



## **4 2012 Development of Options 1A, 1B, and 1C**

### **4.1 Introduction**

As the Town moves forward in development of a Recommended Plan for nitrogen management within the Project Planning Area, one management approach is to collect wastewater, treat it to a very high level, and then recharge the treated effluent back to the ground. The purpose of this Chapter is to summarize the three most recent approaches developed on behalf of the Town for evaluation and modeling by the MEP. That modeling effort is to identify whether the approach presented will achieve the TMDLs under a future condition. This Chapter describes the development and outline of these new options that will form the basis of the Recommended Plan being developed as part of the WNMP.

### **4.2 Background**

In the Spring of 2008, as part of the WNMP, a Draft Alternatives Scenario Analysis and Site Evaluation Report was issued; and a “Nitrex™ Technology Scenario Plan” (Scenario 3—Cluster) was also prepared in order to evaluate five different scenarios for addressing future nitrogen loadings on the Project Planning Area.

These reports, with some updates made to the Scenario 3—Cluster approach, were then run through the MEP Modeling Approach as described in Chapter 3 to evaluate their ability to meet the TMDLs established for Popponesset Bay and Waquoit Bay East. The results were issued in two memorandums dated November 13, 2009 and February 9, 2010. The results were compared to embayment thresholds and those total nitrogen thresholds associated with eelgrass and infauna. These scenarios and findings are summarized in Chapter 3 of this Report.

Following the release of those findings, the Sewer Commission then met to discuss possible discharge locations including those identified previously, such as Site 4 (the Transfer Station) and Site 7 (part of the New Seabury Golf Course), and new locations such as several parcels north of John’s Pond (identified for presentation purposes as the Back Road Parcels), expansion of use at Willowbend Golf Course, and possible expansion of use at the New Seabury Golf Course.

As a result of these initial MEP scenario findings, the Sewer Commission had asked GHD to move forward with the development of two new scenarios to be modeled at that time. The initial step of establishing these two new scenarios was based on a Sewer Commission map which re-divided the Project Planning Area into several sections identifying preliminary collection and treatment locations within the Project Planning Area. These groupings were similar to those established in the Draft Alternatives Scenario Analysis Report (called out as “sewersheds”); however, they were often larger and not necessarily based on potential collection system layouts but more often on neighborhood/development areas. This preliminary figure (Figure 1 dated 12-13-10 in Appendix G) shows each of these areas and their proposed discharge location. This preliminary layout plan included a portion of Barnstable and Falmouth within the planning area, but did not include the Town of Sandwich. However, it was understood that the Town of Sandwich would be included in any alternative to be evaluated in the project.

These layouts were then used to create two initial options (Nos. 1 and 2) that were presented to the Sewer Commission in the Spring of 2011. Based on these two options for addressing nitrogen within the Project



Planning Area, the Sewer Commission offered several suggestions. These were considered and the options were transformed into Option 1A and Option 1B, as described in subsequent sections.

The general comments from the Sewer Commission relative to these initial two options helped form Options 1A and 1B, and were as follows:

- Use of Rock Landing—Consider one option of relocating the wells from that location and a second alternative where Rock Landing site was not available.
- Maximize use of New Seabury Golf Course (under one scenario, the other scenario should focus on it not being available).
- Maximize use of Willowbend Golf Course.
- Sewer Popponesset Island under all options.
- Possible pilot project within the Pirates Cove neighborhood using Nitrex™ technology or PRB technologies.
- Look at options of Barnstable, Falmouth, and Sandwich dealing with their nitrogen loads outside of the watershed. In subsequent meetings, the Sewer Commission requested a second look at the portion of Falmouth east of the Quashnet/Moonakis River in Mashpee (as originally presented to the Committee). Based on this reconsideration, the eastern part of Falmouth was to be addressed within the watershed when developing the options.
- Consider sensitivity analysis of improved attenuation south of Santuit Pond and Quashnet Bogs; and possibly through Willowbend.
- Improve all small WWTFs to 3 mg/L. Initially, the approach by GHD was to only consider improvements to larger facilities as it would likely be more cost-effective in the short term relative to the amount of nitrogen load discharged by these smaller facilities.
- I/A systems for now will continue to be considered at 19 mg/L, with the understanding that it is possible to achieve higher performances if designed, installed, and operated properly (which was the basis for initially considering 10 mg/L TN effluent for some of these facilities). It is presumed that the average 19 mg/L (as shown in recent reports prepared by Barnstable County) is a reasonable assumption for average use and remains consistent with the MassDEP approval process for these systems.

