In 2010, the Town of Mashpee sought and received a $27,500 grant from the County to fund facilitation of a formal inter-municipal agreement between the three towns regarding shared responsibility for meeting the TMDL target based on the “fair share” methodology developed under the Pilot Project, as well as a similar agreement with Sandwich and Falmouth regarding Waquoit Bay. Michael Domenica, P.E., of CH2M Hill (at that time) was hired as the facilitator by the County Water Quality Collaborative. He prepared a draft IMA for Popponesset Bay in 2011, circulated it to the towns, and attended a number of meetings with their relevant committees including the Sandwich Wastewater Advisory Committee, the Barnstable Citizens Advisory Committee for Wastewater Planning, and the Mashpee Sewer Commission. Mashpee and Barnstable indicated support for the IMA. Sandwich took no action, as they had not begun work on a wastewater plan. The last draft of the Popponesset Bay IMA is dated October 2012, after which no further work was done under the grant. No work was ever done on a Waquoit Bay IMA.

3.8 Local Newspaper Coverage

Throughout the course of the project, the Mashpee Enterprise has typically had a reporter at each of the Mashpee Sewer Commission meetings documenting and presenting the findings of each of these meetings. Due to the large number of related articles, they have not been included in this document; however they can be requested from the paper.

3.9 Participation in the MEPA/Development of Regional Impact (DRI) Process

In 2001, the Mashpee Sewer Commission filed the initial Environmental Notification Form (ENF) noticing the project and entering into the MEPA review process. Throughout the process, the Town has submitted several documents for public and regulatory review including two (2) Notice of Project Change documents, the Needs Assessment Report, Alternatives Screening Analysis Report, Draft Recommended Plan and Draft Environmental Impact Report, and this Final Recommended Plan and Final Environmental Impact Report.

The Town held a public hearing as part of the DEIR (listed in Section 3.5), and will hold additional public hearings as part of the Final Environmental Impact Report (FEIR) and DRI processes following the submittal of this document and the subsequent final document.

4 Planning Framework and Summary of Evaluations

4.1 Introduction

The purpose of this chapter is to summarize the Recommended Plan framework as presented in the 2013 Alternatives Screening Analysis Report (ASAR) and the Draft Recommended Plan/Draft Environmental Impact Report (DRP/DEIR) and present the evaluations performed in Chapter 5 of the DRP/DEIR.

Following the Mashpee Sewer Commission meeting held on January 17, 2013, the framework of the Recommended Plan development began to take shape based on the findings of the three Options run through the MEP model and summarized in the ASAR.

Based on the various components being considered in the Recommended Plan, each was grouped into one of the following three categories (each as defined below):

- Source Removal
- Direct Environmental Mitigation
- Land Management Strategies

Source Removal is generally defined for this project as the removal of nitrogen (or some portion of it) and other contaminants before they reach the local groundwater. Source Removal has been further subdivided into the following categories for this plan based on the major controllable sources:

- Wastewater Management
- Stormwater Management
- Fertilizer Management

Each of these management approaches allows the towns within the planning area to mitigate nitrogen before it enters the groundwater and eventually reaches the ponds and estuary systems.

Direct Environmental Mitigation is generally defined for this project as the reduction and/or removal of nitrogen (or some portion of it) at or in close proximity to the area of impact. It has been further subdivided into the following categories:

- Dredging/Inlet Widening
- Shellfish Aquaculture
- Permeable Reactive Barriers (PRBs)
- Enhanced Natural Systems

Each of these management approaches has been identified as an alternative or additional management approach allowing the towns within the planning area to mitigate nitrogen after it has entered the groundwater but prior to or at the point it reaches the ponds and estuary systems.

Land Management Strategies are generally defined for this project as the growth and development management strategies to reduce the potential of the Project Planning Area reaching a build-out condition which increases the cost and difficulty of achieving TMDL compliance.

Much of the discussion as part of this project to date has focused on the Source Removal approach, and recently there has been a greater push for Direct Environmental Mitigation to be used in one of two ways—reduce or eliminate the need for Source Removal in certain areas, or be implemented prior to Source Removal—to either allow longer phasing of any Source Removal strategy or ultimately the reduction of the need for full-scale traditional wastewater management.

As was clearly shown in all eight previous scenarios identified in the ASAR and DRP/DEIR, a massive amount of Source Removal is required to achieve the TMDLs under the build-out condition if Direct Environmental Mitigation is not considered or proven feasible through current efforts and/or demonstration/pilot projects.

Land Management Strategies are intended to reduce the potential for new sources entering the planning area, typically through development and growth. This will be an important component with regards to minimizing future nitrogen levels and funding incentives for controlling growth.

4.2 Source Removal

As discussed in the DRP/DEIR several Source Removal approaches were identified and screened as part of the planning process.

As part of the Draft Recommended Plan the following Source Removal approaches were included:

- Use of existing Wastewater Treatment Plants (WWTP) with needed improvements/expansions/modifications (in the planning area):
  - Joint Base Cape Cod
  - New Seabury
  - Willowbend
  - Mashpee Commons
  - Mashpee High School (depending on JBCC)
  - Cotuit Meadows
  - Wampanoag Village
- Wastewater treatment at existing Wastewater Treatment Facility (WWTF): Operating under existing permit, consider upgrade to improve performance (3 to 6 mg/L TN) based on shellfish results and other adaptive management programs:
  - Forestdale School
  - Mashpee Village
  - Southport
  - South Cape Village
  - Stratford Ponds
  - Windchime Point

- Potential new WWTPs:
  - Transfer Station (Site 4)
  - Possibly at Site 6 (depending on shellfish performance)
  - Possibly at Back Road Sites (as an alternative to Joint Base Cape Cod)
- Continued use of existing septic systems and Innovative and Alternative (I/A) Onsite Systems:
  - Existing I/A systems at various performance levels.
  - Systems used in accordance with Board of Health (BOH) requirements in areas not identified for nitrogen removal.
  - Mashpee will establish how its plan will address these types of systems as part of a management approach if used as part of any TMDL compliance.
- Stormwater improvements:
  - Continued Best Management Practices (BMP) implemented through Department of Public Works (DPW) on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds.
  - Zoning bylaws and subdivision regulations in place regarding stormwater controls.
- Fertilizer Management:
  - Nitrogen bylaw
  - Local regulations and Cape Cod Commission efforts creating a Cape-wide District of Critical Planning Concern (DCPC)

Regarding the last two items, the Town of Mashpee has adopted its fertilizer management bylaw (nitrogen reduction bylaw – as has the Town of Falmouth) and Mashpee has been implementing best management practices regarding stormwater improvements for nitrogen removal since the 1990s both through its zoning requirements for new development and through Town-constructed stormwater projects.

4.3 Direct Environmental Mitigation

Direct environmental mitigation is essentially removal of nitrogen (or some portion of it) at or in close proximity to the area of impact. This can be further divided into the following subcategories, with a brief description of potential considerations for use:

- Shellfish Aquaculture:
  - Build upon the Town's existing program and consider expansion for anticipated positive impact on embayments.
  - Oysters—Mashpee River, Popponesset Bay, Shoestring Bay.
  - Quahogs—Jehu, Hamblin, Great River, Little River, Ockway Bay, and Popponesset Bay.
- CCC 208 Plan Options

- Several alternative technologies were reviewed and identified as part of the 208 planning process. These technologies as proven feasible and either piloted or permitted could be implemented as part of the Adaptive Management Program discussed in Chapter 10.

- Feasibility Study for Implementing Soft Solutions for Restoring the Quashnet/Moonakis River.
  - This was identified as a potential approach to address an area that could not be served by shellfish aquaculture and could potentially reduce the amount of traditional infrastructure that may be necessary to serve this watershed.

4.4 Land Management Strategies

Land management strategies are essentially growth and development management strategies intended to reduce the potential of the PPA reaching a build-out condition. As communities approach a "build-out" condition there is an increase in the cost and difficulty of achieving TMDL compliance.

Typically comprehensive planning regarding wastewater and nutrient management has focused on the Source Removal approach, and with the preparation of the 208 Plan and Piloting projects on Cape Cod there has been a greater regional focus on Direct Environmental Mitigation. This will allow communities like Mashpee and its neighbors to use Direct Environmental Mitigation approaches to reduce or eliminate the need for Source Removal in certain areas, or be implemented prior to Source Removal—to either allow longer phasing of any Source Removal strategy or ultimately the reduction of the need for full-scale traditional wastewater management.

As was clearly shown in all eight previous Scenarios/Options modeled through MEP, a massive amount of nitrogen removal (addressed via "Source Removal" in those Scenarios/Options) is required to achieve the TMDLs under the build-out condition if "Direct Environmental Mitigation" is not considered or not feasible. However, with the use of Land Management Strategies to complement Source Removal and Direct Environmental Mitigation approaches, it is possible to reduce these costs and impacts before new/redevelopment becomes a new nitrogen source.

- Growth Neutral/Flow Neutral:
  - Town will need to develop a policy that meets the criteria of the State Revolving Fund (SRF) program to make themselves eligible for zero-percent SRF loans.

- Purchase of Open Space/Build-out Development Properties:
  - Mashpee has been very proactive in the purchase and protection of land throughout Town. Town's in the planning area can continue to identify properties which could be purchased to reduce build-out potential, therefore reducing potential future flow, and reducing the projected nitrogen loading to the embayments. Mashpee, working with other state and federal agencies, has preserved approximately 4,000 acres over the last 30+ years to: protect natural resources, limit development, and preserve open space for perpetuity.

- Potential Well and/or Treatment and Disposal Sites:
  - Towns can work towards securing additional public drinking water supply well locations and potential treated water recharge sites to foster flexibility in addressing their wastewater needs and protecting their drinking water supplies.

- Seasonal and year-round property phasing impacts:
  - The recommendations identified in the draft plan took into consideration phasing and implementation that targeted year-round developments as part of the Matrix evaluation.

4.5 Summary of DRP/DEIR Evaluations

4.5.1 General

As developed as part of the initial Scenarios/Options, the following sections identify those decisions/recommendations made to date as they relate to Source Removal, Direct Environmental Mitigation, and Land Management Strategies. These were then evaluated as part of the DRP/DEIR and the evaluations and findings are included here.

