the system is controlled by the Town with established regulatory requirements and oversight.

Need for Large Town Capital Expenditure

The Town has committed to remove large amounts of nitrogen in the Pleasant Bay watershed under the 2018 Watershed Permit. The very high costs of that commitment mean that the Town has limited ability to undertake costly nitrogen removal projects in other watersheds, like the Nauset Harbor system. Implementation of this higher cost alternative would delay Pleasant Bay watershed progress or, if implemented in parallel with Pleasant Bay watershed sewering, place a relatively high strain on the Town's finances compared to other alternatives.

Regulatory Acceptability

Sewering is a well-known approach to regulatory agencies for nutrient management. The Town has experience permitting sewering projects through the Downtown and Meetinghouse Pond Sewer Service Areas. Similar permitting steps would be required. Since much of the sewered area was included in the MEPA- and DEP-approved ACWMP it is possible that no further MEPA documentation would be required.

Public Acceptability

As mentioned above, sewers have been implemented in other service areas and this area has been identified as a planned sewer expansion phase. As such it is anticipated that the public would continue to support sewers in the Mill Pond subwatershed. There may be some opposition raised however if there is a perception that implementation of this alternative, with its high capital cost, is preventing achievement of regulatory requirements, preventing implementation of other Town capital priorities, or impacting the Town's financial standing and flexibility.

Flexibility in Face of Unknown TMDL and Applicability to a Phased Approach

Sewering is relatively inflexible compared to some of the other nutrient management approaches included in this Study. Once implemented it is impractical to adjust to a smaller-than-anticipated TMDL due to the installed infrastructure. Should the removal requirement be larger than anticipated the capacity of installed infrastructure may not be adequate. Pairing a sewer alternative with other nutrient management approaches requires careful planning as well. Since sewering removes all the septic load at the source, it can make downgradient management alternatives, such as PRBs, less cost-effective over time as the septic load is reduced. Other alternatives such as urine diversion systems and innovative alternative systems are in direct conflict as these alternatives also target septic nitrogen load specifically.

Where sewering is implemented as a partial solution, planning both spatially and temporally is required to ensure that Town funds are spent efficiently. Consideration should be given to building additional capacity into the sewer system in case future need is identified.

Environmental Impacts

Environmental impacts are limited and many are short-term construction impacts associated with infrastructure installation. They may be more significant than other nutrient management alternatives however due to the amount and type of construction required. Sewers have typically been installed in the streets which reduces habitat impact but would disrupt traffic flow during construction. Excavation would also be required on the properties that connect to the sewer, extending construction impacts beyond the Town's project. Energy use for the local pump station and the incremental energy use at the WWTF to move and treat the flow contributes to the system's overall environmental impact.

Impact on the Orleans WWTF

The existing WWTF has a finite capacity to treat and dispose of municipal wastewater. It will need to be expanded to handle the wastewater that would be collected in the current sewer master plan. Sewer flow generated through this alternative would be conveyed to the WWTF. As described above, the impact on the WWTF depends on the timing of implementation compared to expansion of the WWTF.

Ease of Implementation

The Town's experience with implementation of earlier sewer phases serves as a strong blueprint for implementation in the Mill Pond area. The Town has all the resources and experience required to implement this option in the planning, design, construction, and operational phases.

Summary of Advantages and Disadvantages

Sewering within the Mill Pond groundwater subwatershed and conveying flow to the existing WWTF has these principal benefits:

- Predictable, reliable nitrogen removal; and
- Highly acceptable to public and DEP.

The principal drawbacks include:

- High cost;
- Disruptions during construction; and
- Relatively long time to realize the full benefit of the alternative.