Additional assumptions by GHD used in the analysis:

- Sites being considered (outside of existing WWTF discharge sites) include:
  - Site 2 (Ashumet) for treatment only
  - Site 4 (Transfer Station) for treatment and discharge
  - Site 6 (Keeter) for treatment and discharge
  - Back Road Site for treatment and discharge
  - Site 7 (New Seabury) for discharge
  - New Seabury Golf Course for discharge (expanded beyond the original one fairway)



- Willowbend Golf Course for discharge
- Site 11—Golden Triangle in Sandwich for possible treatment and/or discharge
- Expansion of existing facilities include:
  - Willowbend
  - New Seabury
- New Small WWTF considered with possible expansion:
  - Wampanoag Village
  - Cotuit Meadows
  - A possible cluster northeast of Santuit Pond
- All other existing WWTFs may see upgrade to 3 mg/L and may or may not relocate their discharge.

For the purpose of aggregating flows and loadings, each of the areas highlighted by the Sewer Commission in their December 2010 map were assigned a letter designation; and then those areas not covered, or outside of Mashpee, were assigned a separate designation in GIS, some using past “sewershed” numbers as established in the Draft Scenarios Report, and some new designations.

The following is a brief description of the approximate area (please see Figure 2 – Appendix G).

- A. Seconsett Island
- B. Areas to the east and west of the existing New Seabury facility
- C. Monomoscoy Island
- D. Areas surrounding and including the Keeter Property
- E. Area around Holland Mills Estates, Great Hay Acres, and Southcape Resorts
- F. Pirates Cove
- G. Mashpee Village
- H. Areas south of Johns Pond including the High School
- I. Area around Willowbend
- J. Southport
- K. Cotuit Meadows and portion of Barnstable to the east
- L. North of Johns Pond, Briarwood area
- M. North of Ashumet Pond
- N. Steeplechase
- O. Stratford Ponds
- P. Area around Mashpee Rotary north along Great Neck Road



- Q. Future Wampanoag Village site north towards Town Hall
- R. Northeast of Santuit Pond
- S. West of Santuit Pond (south picking up neighborhoods west and south of Willowbend)
- T. Area along Route 130 between Town Hall and Sandwich

Additional designations include:

- Sandwich Sewersheds 1 through 9 were used again (includes the northernmost part of Mashpee)
- Falmouth Sewersheds 1 through 17
- Barnstable Sewersheds 37, 38, 39, and 42
- Miscellaneous areas were also picked up including areas of Mashpee outside the watersheds, Popponesset Island, areas within the watersheds anticipated to remain on septic systems, and some clusters of I/A systems like Sconset Village and the Nitrex™ system located near Town Hall.

It's important to note that although these options present a way of identifying where flows and loads are collected, treated, and discharged, it is the nitrogen discharge and its location within the watershed(s) that is the critical piece for modeling through MEP. Within any alternative that is ultimately developed, there remains the possibility that flows could be "traded" for balancing purposes if it is determined to be more cost-effective. For example, around Johns Pond some properties may end up potentially being served at the Back Road Site, while other areas might end up outside of the watershed. Most likely there will be some balance between the loads generated from Southport and those generated from the areas south and west of the pond. Once the options are modeled through MEP, the more difficult tasks of cost estimating, refining, and phasing of any alternative plan can take place; however that is not the purpose of this part of the analysis.

Options 1A and 1B were presented in October 2011, and the Sewer Commission requested that a third option (Option 1C) be developed. This third option would reflect parts of Options 1A and 1B. Primarily, it focuses on the New Seabury/Rock Landing sites not being available, however Option 1C requires that the portions of Barnstable, Falmouth, and Sandwich that are proposed to be addressed are handled the same as in Option 1A. Therefore, properties within the Town boundaries of Mashpee are handled very similarly to Option 1B.

Following the October 2011 presentation on Options 1A and 1B, some additional minor changes were made to these scenarios to address questions raised regarding meetings TMDL's within subwatersheds and requests to examine some individual properties. These included the following:

- Barn-39 was included under each scenario (1A, 1B, and the new 1C) to address higher loads to Shoestring Bay. This flow was considered removed from the watershed under each scenario.
- Additional flow removed from Jehu Pond under each scenario (1A, 1B, and 1C) to reduce loads in this watershed (approx. 1,600 gpd treated at either Rock Landing or Keeter Property depending on the Option).
- Added Anthony's Way and Equestrian into the I/A group.



- Identified a double-accounting of build-out wastewater flow within the Mashpee River watershed. As part of the estimation of nitrogen impacts, GHD modified the MEP “Rainbow Spreadsheets” to estimate the nitrogen load and attenuation to the watersheds. MEP had estimated build-out load which included wastewater and non-wastewater sources. To evaluate the options, the MEP build-out load was modified to eliminate wastewater flows (as they are being accounted for as part of the GHD analysis); however, within the Mashpee River watershed, not all the wastewater nitrogen was removed during the initial GHD analysis from the MEP model. This has been corrected as part of this data analysis.
- T. Fudala of the Sewer Commission identified a change in a future 40B project, and flows for Parcel 19-10 were reduced to eliminate 120 apartments; however, the projected remaining build-out as previously identified by the Town is to remain.