4.5.2 Source Removal

The following sites and technologies were selected for further consideration for wastewater treatment and removal. This section will also briefly mention stormwater removal technologies identified previously as part of this project.

4.5.2.1 Sites

As identified in the ASAR, the following new treatment and recharge sites were identified and were carried forward. These sites are illustrated in Figure 4-1.

4.5.2.1.1 Potential New Treatment Sites

1. Site 2—Ashumet Road
2. Site 4—Transfer Station
3. Site 6—Formerly referred to as the Keeter Property
4. Back Road Sites

Although being kept as a viable location, Site 2 will likely be combined with a wastewater treatment and recharge facility at Site 4. Similarly, the Back Road Site may be considered for a cluster facility, it is also considered as a backup location to JBCC.

4.5.2.1.2 New Recharge Sites

The following sites are shown in Figure 4-1:

1. New Seabury/Site 7
2. Back Road Sites
3. Site 4—Transfer Station
4. Site 6
5. Willowbend Golf Course

4.5.2.1.3 Potential Cluster System Sites

The following potential cluster developments were identified in the ASAR for consideration in the Recommended Plan development (Figure 4-2):

- Briarwood/Otis Trailer Village
- Pickerel Cove
- Pirates Cove
- Tri-Town Circle
- Santuit Pond

4.5.2.1.4 Existing WWTF Sites (in the Planning Area)

The Recommended Plan evaluation considers the use of all existing facilities. However the ownership, upgrade, and expansion issues associated with each specific facility will be site-dependent and will need to be taken into consideration as part of the Recommended Plan regarding their integration into that plan.

Upgrade and expansion of the following facilities/locations was identified in the ASAR:

- New Seabury
- Willowbend
- Mashpee High School
- Mashpee Commons

Each of these facilities was discussed in detail as part of the 2007 Needs Assessment Report (NAR) including the identification and history of the facility, a description of each facilities process, flow capacity, and performance.

Upgrade and expansion may include physical plant improvements, upgrades to systems handling the currently permitted design flows, upgrades required to handle additional wastewater flows, or complete replacement of the existing facility with a new facility (due to age of system, year of implementation, and level of treatment).

4.5.2.1.5 Joint Base Cape Cod Site

The potential use of the WWTF at Joint Base Cape Cod was as part of the Draft Recommended Plan development (as recounted later in this chapter); however, because a local or regional plan has yet to be developed or agreed upon with this facility, the details of its use may need to be addressed as part of the adaptive management approach. The Town has taken into consideration the use of this facility with its neighbors Falmouth and Sandwich, but until the JBCC study and findings by MassDevelopment is complete and released to the public, remaining use of this facility in the future remains unknown. The Towns' Board of Selectmen has written a letter dated March 27, 2013 stating the Towns' interest in the use of facilities at this site. A copy of the letter is included in Appendix 4-1. The Sewer Commission has also continued to correspond with those evaluating the facility to maintain its potential as an option for Mashpee.

4.5.2.2 Wastewater Treatment Technologies Being Considered

Wastewater treatment facilities (for the new facilities at Sites 2, 4, 6, or Back Road) with performance to reach 6 to 10 mg/L total nitrogen being carried forward include:

- Activated Sludge/Extended Aeration (AS/EA)
- Sequencing Batch Reactor (SBR)
- Membrane Biological Reactor (MBR)

The use of each of these technologies with denitrification filters to achieve levels less than 3 mg/L will be considered for those facilities that would recharge within one of the watersheds (Popponesset or Waquoit Bay); however, since this can be added to the end of the treatment process, these types of advanced treatment facilities may be phased in over time. There are several different types, and they will be specific based on the treatment system that precedes them and client preference regarding operations. These can include traditional upflow and downflow filters in addition to Nitrex™ or other media-based systems.

Use of Rotating Biological Contactors (RBC) will only be considered as they currently exist within the Town at existing wastewater treatment facilities. Any facility that has to achieve 3 mg/L in the future will be based on one of the three previously identified technologies (AS/EA, SBR, MBR) due to the difficulty of RBC systems to consistently achieve full nitrification of their effluent.

Ultraviolet (UV) disinfection will be the only disinfection technology considered as stated in the ASAR and the Technology Screening Report.

Odor control and sludge management systems/technologies will be considered on a site-by-site and process-by-process basis as part of the Recommended Plan development.

Collection systems (vacuum, gravity, septic tank effluent pump (STEP), septic tank effluent gravity (STEG), and low pressure sewers) all remain in consideration and should be evaluated at the time of design when site conditions, survey, utility constraints, and design requirements are known. At this time the Town/Sewer Commission does not have any formal sewer guidelines or regulations that may dictate the components of the system and therefore impact the cost of installation.

4.5.2.3 Treated Water Recharge Technologies

As stated previously, use of open sand beds, traditional subsurface leaching facilities, and drip irrigation are being carried forward as treated water recharge technologies. Spray irrigation is limited by its use, its infrastructure requirements, and the DEP regulations that regulate it and its effluent quality. In addition, there are also time-of-year use restrictions and other considerations when dealing with spray irrigation that have screened it from consideration.

4.5.2.4 Eco-Toilets

Although not currently being considered as part of Mashpee's Draft Recommended Plan for TMDL compliance, if considered later through their Adaptive Management Program the Town will need to establish how Eco-Toilets could be used, monitored, and reported as part of TMDL compliance through Adaptive Management. The Town of Falmouth is actively leading this work in demonstration projects, and the Town of Mashpee currently has regulations allowing the use of certain types of Eco-Toilets (See Appendix 4-2); but a robust plan of how these can be used as part of achieving TMDL compliance must be

established in order to be considered part of the adaptive management approach of the Recommended Plan.

4.5.2.5 Innovative and Alternative Septic System Technologies

Although not being considered for a PPA-wide implementation, based on previous MEP modeling of the use of these technologies under the current systems approved for "General Use", the use of these systems could be considered through adaptive management. Their use would depend on water quality improvements seen within watersheds that could be addressed through shellfish propagation. There are other systems currently approved for "Pilot" or "Provisional Use" with different levels of nitrogen removal performance that could be considered for use through the Adaptive Management Process.

It is understood that there are a large variety of these types of systems for individual home owners (as documented through the Barnstable County Department of Health and Environment Reports developed in 2007). These systems could be used to address isolated areas depending on the level of performance required and allowable nitrogen load to that watershed.

In order to consider these systems further as part of a TMDL compliance plan, the Town/District would need to develop a management plan in order to monitor and report performance. It is expected that because this would be considered for TMDL compliance, a more rigorous monitoring program and operational and maintenance requirements would be necessary to ensure that these systems were performing at the levels required based on the loading limits within any particular watershed. This could lead to additional costs for both the property owner and the Town.

4.5.2.6 Stormwater

Best Management Practices need to be implemented on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds. The Town should continue the implementation of these features and focus on the use of the following technologies within the more sensitive watersheds:

- Dry extended detention basins.
- Wet retention ponds.
- Infiltration basins.
- Stormwater wetlands.
- Submerged gravel wetlands.
- Bioretention (rain gardens).
- Water quality swales.
- Infiltration trenches.

Appendix 4-3 includes the Town's current bylaw regarding BMP use for residential and non-residential development and a copy of the Town's (2013) MS4 Annual report.

4.5.2.7 Fertilizer Management

Fertilizer management is identified as another nitrogen (and phosphorus) source that is currently impacting water resources within the PPA. The Cape Cod Commission (CCC) has developed model

regulations that Town BOHs can adopt regarding Fertilizer Management Regulations. The CCC has designated the entire Cape a Fertilizer Management District of Critical Planning Concern (DCPC), allowing the development of these regulations that can be adopted by local BOHs.

The Town of Mashpee has also developed a Nitrogen Control Bylaw designed to reduce the amount of excess nitrogen entering the Town's Resource Areas and to improve the water quality in Waquoit Bay and Popponesset Bay. A copy of this Bylaw is included in Appendix 4-3.

4.5.3 Direct Environmental Mitigation

As discussed previously in this chapter, these measures will be considered as applicable. Their implementation will depend on several factors, which will be a function of existing pilot projects, new pilot/demonstration projects, and adaptive management strategies developed with the Recommended Plan. Therefore the following options have been identified and will be discussed further in this document:

- Shellfish Aquaculture (intended to be a significant component of any proposed recommended plan).
- Dredging/Inlet Opening.
- PRBs.
- Enhanced Natural Systems (wetlands/old cranberry bog restoration).

4.5.4 Land Management Strategies

In addition to the traditional Source Removal and Direct Environmental Mitigation measures, the Town/District has considered how to include other nitrogen mitigation measures through the following approaches identified previously:

- Growth Neutral/Flow Neutral.
- Purchase of Open Space/Build-out Development Properties.
- Potential Well and/or Treatment and Disposal Sites.
- Seasonal and year-round property phasing impacts.

4.6 DRP/DEIR Evaluations

4.6.1 Introduction

As discussed in the DRP/DEIR, Option 1A was the basis for the development of the Draft Recommended Plan and formed the contingency plan if shellfish aquaculture were not successful. However, because this was based on a fully traditional approach to managing wastewater nitrogen, additional evaluations and considerations were made for the Draft and Final Recommended Plans which are predicated on using non-traditional methods to potentially reduce the amount of traditional infrastructure. The following sections include the evaluations performed as part of the DRP/DEIR where alternative approaches to achieving the TMDL were considered; and based on the findings of the evaluations, recommendations of modifications to Option 1A were considered while achieving the same TMDL compliance goal. The subareas created for the evaluations are shown on Figure 4-3.

4.6.2 Option 1A Summary

Option 1A, as shown in Figure 4-4, consisted of the following primary components (all flows presented as average annual):

- Three new wastewater treatment facilities (WWTF) located at Sites 2, 4, 6, and the "Back Road" site; treating approximately 1.2 million gallons per day (mgd).
- Reuse of existing WWTF:
  - South Cape Village
  - New Seabury
  - Willowbend
  - Windchime Point
  - Stratford Ponds
  - Mashpee High School
  - Southport
- Reuse and expansion of the service area for the following WWTFs:
  - Cotuit Meadows
  - Wampanoag Village
- New effluent disposal facilities:
  - Site 7/New Seabury (approximately 1 mgd)
  - Back Road (approximately 370,000 gpd)
  - Site 4 (approximately 110,000 gpd)
- Adjacent communities (portions within the PPA):
  - Falmouth
    - § Approximately 50,000 gpd recharged outside watershed
    - § Limited septic system use
    - § Balance addressed at Site 6
  - Barnstable
    - § Approximately 80,000 gpd recharged outside watershed
    - § Balance remained on septic systems
  - Sandwich
    - § Approximately 300,000 gpd recharged outside watershed
    - § Balance remained on septic systems or at Forestdale School WWTF
- Innovative and Alternative (I/A) Systems:
  - Large "cluster"/neighborhood systems to remain

4.6.3 Targeted Evaluations

Option 1A allows the Town to achieve its TMDLs based on the recharge locations identified above and the MEP modeling results[1]. However, several alternative approaches to Option 1A to managing the nitrogen have been proposed, and the following sections will examine those approaches and discuss their advantages, disadvantages, and cost impacts. Environmental impacts associated are discussed in Chapter 7 of this report.

These alternatives will look at components of Option 1A including:

- Centralized versus cluster development at specific locations.
- Regional solutions (i.e. use of Joint Base Cape Cod and portions of Falmouth being addressed within Mashpee).
- Existing WWTF upgrade versus replacement and management options.
- Traditional versus hybrid solutions:
  - Shellfish
  - PRBs
  - Bog/Wetland restoration

Alternative evaluation areas are depicted in Figure 4-5.

4.6.4 Centralized Versus New Cluster Area Treatment Facilities

The Town of Mashpee has several existing “cluster” or neighborhood developments, most of which are currently served by small wastewater treatment facilities as have been discussed in previous reports submitted as part of this project. Although the term cluster has been used in several ways, it is often associated with areas serving less than 30 properties (as stated in the 2010 Barnstable County Wastewater Task Force Report); however for the purpose of this report, the term simply refers to a subset of the community or neighborhood that could be served by its own treatment facility. This is similar to the existing package treatment facilities serving neighborhoods and developments throughout Mashpee (examples of such facilities include Southport, Windchime Point, or Willowbend).

This evaluation will focus on potential new “cluster” development service areas. These areas typically fall within “subareas” previously identified for nitrogen mitigation in order to meet the established TMDLs; however Briarwood actually includes sections of two “subareas”. The cluster areas being considered were identified in the ASAR, and include:

- Briarwood/Otis Trailer Village;
- Pickerel Cove;
- Pirates Cove;
- Tri-Town Circle; and
- Santuit Pond.

[1] Based on original MEP model runs for Waquoit Bay East. This also is considering that although the new MEP model was for all of Waquoit Bay and the limits were close but not below the TMDLs, MEP explicitly stated that the new model had assumed no improvements made by Falmouth in the rest of that watershed, which is unlikely and also outside the limits of this Project Planning Area; and with improvements in those areas, the TMDLs would be achieved.

These five (5) potential "cluster" development areas were identified for further evaluation in order to compare the option of having their wastewater treated locally (to the development) versus being connected to an existing or new WWTF potentially serving a larger part of the community. Each cluster area which falls within an area identified for advanced treatment in Option 1A would be treated and recharged locally and compared to the proposed treatment and recharge options as presented in Option 1A as identified in Chapter 4 of the ASAR.

Table 4-1 identifies various characteristics of these cluster areas that could impact wastewater treatment and recharge facilities located within these developments. These include proximity to Zone II's, flood plains, and protected habitats. Although each of these areas includes some of these features, it is probable that sufficient area to support a cluster system is present. If not, potential cluster areas will be served by the appropriate WWTF.

Table 4-1 Potential Cluster System Site Review

Cluster Sites	In Zone II	In 100 Year Flood	In V Zone	In 500 Year Flood	In Natural Habitat
Briarwood/Otis Trailer Village					Yes-Part
Pickerel Cove					Yes–Part
Pirates Cove		Yes-Part	Yes-Part	Yes-Part	
Santuit Pond	Yes–Part				Yes-Part
Tri-Town Circle	Yes-Part				

Notes:

1. Blank boxes indicate that these features are not within the mapped areas shown in Figure 4-2. "Part" indicates that a portion of that area includes the related feature; however it may not impact the development of a cluster system at that location.

The following table summarizes several characteristics of these subareas, including the primary watershed within which they are located and would recharge (under a cluster approach); which larger subarea they have been assigned as part of Option 1A; their estimated flows; and estimated number of properties served. It should be noted that as part of Option 1A, Santuit Pond Cluster area was not an area targeted for new treatment and recharge.

(continued)

Table 4-2 Possible Cluster Subareas and Estimated Flows

Subarea ID – "Cluster"	Subarea Description	Primary MEP Watershed	Approx. Subarea Size (acres)	Estimated Existing Flow (in gpd)	Estimated Future Flow (in gpd)	Total Number of Parcels
Briarwood/Otis Trailer Village	Potential Cluster site {Part of Subarea L}	Waquoit	240	34,000	52,000	320
Pickerel Cove	Potential Cluster site {Part of Subarea T}	Popponesset	75	6,200	8,000	60
Pirates Cove	Potential Cluster site {Subarea F}	Popponesset	70	13,000	14,000	150
Tri-Town Circle	Potential Cluster site {Subarea M}	Waquoit	50	6,300	11,000	90
Santuit Pond	Potential Cluster site {Subarea R}	Popponesset	110	29,000	30,000	180

Note: Values in table are rounded.

Each of these areas was included in the subareas modeled through MEP as part of Options 1A, 1B, and 1C evaluated in the ASAR; and their proposed treatment level, treatment location, and recharge locations were identified for each and are summarized in Table 4-3 for reference.

(continued)

Table 4-3 Originally Proposed Treatment and Recharge Areas to Meet TMDLs Per MEP Modeling

Subarea ID – "Cluster"	Subarea Description	Estimated Existing Flow (in gpd)	Estimated Future Flow (in gpd)	Option 1A	Option 1B	Option 1C
				Proposed Treatment (T) and Recharge (R)		
Briarwood/Otis Trailer Village	Potential Cluster site {Parts of Subarea L and H}	34,000	52,000	Back Road	Back Road	Back Road
Pickerel Cove	Potential Cluster site {Part of Subarea T}	6,200	8,000	Site 2 (T) Site 7 (R)	Site 2 (T) Willowbend (R)	Site 2 (T) Willowbend (R)
Pirates Cove	Potential Cluster site {Subarea F}	13,000	14,000	Site 6 (T) Site 7 (R)	Local Cluster	Local Cluster
Tri-Town Circle	Potential Cluster site {Subarea M}	6,300	11,000	Back Road	Back Road	Back Road
Santuit Pond	Potential Cluster site {Subarea R}	29,000	30,000	Title 5	Local Cluster	Title 5

Although being presented as an alternative approach to wastewater management, several of these areas were already considered for a "cluster" approach. As can be seen from Table 4-3, two areas—Pirates Cove and Santuit Pond—were identified as Subareas R and F and as a cluster system under either Option 1B or 1C based on their relatively isolated locations. Of these two locations, Santuit Pond (Subarea R) was not included in Option 1A for any change in its wastewater management (properties were identified to remain on Title 5 septic systems). Therefore as part of the Recommended Plan development, this area would continue to remain as is and therefore will not be evaluated compared to the potential connection to a centralized facility. However, in the future this area may be addressed (through adaptive management) in order to further assist in improving the water quality of Santuit Pond (as it relates to phosphorus impacts) or other needs in that area.

As for the remaining four proposed cluster sites identified in Table 4-3, each of these "clusters" will be evaluated and compared to Option 1A as presented previously in this Chapter.

The following is a brief summary of these four cluster areas:

- Briarwood/Otis Trailer Village (Parts of Subarea L and H) and Tri-Town Circle (Subarea M) are areas that were proposed to go to the Back Road Sites for treatment and recharge. As part of a cluster analysis this would be unlikely to change, the difference being how much additional flow from other areas around the John's Pond/Ashumet Pond areas would go there as well, changing from a cluster facility to a larger system. This area will also be evaluated later in this Chapter as part of the regional option and potential use of Joint Base Cape Cod (formerly the Massachusetts Military Reservation (MMR)). Although portions of these areas are outside of the Waquoit East Watersheds, they are still part of the greater Waquoit watersheds and within the planning area

and therefore contribute nitrogen load to one of the embayments of interest. Although the MEP report identified "one" scenario for nitrogen removal, removal in other portions of the watershed is not a negative and shouldn't be flagged as "not-requiring" nitrogen removal—it is a function of cost-effectiveness and coordination and addressing other needs as well. It should also be noted that reduction of phosphorus impacts on freshwater bodies, such as Ashumet and Johns Ponds, is of importance to the Town.

- Pickerel Cove (part of Subarea T) is also fairly isolated and could be potentially served by a cluster system if land is available.
- Pirates Cove (Subarea F) is another isolated area (south of Willowbend) and in other options was identified as a potential cluster area. This area will be evaluated under both situations as part of this section.

Each of the cluster areas is evaluated on its own and then compared to how the same area would be addressed as part of the Option 1A proposal. In addition, each will then be compared to a limited number of possible variations of the Option 1A approach to TMDL compliance (i.e. alternate treatment and/or recharge sites).

4.6.4.1 Costs

The cost evaluation component for examining each of the cluster areas versus facilities serving a larger constituency were based on the Barnstable County Wastewater Cost Task Force Report dated April 2010, and the associated cost graphs (Figures 3 and 4 of that document). That report was based on facilities that would typically achieve an average TN of 6 to 8 mg/L for cluster/satellite type systems, and 5 mg/L TN in the effluent of larger facilities (assumed to be larger than 1 mgd); therefore additional costs were considered for facilities proposed as part of the Draft Recommended Plan to achieve less than 3 mg/L TN. These higher levels of performance were dictated by the MEP modeling which demonstrated that the effluent concentration within the majority of watersheds within the planning area would need to be at the limit of technology (i.e. 3 mg/L). To develop these costs, these dollars per gallon treatment values (as presented in the Barnstable County report) were supplemented by increased performance cost escalators as presented in the referenced Chesapeake Bay Study[2] prepared in 2002 examining the incremental treatment and operations and maintenance (O&M) costs between biological nitrogen removal (6 to 10 mg/L) to enhanced nitrogen removal (3 to 5 mg/L). This was also compared to the costs from similar local facilities on Cape Cod (namely the improvements at the Barnstable Water Pollution Control Facility (WPCF) and the Chatham WPCF), each of which have had related improvements approaching this higher level of performance.