### **4.3 Option Description**

#### **4.3.1 Option 1A Description**

This option was a modification to the first of two presented in the Spring of 2011. The primary goal was to look at sending as much flow as possible to the existing Rock Landing Well Site or Site 7, under the assumption for Rock Landing to be considered that these wells would be relocated in the future to allow treated water recharge to occur at this site. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 1 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1A the majority of the treated flow is proposed to be sent out of the watershed to the south in Mashpee; the majority of the smaller WWTF would remain although treated at a higher level; and portions of Barnstable, Falmouth, and Sandwich would be treated out of the watershed.

Figure 3 shows the location and discharge areas summarized on Table 1 (figures and tables can be found in Appendix G).

#### **4.3.2 Option 1B Description**

This option was developed after receiving comments from the Sewer Commission on Option 1A. The primary goal was to look at how wastewater might be managed if the Rock Landing and New Seabury discharge locations were not available. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 2 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future under this option, and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1B the future flows are more dispersed with eastern Mashpee (around Willowbend) receiving the largest portion of the flow, with other large recharges at Sites 4, 6, and the Back Road parcels. Again some of the smaller WWTFs would remain with a higher treatment level. This option also assumes that all of Sandwich’s flow remains within the Project Planning Area, and Barnstable’s flows are treated within the planning area as well. This option does consider that the portion of Falmouth west of the Moonakis/Quashnet River is removed from the Project Planning Area (similar to Option 1A).



Figure 4 shows the location and discharge areas summarized on Table 2 (figures and tables can be found in Appendix G).

#### **4.3.3 Option 1C Description**

This option was developed after receiving comments from the Sewer Commission following the submittal of the October 3, 2011 Draft Memorandum on Options 1A and 1B. This option is similar to 1B as it looks at how wastewater might be managed if the Rock Landing and New Seabury discharge locations were not available; however, there was concern that Options 1A and 1B managed flow from the neighboring towns differently, so Option 1C was established to replicate how flows in Barnstable, Falmouth, and Sandwich are managed similar to Option 1A. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 3 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future under this option, and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1C the future flows are more dispersed with eastern Mashpee (around Willowbend) receiving the largest portion of the flow, with other large recharges at Sites 4, 6, and the Back Road parcels. Again, some of the smaller WWTFs would remain with a higher treatment level. This option manages the neighboring towns in the same manner as done in Option 1A.

Figure 5 shows the location and discharge areas summarized on Table 3 (figures and tables can be found in Appendix G).

#### **4.3.4 Preliminary Findings Leading to MEP Model Runs**

The results of this analysis were then entered into previously developed MEP “Rainbow Spreadsheets” that were modified/updated to show the recharges based on the tables referenced above and compared against the MassDEP issued TMDLs for nitrogen in the various watersheds. The preliminary results are shown in Table 4 (Appendix F) which demonstrates that distribution of the nitrogen loads should be within the allowable thresholds.

Because this was not the official model run by the MEP, the impact on the various watersheds was considered approximate until run through the MEP model for verification. This analysis and the supporting data (GIS data set of the unified database) was submitted to MEP to run each of the three options in their model. MEP then issued another technical memorandum summarizing the results, similar to those issued November 13, 2009 and February 9, 2010.

The following caveats were issued as part of the Option development for MEP modeling:

- The focus of this step is to identify the discharge locations and volumes so they can be incorporated into a scenario including considerations for maximum month and peak day conditions required for facilities design.
- All these options are based on the assumption that private facilities will be owned and operated in the future by the Town or District. The Town/District should continue with negotiations with all of these facilities.
- All these options are based on the assumption that the recharge sites can accommodate the flows (at all conditions: average, maximum month, peak day); the Town/District will need to verify this as part of preliminary design, final design, or as an amendment to this project.



- Recharge to the Keeter Property assumes there is a distribution of treated recharge to several watersheds including directly to Nantucket Sound. More recent USGS modeling efforts may provide a clearer estimation of the distribution of this nitrogen load.
- This assumes that towns will manage their respective loads or be willing to enter into agreements regarding regional facilities.
- Nitrogen concentrations from septic systems at 26.25 mg/L are based on MEP/DEP findings.
- Nitrogen concentrations from I/A systems are assumed to be 19 mg/L based on current MassDEP permitting and the findings of the Barnstable County study; however it is understood that some of these facilities may be able to achieve much higher treatment performance, however a conservative approach was selected.
- Flows are based on those in the unified database and build-out information developed previously. It is also understood that MEP has been developing the full Waquoit Bay Watershed TMDL, and therefore adjustment may be required to address changes related to those findings as an amendment to this project.
- The development of the Recommended Plan is where the implementation and phasing approach of the project will be developed, which will focus on addressing current wastewater needs with the understanding that proposed facilities will need to be able to accommodate future growth.
- It is understood that the current economic climate and population trends across the Cape are flat; however any future plan will have to consider that over a 20-year period these conditions will change, and will need to be flexible in both a positive (growth) and negative (declining) direction. Per the 2010 Census, Barnstable County saw a 2.9-percent decrease in population while Mashpee experienced a growth of almost 9-percent over that same period.

#### **4.4 MEP Data**

The Unified Database was transmitted to MEP with additional columns provided to allow correlation to Tables 1 through 3. The following options as outlined in Tables 4-1 through 4-3 were referenced for model runs.



**Table 4-1 Option 1A—Summary of Recharges (from Table 1)**

<b>Planning Area</b>	<b>Locations</b>	<b>Est. Average Annual Future Flow (gpd, rounded)</b>
WWTF recharge within Popponeset Bay Watershed	South Cape Village; Site 4 (Transfer Station); Willowbend; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village	280,000
WWTF recharge within Waquoit Bay East Watershed	Back Road	370,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Rock Landing; New Seabury; Sandwich; Barnstable; Falmouth	1,550,000
<b>Totals (rounded)</b>		<b>2,700,000</b>

**Table 4-2 Option 1B—Summary of Recharges (from Table 2)**

<b>Planning Area</b>	<b>Locations</b>	<b>Est. Average Annual Future Flow (gpd, rounded)</b>
WWTF recharge within Popponeset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster, Sandwich	1,520,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	340,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Falmouth	350,000
<b>Totals (rounded)</b>		<b>2,700,000</b>



**Table 4-3 Option 1C—Summary of Recharges (from Table 3)**

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster,	1,030,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Sandwich; Falmouth	690,000
<b>Totals (rounded)</b>		<b>2,700,000</b>

**4.5 MEP Model Results**

In November 2012, the University of Massachusetts Dartmouth SMAST issued the model results for the three options (1A, 1B, and 1C). The results indicated that “all three options meet the threshold values/TMDLs at the sentinel station for restoration of eelgrass in Popponesset Bay.” The results also indicated that “all three options do not meet the threshold values at the sentinel station for restoration of eelgrass in Jehu Pond or Hamblin Pond. All three options do meet the water column TN concentration that would be restorative of infaunal habitat in the Quashnet River. Their model result tables also indicate that all three options meet the TMDL/MEP threshold for Great/Little River and Upper Waquoit Bay.

Based on their model analysis in this watershed, Options 1A and 1B removed more nitrogen than necessary indicating that these options could potentially be adjusted to reduce the amount of sewerage or accept additional flows from the Waquoit Bay watershed to help address the nitrogen load in Jehu Pond and/or Hamblin Pond. In addition, discussions with MEP indicate that although Jehu and Hamblin Ponds do not meet the TMDL thresholds, this is a reflection of the New Model including all of Waquoit Bay, not just the portions evaluated previously. This also reflects no nitrogen removal in other parts of Waquoit Bay. If additional nitrogen removal occurs in Falmouth, it is very likely that these two watersheds will meet the TMDLs.

The following Table 4-5 summarizes the findings as presented in Tables 3 and 4 from the MEP technical memorandum.



**Table 4-4 Summary of Threshold Comparison Results**

<b>Watershed/Embayment Section</b>	<b>TMDL/MEP Threshold</b>	<b>Option 1A</b>	<b>Option 1B</b>	<b>Option 1C</b>
	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>
Popponesset Bay—Head	0.38	0.359	0.366	<b>0.381</b>
Mashpee River—Mid to lower	0.4-0.5	0.447	0.474	0.492
Shoestring Bay—Upper to lower	0.4-0.5	0.433	0.440	0.481
Ockway Bay—Upper	0.4-0.5	0.413	0.436	0.451
Jehu Pond—WB1	0.446	<b>0.471</b>	<b>0.481</b>	<b>0.481</b>
Great/Little River—WB3	0.38	0.355	0.359	0.359
Hamblin Pond—WB4	0.38	<b>0.39</b>	<b>0.398</b>	<b>0.398</b>
Quashnet River—WB7, WB8	0.52	0.502	0.503	0.503
Upper Waquoit Bay—WB12	0.38	0.358	0.359	0.359

Blue shading represents those that do not meet the Threshold.