For use in this analysis, costs from the Barnstable County and Chesapeake Bay reports were adjusted for the following factors:

- Costs were escalated using an estimated Engineering News Record (ENR) index of 9922 (Year 2017 estimate); and
- Contingency and fiscal, legal, and engineering services were added where applicable.

In the 2010 Barnstable County Report, graphs outlining their cost estimates for treatment were presented as "pure construction costs" and an ENR index of 8600. The engineering, fiscal, legal, and contingency

[2] Nutrient Reduction Technology Cost Estimations for Point Sources in Chesapeake Bay Watershed, 2002.

was then added in later in their analysis. In that report, a factor of 40-percent was carried to cover those costs in addition to land purchase to arrive at a total capital cost, and this same factor was added as part of this evaluation. In addition, as a planning document, the cost estimates have been rounded to two significant figures and carry a contingency appropriate for planning level documents.

In the Chesapeake Bay Report, costs were based on year 2000 dollars (and we assumed a mid-year ENR index of 6343 for that year), and included engineering and contingency similar to those carried by the Barnstable County Report.

The following tables (Table 4-4 and Table 4-5) summarize Total Capital Costs and O&M Costs, respectively, for a range of $/gpd treated based on the approach developed for this report.

Table 4-4 Estimated Capital Wastewater Treatment Cost per Gallon Treated

Facility Size	Cost to 6 to 8 mg/L TN	Cost to <3 mg/L
10,000 to 100,000 gpd	$120/gal to $60/gal	$150/gal to $70/gal
100,000 gpd to 1 mgd	$60/gal to $25/gal	$70/gal to $30/gal
Greater than 1 mgd	$25/gal	$30/gal

Values rounded and presented as “best fit” trend line.

Table 4-5 Estimated O&M Wastewater Treatment Cost per Gallon Treated

Facility Size	Cost to 6 to 8 mg/L TN	Cost to <3 mg/L
10,000 to 100,000 gpd	$13/gal to $5/gal	$14/gal to $5.5/gal
100,000 gpd to 1 mgd	$5/gal to $2/gal	$5.5/gal to $2.2/gal
Greater than 1 mgd	$2/gal	$2.2/gal

Values rounded.

The focus of these evaluations is on the treatment facility, and it assumes that the recharge facility and collection system costs would be proportional to the area served and similar across each approach, and therefore would not influence the cost evaluation. In some areas it will be explained that “transportation” costs (i.e. force main to remote locations) may be considered if that was identified in Option 1A. However, in areas like Briarwood and Tri-Town, their location relative to either Back Road or Joint Base Cape Cod makes this analysis unnecessary. For areas like Pirates Cove and Pickerel Cove, transportation costs are significant and are included in the analysis.

In addition, improvements proposed as part of a facility at Joint Base Cape Cod to serve portions of the planning area (as an alternative to the approach presented in the original Option 1A) were also developed based on similar types of facilities on Cape Cod (namely the Barnstable WPCF and the Chatham WPCF again).

Table 4-6 Estimated JBCC Improvement Costs [1, 2] per Gallon

Component	Capital Cost	O&M [3]
Expansion of Secondary Process	$6.0/gal	-
Clarification	$2.0/gal	-
Misc. Improvements	$1.0/gal	-
Construction Contingency	$4.0/gal	-
Total	$13/gal	$1.0/gal

Notes:

1. Based on recent improvement projects at Hyannis WPCF and Chatham WPCF.
2. Costs only related to improvements at the facility and do not include O&M costs related to existing facilities or improvements that may be necessary at the existing facility due to age or other compliance related issues.
3. O&M values not broken out by category.

4.6.4.2 Briarwood/Otis Trailer Village and Tri-Town Circle

This evaluation considers the advantages and disadvantages of Briarwood/Otis Trailer Village and Tri-Town Circle (within subareas (L and M) respectively) cluster areas being part of one larger facility or two smaller facilities. It is important to note that the Briarwood/Otis Trailer Village would use the same location as the proposed Back Road site for treatment and recharge as identified in Option 1A serving several subareas of Mashpee. The Briarwood and Tri-Town cluster areas—as shown on Figure 4-5—are located adjacent to Johns/Ashumet Ponds and are relatively isolated in respect to other facilities within the Town of Mashpee.

As identified previously, this area is also targeted for potential treatment and recharge at the Joint Base Cape Cod existing WWTF as an alternative to the approach presented in Option 1A. However, that is evaluated in the next section of this Chapter; this section focuses on the Option 1A approach for this area versus breaking these areas off into “cluster” facilities.

Cost evaluations were based on the approach outlined in Section 4.6.4.1, and consider the treatment facility only. O&M values ranging from five to 13 dollars per gallon (as presented in Table 4-5) were used to estimate O&M costs, and these values were then converted to a present-worth value based on an interest rate of 3-percent and applied over 20 years (reference NISTIR 85-3273-28).

These values were then compared to a new facility constructed at the Back Road site that would serve these areas and the other areas identified in Option 1A. In both cases, treated effluent recharge/disposal was not included because the incremental cost increase would be proportional to the size of the facility and therefore is considered inconsequential to the evaluation; however, costs of the selected approach developed for the Recommended Plan would include these costs. For comparison purposes a treatment cost for upgrade of the Joint Base Cape Cod facility was also included (that facility is assumed to have sufficient recharge capacity under that approach, as will be discussed later in this Chapter). According to the Barnstable County Report, small/cluster/satellite systems treating less than 50,000 gpd are typically

less cost-effective on a cost per nitrogen removed than a centralized facility; however, they have the advantage of best use for isolated areas.

The following cost table represents a stepped approach and focuses on the cost of treating each "cluster" area individually compared to treating it as part of a larger group. This was done to show the economy of scale of going from a small isolated facility to larger and larger facilities serving larger populations with an economic advantage.

Therefore, in Table 4-7 the Tri-Town Area treatment costs are developed for just that area; then a cost was estimated for treating only Tri-Town and the Briarwood cluster areas together; then how the Tri-Town Area cost might be distributed if it were part of the Option 1A Back Road Site; and lastly, if this area was collected and treated as part of a regional facility at Joint Base Cape Cod.

Table 4-7 Summary of Treatment Costs [5]—Tri-Town Area

Facility	Estimated Future Average Flow (in gpd)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth (TPW)	Estimated Present Worth Cost/Gallon Treated[3]	Estimated Present Worth Cost/lb TN Removed[4]
Tri-Town Only	11,000	$1.9 Million	$140,000	$4.1 Million	$370	$350
Tri-Town and Briarwood	63,000	$7.0 Million	$480,000	$14 Million	$220	$210
Back Road Facility[1]	270,000	$17 Million	$1 Million	$33 Million	$120	$120
Joint Base Cape Cod [2]	320,000	$8.8 Million	$480,000	$16.1 Million	$50	$70

Notes:

1. Back Road Facility assumes that Southport does not connect. Based on the MBR approach.
2. Joint Base Cape Cod assumes same flow that would go to Back Road Site (no Southport) plus three Sandwich subareas (cost is only the added cost for improvements and the incremental O&M cost to treat total new flow sent to JBCC). No improved performance levels required assuming current permit remains in place of less than 10 mg/L TN.
3. TPW cost/gallon treated based on Future Average Annual gpd.
4. Nitrogen "removed" based on difference between septic load (based on nitrogen concentration of 26.25 mg/L) of area and recharge load from the WWTF/cluster system (based on an effluent concentration of 3 mg/L if recharged within watershed, and 10 mg/L if recharged out of watershed).
5. Values rounded to two significant figures.

Similar to Table 4-7, Table 4-8 presents the same "stepped" approach, but this time it reviews the Briarwood cluster area on its own and as part of a larger service area.

Table 4-8 Summary of Treatment Costs [5]—Briarwood/Otis Trailer Park Area

Facility	Estimated Future Average Flow (in gpd)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth	Estimated Present Worth Cost/gallon Treated[3]	Estimated Present Worth Cost/lb TN Removed[4]
Briarwood Only	52,000	$6.1 Million	$450,000	$13 Million	$250	$230
Tri-Town and Briarwood	63,000	$7.0 Million	$480,000	$14 Million	$220	$210
Back Road Facility[1]	270,000	$17 Million	$1 Million	$33 Million	$120	$120
Joint Base Cape Cod[2]	320,000	$8.8 Million	$480,000	$16.1 Million	$50	$70

Notes:

1. Back Road Facility assumes that Southport does not connect. Based on the MBR approach.
2. Joint Base Cape Cod assumes same flow that would go to Back Road Site (no Southport) plus three Sandwich subareas (cost is only the added cost for improvements and the incremental O&M cost to treat total new flow sent to JBCC). No improved performance levels required assuming current permit remains in place of 10 mg/L TN.
3. TPW cost/gallon treated based on Future Average Annual gpd.
4. Nitrogen "removed" based on difference between septic load (based on nitrogen concentration of 26.25 mg/L) of area and recharge load from the WWTF/cluster system (based on an effluent concentration of 3 mg/L if recharged within watershed, and 10 mg/L if recharged out of watershed).
5. Values rounded to two significant figures.

Costs developed do not consider costs associated with existing infrastructure or O&M costs currently expended on existing facilities. Costs are only intended to reflect the "added" cost of providing a new facility or upgrading/expanding existing systems to address the flows from these areas.

Because of the proximity of these cluster areas/subareas to either the Back Road Site or JBCC, transportation costs were not included in the evaluation; and because the Back Road Site would be recharging locally (similar to a cluster/satellite facility—the JBCC already has recharge facilities in operation) those costs were not included in the evaluation either. Recharge facilities costs are carried as part of the Draft Recommended Plan.

As shown in both tables, the alternative of being able to send flow to an expanded facility at Joint Base Cape Cod is significantly more cost-effective on both a dollar per flow and dollar per pound of nitrogen removed basis. In consideration of the need for construction of effluent recharge facilities at the other sites, JBCC becomes even more cost-effective and therefore is recommended for consideration as part of the Final Recommended Plan.

Table 4-9 summarizes the advantages and disadvantages of each approach (outside of the costs discussed above) regarding the use of these facilities.

Table 4-9 Advantages and Disadvantages Summary—Briarwood/Otis Trailer Park Area

Type	Advantages	Disadvantages
Small "Cluster" Facility (Briarwood/Tri-Town)	· If Joint Base Cape Cod is not available, these areas are isolated and ideal for satellite systems. · Briarwood has potential land area adjacent to the development including Back Road site and is not within a Zone II area. · Combined, Briarwood and Tri-Town circle would have design flows potentially greater than 50,000 gpd, improving its cost-effectiveness. · Any wastewater treatment in the Tri-Town area would provide additional protection for the existing Zone II area. · Reduces transportation cost by keeping facility local (relative to Site 4).	· Tri-Town subarea is primarily located within a Zone II area, therefore treatment costs to recharge within that area would be very high. · Both areas are within Natural Heritage and Endangered Species Program (NHESP) Estimated Habitats. · Briarwood and Tri-Town subareas have less than 50,000 gpd. (less cost effective) · Both would require land-takings unless Back Road site is used for Briarwood. · Would result in the area around Johns Pond and Ashumet Pond to have over six WWTFs located within this one area—these two new facilities and the facilities at JBCC, Southport, Mashpee High School, and Mashpee Village (in design). · Potential impacts of recharge facilities located upgradient of the two ponds may require additional phosphorus removal, adding to the facility costs.
Centralized Facilities (Back Road or Site 4)	· Economy of scale as identified in Barnstable County Report. · Reduction in the number of WWTFs required to operate in the area. · Reduction in the number of existing WWTF upgrades potentially required. · Centralized sites are located outside Zone II areas.	· Back Road site is within NHESP Estimated Habitats. · Access easement required for Back Road site (location would need to be negotiated). · Potential impacts from recharge at Back Road site upgradient of the two ponds may require additional phosphorus removal, adding to the facility costs.

Advantages and disadvantages of a cluster area approach for wastewater management versus treatment at a regional facility at JBCC are discussed later in this section.

4.6.4.3 Pickerel Cove Versus Site 2 or Site 4

The Pickerel Cove Cluster Area is a subset of approximately 60 properties that was included in the original Subarea "T". As part of Option 1A, this subarea (T) was designated to be treated at Site 2; however it could also have been collected, transported, and treated at Site 4. This evaluation will look at the costs of dealing with Pickerel Cove alone, treating it as part of Subarea T at Site 2, or treating it as part of Subarea T at Site 4 with other areas of Town designated to go to Site 4 as part of Option 1A. In the case of the latter, Site 4 would include flows from Subareas S, P, N, O, and I.

Under this evaluation, transportation (force main transmission of flow) costs from Pickerel Cove to either Site 2 or Site 4 need to be taken into consideration as do transportation costs to recharge at Site 7 from either of these two locations.

Table 4-10 summarizes these estimated costs.

Table 4-10 Summary of Transmission Costs [(1)]—Pickerel Cove Area

Facility	Estimated Distance (miles)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth
Pickerel Cove to Site 2	2.5	$3.5 Million	$60,000	$4.4 Million
Pickerel Cove to Site 4	4	$5.6 Million	$95,000	$7.0 Million
Site 2 to Site 7/New Seabury	8	$11 Million	$190,000	$14 Million
Site 4 to Site 7/New Seabury	6	$8.5 Million	$140,000	$10 Million

Notes:

1. Values rounded to two significant figures

The following Table 4-11 summarizes the estimated cost evaluation for serving the Pickerel Cove Area.

(continued)

Table 4-11 Summary of Costs [4, 8, 10]—Pickerel Cove Area

Facility	Estimated Future Average Flow (in gpd)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth	Estimated Present Worth Cost/gallon Treated	Estimated Present Worth Cost/lb TN Removed[9]
Pickerel Cove	8,000	$1.5 Million	$120,000	$3.5 Million	$410	$390
Site 2 Facility[1,3,5]	110,000	$23 Million	$800,000	$35 Million	$330	$440
Site 4 Facility (recharge outside watershed) [2,3,5,7]	530,000	$35 Million	$1.6 Million	$59 Million	$110	$150
Site 4 Facility (recharge within the watershed)[2,6,7]	530,000	$27 Million	$1.4 Million	$48 Million	$90	$90

Notes:

1. Site 2 Facility assumes that all of Subarea T is connected and treated at that location. Based on the more expensive MBR versus SBR approach. See Figures 4-1 and 4-3.
2. Site 4 Facility assumes treatment of Subareas S, P, N, O, and I.
3. Recharge from Site 2 or Site 4 would be out of the watershed at Site 7 per Option 1A. Therefore treatment levels are only to 10 mg/L TN, whereas Pickerel Cove will need to achieve 3 mg/L.
4. No collection or recharge costs are considered.
5. Costs for Sites 2 and 4 include transmission costs (see Table 4-10) to those sites (since the pumping flow to those locations is significantly greater than the cluster area). Discharge to outside watershed also included an additional transmission cost to Site 7.
6. Recharge at Site 4 within the watershed would be split between local recharge and the Willowbend Golf Course.
7. Each Site 4 facility under this evaluation assumes that Mashpee Commons is treated and recharged through its existing facility.
8. Costs developed do not consider costs associated with existing infrastructure or O&M costs currently expended by existing facilities. Costs are only intended to reflect the “added” cost of providing a new facility or upgrading/expanding existing systems to address the flows from these areas.
9. Nitrogen “removed” based on difference between septic load (based on nitrogen concentration of 26.25 mg/L) of area and recharge load from the WWTF/cluster system (based on an effluent concentration of 3 mg/L if recharged within watershed, and 10 mg/L if recharged out of watershed).
10. Values rounded to two significant figures.

In evaluating the costs of treating the wastewater from the area, the costs show that on cost per gallon of wastewater treated, and cost per pound of nitrogen removed that it is most cost-effective to consider treatment at a larger facility located at Site 4 than it is to treat it locally at Pickerel Cove. Although Site 4 could be used as a recharge location—under Option 1A this flow would be treated and recharged at Site 7

(outside of the watershed)—there would be an added cost to transport it outside of the watershed. However, at this size facility, it is more cost-effective to treat to a higher level and locally recharging than sending to Site 7. This is a result of the transportation cost offsetting the higher level of treatment cost to stay within the watershed. However, the sensitivity of the watershed to nitrogen makes sending it out of the watershed more of a necessity.

The following table summarizes other advantages and disadvantages (outside of the costs previously discussed) regarding the use of these facilities. Table 4-12 presents advantages and disadvantages of each approach:

Table 4-12 Advantages and Disadvantages Summary—Pickerel Cove Area

Type	Advantages	Disadvantages
Small "Cluster" Facility (Pickerel Cove)	· These areas are isolated and ideal for satellite systems. · Pickerel Cove has potential land area adjacent to the development · Recharge could be located outside a Zone II area. · Any wastewater treatment in the Pickerel Cove area would provide additional protection for Mashpee-Wakeby Pond.	· Pickerel Cove subarea is primarily located within the recharge area to Mashpee-Wakeby Pond and there may be additional costs for Total Phosphorus (TP) removal. · Pickerel Cove subarea has less than 50,000 gpd. · Would require land-takings.
Centralized Facilities (Site 2 or Site 4)	· Economy of scale as identified in Barnstable County Report. · Reduction in the number of WWTFs required to operate in the area and related upgrades required. · Centralized sites (Site 2 and Site 4) are located outside Zone II areas; recharge at Site 7 is outside watershed and Zone II areas.	· Site 2 is not cost-effective (less cost-effective than Pickerel Cove on a cost per parcel basis, but more effective on $/lb N removal and gallon treated). · Site 4 is limited in recharge (due to TMDL compliance) and therefore there is added cost to transport effluent to Site 7.

Based on this evaluation, this area is recommended to be served through Site 4 and is carried forward as part of the Recommended Plan.

4.6.4.4 Pirates Cove Versus Site 6/Site 4 or Willowbend

Pirates Cove is located at the mouth of the Mashpee River and consists of approximately 150 properties. As part of Option 1A this area was designated as Subarea "F". Also as part of Option 1A, this Subarea was designated to be treated at Site 6; however it could also have been collected, transported, and treated at Site 4 or Willowbend. This evaluation included the costs of addressing Pirates Cove alone, treating it as part of areas designated to go to Site 6, or Site 4 with other areas of Town designated to go to Site 4 as part of Option 1A. In the case of the latter, Site 4 would include flows from Subareas S, P, N, O, and I.

Under this evaluation, transportation (force main transmission of flow) costs from Pirates Cove to either Site 4 or Site 6 need to be taken into consideration as do transportation costs to recharge at Site 7 from either of these two locations.

Table 4-13 summarizes these estimated costs.

Table 4-13 Summary of Transmission Costs [(1)]—Pirates Cove Area

Facility	Estimated Distance (miles)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth
Pirates Cove to Site 4	2.5	$3.5 Million	$60,000	$4.4 Million
Pirates Cove to Site 6	6.5	$9.1 Million	$150,000	$11 Million
Site 4 to Site 7/New Seabury	6	$8.5 Million	$140,000	$11 Million
Site 6 to Site 7/New Seabury	2.5	$3.5 Million	$60,000	$4.4 Million

Notes:

1. Values rounded to two significant figures.

The following Table 4-14 summarizes the estimated cost evaluation for serving the Pirates Cove Area.

(continued)

Table 4-14 Summary of Costs [1, 4]—Pirates Cove Area

Facility	Estimated Future Average Flow (in gpd)	Estimated Capital Cost	Estimated O&M Cost	Estimated Total Present Worth	Estimated Present Worth Cost/gallon Treated	Estimated Present Worth Cost/lb TN Removed
Pirates Cove	14,000	$2.4 Million	$170,000	$4.5 Million	$320	$350
Site 6 Facility [3,5]	240,000	$25 Million	$1.1 Million	$42 Million	$180	$240
Site 4 Facility (recharge outside watershed) [2,3.5.6,7]	530,000	$33 Million	$1.5 Million	$56 Million	$110	$140
Site 4 Facility (recharge within the watershed) [2,3.5.6,7]	530,000	$25 Million	$1.4 Million	$46 Million	$85	$80

Notes:

1. Values rounded to two significant figures.
2. Site 4 Facility assumes treatment of Subareas S, P, N, O, and I. See Figures 4-1 and 4-3.
3. Recharge from Site 6 or Site 4 would be out of the watershed at Site 7 per Option 1A. Therefore treatment levels are only to 10 mg/L TN, whereas Pirates Cove will need to achieve 3 mg/L.
4. No collection or recharge costs are considered.
5. Costs for Sites 4 and 6 include transportation to those sites (since the transportation to those locations is significantly greater than the cluster area). Discharge to outside watershed also included an additional transportation cost to Site 7.
6. Each Site 4 facility under this evaluation assumes that Mashpee Commons is treated and recharged through its existing facility.
7. Costs developed do not consider costs associated with existing infrastructure or O&M costs currently expended by existing facilities. Costs are only intended to reflect the "added" cost of providing a new facility or upgrading/expanding existing systems to address the flows from these areas.

In evaluating the costs of treating the wastewater from the area, the costs show that on cost per gallon of wastewater treated, and cost per pound of nitrogen removed that it is most cost-effective to consider recharge at a larger facility located at Site 4 than it is to treat it locally at Pirates Cove. Although Site 4 could be used as a recharge location—under Option 1A this flow would be treated and recharged at Site 7 (outside of the watershed)—there would be an added cost to transport it outside of the watershed; however at this size facility, there is only a nominal cost savings when going from treating to 3 mg/L to less than 10 mg/L which is lost in the transport to Site 7. The sensitivity of the watershed makes sending it out of the watershed more of a necessity.

The following information summarizes other advantages and disadvantages (outside of the costs previously discussed) regarding the use of these facilities. Table 4-15 presents advantages and disadvantages of each approach.

Table 4-15 Advantages and Disadvantages Summary—Pirates Cove Area

Type	Advantages	Disadvantages
Small "Cluster" Facility (Pirates Cove)	· These areas are isolated and ideal for satellite systems. · Pirates Cove has potential land area adjacent to the development and is not within a Zone II area.	· Pirates Cove subarea has less than 50,000 gpd and therefore is less cost-effective. · Would require land-takings.
Centralized Facilities (Site 4 or Site 6)	· Economy of scale as identified in Barnstable County Report. · Reduction in the number of WWTFs required to operate in the area. · Centralized site (Site 4) is located outside Zone II areas; recharge at Site 7 is outside watershed and Zone II areas.	· Site 6 is located within a Zone II therefore discharge must be at Site 7, or a significantly higher level of treatment is required. · Site 4 is limited in recharge (due to TMDL compliance) and therefore there is added cost to transport effluent to Site 7. · Both Sites 4 and 6 have significant costs associated with transportation to the site(s) from Pirates Cove and from those treatment locations to Site 7 if discharging outside of the watershed.

Based on these evaluations, the Recommended Plan was developed based on the use of Site 4 and recharge within the watersheds, however recharge location may require shifting to Site 7 if shellfish performance is not at the levels expected in the subwatersheds that surround the Pirates Cove area.

4.6.5 Regional Solutions

Several regional approaches have been considered as part of this planning effort. Each of the most recent options considered the treatment and recharge within Mashpee of flow from the area east of the Quashnet/Moonakis River in Falmouth. Option 1B was based on a large portion of Cotuit located in the Popponesset Bay watershed being treated and recharged within Mashpee. However the most recent consideration (and most cost-effective) is for the use of the existing WWTF located at JBCC which is located within the Project Planning Area in Sandwich near the Ashumet Pond and Johns Pond parts of Mashpee, as shown on Figure 4-5.

As part of this evaluation, the focus is on the impact of sending flow to JBCC to get additional flow outside of the Waquoit Bay watershed, potentially reducing the needed infrastructure to address nitrogen in this watershed, eliminates advance nitrogen treatment needs within the watershed, and it removes groundwater contaminants in well recharge areas (Zone IIs and private wells) from existing septic systems.

Advantages:

- Use of JBCC (with associated upgrade and improvements) appears to be less than half the cost of a new facility at Back Road Site. JBCC has effluent disposal capacity that would just need to add a third carrousel train and clarifier. Would pick up Sandwich 1, 2, 3, and Subareas G, H, J (less Southport), L, and M. Southport would need to achieve between 5 and 7 mg/L and could remain in its same location.
- New facilities for those areas at Back Road would be approximately $20M (when considering recharge facilities). These facilities would need to be designed for the limit of technology, and costs do not consider any advanced treatment for potential phosphorus removal due to its location (of the recharge) upgradient of two fresh water ponds (Johns and Ashumet).
- Upgrade at JBCC likely around $4M, compared to $20M.
- Favors a regional solution with Sandwich and serves all high priority areas in both towns.
- Assumes collection system costs are the same with both options (savings on treatment and recharge).
- The Joint Base Cape Cod site also offers the advantage of potentially being expanded for use for Falmouth within Waquoit Bay Watershed, presuming the recharge capacity is available at the existing four open sand beds.
- Recharge is outside of the PPA watersheds.
- Regional solutions may carry more weight in funding opportunities, and are supported at the County and State level.

Disadvantages:

- Future of the JBCC facilities ownership is unclear and may not be available for Mashpee.
- The timing of a JBCC ownership decision may push this area out further in the timeline.
- Will require development of Memorandums of Understanding (MOUs) with several adjoining towns, regional entities, and/or the Mashpee Water District.

It is recommended that a regional solution approach be carried forward in the Recommended Plan.

4.6.6 Existing WWTFs

As part of considering alternatives to Option 1A, this section briefly identifies each of the existing small wastewater treatment facilities and their proposed use as part of Option 1A. Alternatives to those recommendations are considered in this section. Two of the largest impacts to any change in the use of existing WWTFs as outlined in Option 1A would be the use of shellfish as a means to mitigate the nitrogen issue within the estuary as discussed in a subsequent section of this report, and the use of Joint Base Cape Cod, both of which change the extent of traditional infrastructure needs within the PPA.

Table 4-16 summarizes the existing WWTFs within the PPA and identifies how they were incorporated into Option 1A, and also how Option 1A might be altered to consider an alternative approach to handing those facilities (either in treatment performance, treatment location, or recharge location for example).

Table 4-16 Summary of Existing WWTF and Proposed Future Operation

Facility	Permitted Flow (gpd) [3]	Proposed Use in Option 1A [1]	Alternative to Option 1A
Forestdale School	20,000	No change.	No change.
New Seabury	300,000	Use existing capacity for adjacent Subareas.	No change.
Mashpee Commons	180,000	Improved treatment to 3 mg/L and recharge proposed to be relocated to Site 4.	Flow remains treated and recharged at existing site.
South Cape Village	24,000	Improved to 3 mg/L.	Monitor per AM [2].
Mashpee High School	18,000	Flow proposed to be treated to 3 mg/L and recharged at Back Road Site.	Treated and recharged at JBCC.
Southport	172,000		Flow remains treated and recharged at existing site.
Willowbend	132,000	Improved to 3 mg/L.	Expand recharge area as alternate recharge area for Site 4, moderate improvements to less than 6 mg/L and monitor per AM.
Stratford Ponds	35,500	Improved to 3 mg/L.	Monitor per AM.
Cotuit Meadows	59,000	Connect small adjacent area.	Monitor per AM.
Wampanoag Village	10,000	Connect small adjacent area.	Monitor per AM.
Joint Base Cape Cod		Not included	Treatment and Recharge
Windchime Point	40,000	Improved to 3 mg/L.	Monitor per AM.

Notes:

1. As modeled through MEP.
2. AM = Adaptive Management program.
3. Values from each facility's MassDEP Groundwater Discharge Permit.

For each of the existing WWTFs within the PPA, several approaches for their use as part of a Recommended Plan were identified including upgrade, reconstruction, replacement, and the considerations of public or private operations. These approaches are summarized below:

- Upgrade or reconstruction/replacement of existing WWTF:
  - Use of Joint Base Cape Cod will not require major improvements to Southport or High School.
  - The cost-effectiveness of this was shown in the cluster evaluation for both the High School and Southport; where Southport would need no major improvements over what is currently required, and the High School facility could remain until it was determined its flow needed to be transported to JBCC for treatment and recharge.
  - Under the proposed alternative, the Mashpee Commons facility would be allowed to continue under its current proposed improved treatment, thereby reducing the cost of a larger facility at Site 4 and potential transport to either Willowbend or Site 7 for recharge.
  - Increased propagation of shellfish should allow smaller facilities to operate within their existing permits and be monitored as part of adaptive management to determine if future improvements could be implemented without having to treat to the limit of technology which would be difficult for several of the smaller facilities.
  - Wampanoag Village facility: The expansion is required to offset 237 lbs N/yr produced by the housing development. In addition, the constructed treatment plant has significant capacity in excess of that needed for Wampanoag Village and the 237 lbs N/yr Groundwater Discharge Permit (GWDP) requirement, regarding which the Town and Tribe have begun discussions about extending the collection system served by the facility to include Town Hall and the surrounding area.
- Public versus private ownership and operations:
  - By allowing Southport and Mashpee Commons to remain independent (private), the future number of facilities owned, operated, and maintained by the Town/Mashpee Water District is reduced.
  - Further analysis by the Town/Water District should be performed to establish the cost benefits of public versus private ownership and operation.

4.6.7 Traditional Versus Hybrid Solutions

4.6.7.1 Shellfish Aquaculture

The Town of Mashpee Shellfish Constable/Resource Officer identified several embayments where the Town is either actively pursuing and implementing shellfish propagation or areas where they plan to expand the shellfish resources in the future (i.e. new or larger shellfish beds). This program has been developed with the goal of restoring the historic shellfish resources in the area with the added benefit of addressing the nitrogen load within some of the Town's sensitive water bodies.

Table 4-17 presents a summary of this information identifying the watersheds, estimated nitrogen removal, and proposed shellfish type to be used. This information also provides a comparison to the estimated attenuated load to these embayments from various watersheds and an estimated percent removal of septic/wastewater nitrogen was estimated.

Table 4-17 Existing Shellfish Estimated Positive Impact [4, 5]

Watershed [3]	Estimated Existing Attenuated Wastewater Nitrogen (m ton/yr)	Estimated Nitrogen Removal by Shellfish (m ton/yr)	Shellfish Type	Potential Percent of Existing WW Nitrogen Removal with Shellfish
Mashpee River	5.0	2.5	Oysters	50%
Popponesset Bay [1]	1.5	1.5	Quahogs	100%
Ockway Bay	0.9	0.9	Quahogs	100%
Shoestring Bay	4.0	2.0	Oysters	50%
Great River	1.0	1.0	Quahogs	100%
Jehu Pond	1.0	1.0	Quahogs	100%
Hamblin Pond [2]	3.7	3.7	Quahogs	100%
Quashnet River	3.0	0	0	0%

Notes:

1. Includes Popponesset Creek.
2. Includes both Red Brook and Little River watersheds.
3. Watersheds are made up of multiple subwatersheds, but do not extend above Mashpee-Wakeby Pond.
4. Values based on MEP 2001 wastewater flow estimates.
5. All values based on “existing” conditions from MEP reports.

As shown above, per the existing conditions, several of the watersheds are estimated to have 100% of the load that exceeds the threshold (from any sources) would be removed. Shoestring Bay and Mashpee River are estimated to have a 50% removal, but the actual performance would be determined through monitoring and future watershed modeling.

Table 4-18 provides an estimate of the number of parcels based on subareas projected to be served within each watershed area that could potentially be addressed once the shellfish propagation reaches the proposed growth levels as identified in Chapter 5 which summarized the Draft Plan and Chapter 6 where the Final Recommended Plan is discussed. The estimated number of parcels addressed is based on the estimated removal percentage of nitrogen being targeted using this management approach.

Table 4-18 presents the percent removal information but under a future nitrogen load in terms of equivalent parcels as estimated and modeled as part of the ASAR evaluation of Options 1A, 1B, and 1C.

Table 4-18 Future Shellfish Estimated Positive Impact (equivalent number of dwellings addressed) [5]

Watershed [3]	Estimated Existing Developed Parcels in Subarea [4]	Estimated Percent Nitrogen Removal via Shellfish Aquaculture	Estimated Number of Parcels Addressed[4]
Mashpee River	1,100	50%	550
Popponesset Bay [1]	420	100%	420
Ockway Bay	210	100%	210
Shoestring Bay	2,000	50%	1,000
Great River	260	100%	260
Jehu Pond	190	100%	190
Hamblin Pond [2]	460	100%	460
Little River	70	100%	70

Notes:

1. Includes Popponesset Creek.
2. Includes both Red Brook watersheds.
3. Watersheds are made up of multiple subwatersheds, but do not extend above Mashpee-Wakeby Pond.
4. Rounded to two significant figures.
5. Based on final Popponesset Bay and Waquoit Bay MEP and TMDL reports.

One approach to consider the potential cost savings of using shellfish aquaculture over traditional infrastructure is to consider how many potential parcels would be connected to a collection system for treatment if no shellfish were considered. Using the cost estimating approach for collection systems as presented in Chapter 5 of the ASAR, assuming an average of $23,000 per property connected including the sewer mains, pumping stations, and road construction (excluding property owner connection costs, treatment, recharge, force mains, or design engineering or contingencies), a significant savings is estimated in the implementation of this program. This can then be compared to the estimated costs associated with the long-term management of the proposed shellfish program within these watersheds. Operation and Maintenance was conservatively estimated at an average of $130.00 per property per year to cover pumping stations operations, piping, and possible Town ownership/maintenance of individual grinder, vacuum valve pits, or septic tank effluent systems. Table 4-19 presents the estimated costs for implementation of the shellfish program in present worth dollars compared to the estimated present worth value of equivalent collection system costs by watershed area (based on the estimated number of properties potentially addressed through shellfish propagation under existing conditions). Treatment and recharge costs are not shown in the comparison as they are dependent on the size of the area being served (as shown in previous evaluations in this chapter); however additional cost savings are anticipated if those facilities are reduced in size or not required as a result of improved water quality from the propagation of shellfish.

The estimated annual cost for supporting shellfish aquaculture in each watershed is estimated as:

- Mashpee River $140,000
- Popponesset Bay/Creek $233,000
- Ockway Bay $140,000
- Shoestring Bay $112,000
- Great River $160,000
- Jehu Pond $160,000
- Hamblin Pond/Little River $547,000

The shellfish aquaculture annual costs were then converted into a Total Present Worth (TPW) cost as summarized in Table 4-19 to be compared to a TPW estimated value for simply the construction of a collection system within the road right-of-way to serve these same areas.

Table 4-19 Shellfish Program Versus Equivalent Parcels Collection System Total Present Worth Costs [1, 2]

Watershed	Estimated Shellfish $ [3,4]	Equivalent Parcels Collection System $ [5]
Mashpee River	$2,000,000	$16,000,000
Popponesset Bay (including Popponesset Creek)	$3,500,000	$10,000,000
Ockway Bay	$2,000,000	$5,100,000
Shoestring Bay	$1,600,000	$24,000,000
Great River	$2,400,000	$6,400,000
Jehu Pond	$2,400,000	$4,600,000
Hamblin Pond (Including Red Brook, Little River)	$8,100,000	$18,000,000
Total	$22,000,000	$80,000,000

Notes:

1. Values rounded to two significant figures.
2. Total Present worth based on 3% interest over 20 years.
3. Shellfish costs are conservative and assume that there is no natural reseeding and therefore there is a continuous annual cost, whereas, it is likely to be significantly less with natural reseeding.
4. Shellfish costs also do not consider the overall economic benefit through harvest into the local economy.
5. Collection system cost estimated based on future nitrogen loading from watershed.
6. Estimated costs are based on average cost per property connected for collection system mains only. Individual property service connections, and annual sewer user fees are not included. Treatment and recharge cost are dependent on the size of area being served, therefore are not shown as part of this analysis.

The cost savings in the total present worth of collection system costs is roughly 70% which does not include the cost savings in wastewater treatment and recharge costs; and this does not take into

consideration any natural reseeding of shellfish that will reduce the annual cost related to shellfish aquaculture.

The results indicate that shellfish propagation within Popponesset Bay and Ockway Bay has the potential for a major reduction in Subarea D.

In addition, expanded shellfish resources as proposed in Hamblin/Jehu/Little River/Great River/Red Brook could potentially reduce the nitrogen loading impacts from Subareas A, and most of Subareas B, C, D, E, and F-1 through F-12.

Advantages of this approach over conventional treatment approaches are:

- Starts addressing the nitrogen currently within the embayments.
- Has a much lower capital and O&M cost associated with it.
- Public perception and reception of this approach is typically higher than traditional methods on Cape Cod.
- Helps restore existing and historic shellfish resources.
- Has the potential to generate additional capital through additional licenses, permits, and sales of shellfish.
- Has the potential to generate other positive impacts related to habitat generation and shore stabilization.
- Has potential to reduce storm impacts through reef creation.
- Has the potential to address some of the existing benthic flux nitrogen loading, which traditional infrastructure would not address.
- The proposed shellfish implementation in Mashpee would be sub-tidal (out of sight) and therefore would not create aesthetic impacts associated with support/growth systems (i.e. bags, and other artificial substrate visible at the surface).

Disadvantages of this approach versus conventional treatment approaches are:

- Only watersheds with appropriate habitat characteristics can be targeted.
- Natural predators of shellfish and diseases can impact performance.
- Long-term performance by watershed is unknown.
- Regulatory requirements and permitting when considering as part of a CWMP are not established. Work is currently underway with the State to provide greater guidance on the use of these systems. If successful, the shellfish will contribute to achieving the nitrogen TMDL/water quality restoration whether they are part of an approved plan or not and would be considered under adaptive management.
- Does not address other constituents in septic system effluent that can be addressed through advanced wastewater treatment.
- Does not address the source, and is considered a Direct Environmental Management Approach.
- Long-term “maintenance” is unknown relative to maintaining TMDL compliance. Annual seeding may be required in certain areas (like Popponesset Bay/Creek) due to higher water flow rates.

Based on this evaluation, shellfish aquaculture is recommended to be considered as part of the Recommended Plan.

4.6.7.2 Permeable Reactive Barrier (PRB) Use

At this time, no additional specific areas (beyond the Pirates Cove proposal) within the Project Planning Area have been identified as a definite candidate site for PRB installation. As the Town of Falmouth moves forward with its demonstration project program as part of their ongoing planning efforts, the Town of Mashpee shall look to learn from Falmouth's experiences.

The potential for use of these facilities has been identified for discussion purposes including:

- Around existing recharge facilities.
- The Pirates Cove area.

Advantages of this approach over conventional treatment approaches are:

- Starts addressing the nitrogen currently within the embayments.
- Reduction in traditional infrastructure.
- Reduced O&M costs associated with long-term operation.

Disadvantages of this approach versus conventional treatment approaches are:

- Only areas with shallow depths to groundwater are typically considered, and may have limited application within the PPA.
- Long-term performance within any particular watershed is unknown.
- Regulatory requirements and permitting when considering as part of a Comprehensive Wastewater Management Plan (CWMP) are not established. Work is currently underway with the State to provide greater guidance on the use of these systems.
- Siting will depend on wetland and conservation commission regulations. Potentially significant permitting and regulation requirements.
- Does not necessarily address other constituents in septic system effluent that can be addressed through advanced wastewater treatment. Additional study and piloting would be required to demonstrate performance.
- Does not address the source and is considered a Direct Environmental Management Approach.
- Long-term maintenance of this system is unknown relative to maintaining long-term TMDL compliance.
- Level of disturbance dictated by type of barrier selected (open trench versus injection type).
- No operational control.

At this time, until PRB piloting is complete in neighboring communities or more technical information is available on their performance for nitrogen removal in coastal communities such as Mashpee, they will remain in the "toolbox" for consideration as part of Adaptive Management, but are not being recommended as a formal part of the plan.

4.6.7.3 Bog and Wetland Restoration

Advantages of this approach over conventional treatment approaches are:

- Restoration and reuse of an existing or historic natural resource.
- Potential reduction in conventional treatment and infrastructure required.
- Reduced O&M costs.

Disadvantages of this approach versus conventional treatment approaches are:

- Long-term performance is unknown.
- Regulatory requirements and permitting when considering as part of a CWMP are not established. Work is currently underway with the State to provide greater guidance on the use of these systems.
- Does not necessarily address other constituents in septic system effluent that can be addressed through advanced wastewater treatment.
- Does not address the source and is considered a Direct Environmental Management Approach.
- Long-term maintenance of this system is unknown relative to maintaining TMDL compliance.

At this time, bog and wetland restoration will remain in the "toolbox" for consideration as part of Adaptive Management, but are not being recommended as a formal part of the plan.

4.6.7.4 Onsite Systems

As part of a Recommended Plan, those properties proposed to either remain on septic systems or upgrade to I/A per Town requirements will also require a management strategy related to TMDL compliance. As part of the Recommended Plan, the Town/District will need to discuss opportunities and obstacles for using technologies assigned with MassDEP provisional approval (seasonal issues, permitting, proprietary nature, ownership, permitting, and oversight), in addition to long-term maintenance and performance testing/permitting to show compliance with TMDLs.

Advantages of this approach over conventional treatment approaches are:

- Is a source removal technology.
- Existing facilities can remain.
- I/A type systems (with nitrogen removal) provide a greater level of treatment over existing septic systems and cesspools.

Disadvantages of this approach versus conventional treatment approaches are:

- Highly variable systems, performance levels vary both on technology type and application.
- Average performance of existing systems on Cape Cod demonstrate performance levels short of needed levels for TMDL compliance.
- Does not necessarily address other constituents in septic system effluent that can be addressed through advanced wastewater treatment at a larger facility.
- Requires appropriate space on individual properties, puts operational responsibilities on the homeowner/property owner for compliance.

- Long-term maintenance of these types of systems is unknown relative to maintaining TMDL compliance when applied on a Town-wide basis.

At this time, I/A systems use will remain in the “toolbox” for consideration as part of Adaptive Management and within those areas or watersheds where sewering or shellfish aquaculture are not being considered.

4.7 Matrix Evaluation

As presented previously and as part of the ASAR, the Project Planning Area was broken into several “subareas” in order to assign flows to various treatment and recharge locations, and to allow a prioritization of the PPA to be used as part of implementation. Tables 4-20, 4-21, and 4-22 provide a summary of the general information on each planning area, information on wastewater generation, drinking water supply, watersheds, proximity to infrastructure, and other considerations. This general “demographic” information was then evaluated based on various weighted criteria so that each Subarea could be ranked.

General information included the following:

- Subarea identification;
- Subarea description;
- Primary MEP Watershed (Popponesset Bay, Waquoit Bay, or both);
- Subarea size (acres);
- Estimated existing wastewater (gpd);
- Estimated future wastewater (gpd);
- Number of parcels;
- Estimated number of “existing” developed parcels; and
- Estimated number of total potential developed parcels.

Wastewater generation information included:

- Percent of flow “existing” versus “future” (to show development potential);
- Estimated census occupancy by planning area (percent of year-round occupied—as provided by planning department);
- Estimated gallons per acre (“existing”) to show density;
- Estimated gallons per acre (“future”) to show future density;
- Estimated existing attenuated nitrogen load (kg/y per acre); and
- Estimated future attenuated nitrogen load (kg/y per acre).

Drinking water supply information included:

- Percent of planning area in Zone II;
- Percent of Subarea in USGS well recharge area; and
- Estimated percent of parcels in Subarea on private wells.

Watershed information included:

- Watershed attenuation;

TABLE 4-20 : MATRIX EVALUATION POINTS

		Points per Category	Maximum Points by Group
GENERAL INFORMATION	Subarea ID		
	Subarea Description		
	Primary MEP Watershed		
	Subarea Size (acres)		
	Existing gpd		
	Future gpd		
	Total number of parcels		
	Number "existing" developed		
	Number of developed / developable parcels		
WASTEWATER GENERATION	Percent of flow existing vs. at future (weight)	5	30
	Est. Census Occupancy by planning area (% year round) (weight)	5	
	Existing Gal/Ac (Weight)	5	
	Future Gal/Ac (weight)	5	
	Est. Existing Attenuated load (kg/y per acre) (weight)	5	
	Est. Future attenuated load (kg/y per acre) (weight)	5	
DRINKING WATER	Percent of Subarea in Zone II (weight)	5	20
	Percent of Subarea in USGS Well Recharge Area (weight)	10	
	Estimated Percent on Private Wells (weight)	5	
WATERSHED	Watershed Attenuation (weight)	10	30
	In Subwatershed to Shellfish Propogation (weight)	5	
	Embayment Habitat Quality (weight)	10	
	Number of upgradient properties within 300ft Fresh Water (P) (weight)	5	
PROXIMITY TO INFRASTRUCTURE	Proximity to JBCC (weight)	3	20
	Proximity to "Closest" Existing WWTF (weight)	4	
	Proximity to "Closest" Potential New WWTF (weight)	3	
	Proximity to Potential Recharge - New Seabury (weight)	3	
	Proximity to Potential New Recharge - Back Road (weight)	2	
	Proximity to Potential New Recharge - Site 4 (weight)	2	
	Proximity to Potential New Recharge - Site 6 WWTF (weight)	1	
	Proximity to Potential New Recharge Willowbend (weight)	2	
BONUS	Subarea includes: Summerwood Condos, Sea Oaks Condos, Lake Side Estates, or South Cape Resort	+5	+10
	Subarea within Mashpee River Watershed	+5	
RANK	VALUE TOTAL (with Maximum Bonus)	110	110
	RANK	#	

TABLE 4-21: SUBAREA DATA (FOR MATRIX EVALUATION - ROUNDED)

GENERAL INFORMATION									WASTEWATER GENERATION												DRINKING WATER SUPPLY				WATERSHED					PROXIMITY TO INFRASTRUCTURE									OTHER			
Subarea ID	Subarea Description	Primary MEP Watershed	Subarea Size (acres)	Existing gpd	Future gpd	Total number of parcels	Number "existing" developed	Number of developed / developable parcels	Percent of flow "Existing" vs. "Future"	Est. Census Occupancy by planning area (% year round)	Gallons Per Acre ("Existing")	Gallons Per Acre ("Future")	Est. "Existing" N. Load (septic) kg/yr	Est. "Future" N. Load (septic) kg/yr	Est. "Existing" Unattunated Load per acre (kg/y/ac)	Est. "Future" Unattunated Load per acre (kg/y/ac)	"Existing" Nitrogen Loading Att. (kg/y)	"Future" Nitrogen Loading Att. (kg/y)	Est. "Existing" Attenuated load (kg/y) per acre	Est. "Future" Attenuated load (kg/y) per acre	% Area within Zone II	Percent of Planning Area in USGS Well Recharge Area (weight)	Estimated Number of Private Wells	Est. Percent on Private Wells	Watershed Attenuation % (future)	In Subwatershed to Shellfish Propogation	Embayment Habitat Quality	Number of upgradient properties within 300ft Fresh Water (P)	Percent of upgradient properties within 300ft Fresh Water (P)	Proximity to JBCC (miles)	Proximity to "Closest" Existing WWTF (miles)	Proximity to "Closest" Potential New WWTF (miles)	Proximity to Potential Recharge - New Seabury	Proximity to Potential New Recharge - Back Road	Proximity to Potential New Recharge - Site 4	Proximity to Potential New Recharge - Site 6 WWTF	Proximity to Potential New Recharge Willowbend	Needs Assessment Priority Areas	Bonus Criteria For Matrix	Summerwood/Lakeside Estates Trailer Park/Sea Oaks/ South Cape Resort	Percent in Mashpee River Watershed
{alpha#}	{Desc.}	{Poppy / Waquiot / Both}	{#}	{#}	{#}	{#}	{#}	{#}	{%}	{%}	{#}	{#}	{#}	{#}	{#}	{#}	{#}	{#}	{#}	{#}	{%}	{%}	{#}	{%}	{%}	{yes/no}	{Level of Impairment}	{#}	{%}	{#}	{#}	{#}	{#}	{#}	{#}	{#}	{Pri. /Sec. /Ter.}	{Yes/No}	{Yes/No}	{%}
A	A. Seconsett Island	Waquoit	40	10,000	13,000	90	80	80	82%	41%	267	326	380	460	10	12	380	460	10	12	0%	0%	0	0%	0%	yes	MI	0	0%	5.2	1.3	1.6	1.7	5.3	4.8	1.8	4.8	Secondary	No	No	0%
B	B. Areas to the east and west of the existing New Seabury facility	Waquoit	220	53,000	75,000	530	440	490	71%	29%	234	332	1,900	2,700	8	12	1,910	2,710	8	12	11%	0%	0	0%	0%	yes	MI	0	0%	5.4	0.1	0.8	0.9	5.4	4.7	1.6	4.5	Secondary	No	No	0%
C	C. Monomoscoy Island	Waquoit	70	12,000	18,000	220	130	160	71%	50%	166	235	450	640	6	9	450	640	6	9	0%	0%	0	0%	0%	yes	H/MI	0	0%	5.1	1.1	1.0	1.3	5.0	4.5	1.6	4.5	Secondary	No	No	0%
D	D. Areas surrounding and including the Keeter Property (not including outside watershed area)	Both	690	110,000	140,000	1030	810	920	80%	48%	159	198	4,000	4,900	6	7	3,900	4,900	6	7	74%	7%	65	6%	0%	yes	SI	0	0%	4.1	1.2	0.0	1.7	4.4	3.1	0.1	2.8	Secondary	Yes	No	3%
E	E. Area around Holland Mills Estates, Great Hay Acres, and Southcape Resorts	Waquoit	90	16,000	22,000	100	60	90	71%	69%	176	249	570	800	6	9	570	800	6	9	100%	0%	0	0%	0%	yes	MI	0	0%	3.7	1.3	0.7	2.4	3.3	2.6	1.1	2.7	Tertiary	Yes	Yes	0%
F	F. Pirates Cove	Popponessett	50	13,000	14,000	160	140	150	91%	43%	233	256	500	500	8	9	460	500	8	9	0%	0%	0	0%	0%	yes	SI	0	0%	4.5	1.2	1.1	2.7	3.8	2.1	1.3	1.7	Primary	Yes	No	43%
G	G. Mashpee Village	Waquoit	30	13,000	20,000	0	0	0	65%	95%	386	598	500	700	14	22	480	740	14	22	24%	0%	0	0%	0%	no	SD	0	0%	2.3	0.1	1.3	4.3	1.7	1.6	2.8	2.3	Primary	No	No	0%
H	H. Areas south of Johns Pond including the High School	Waquoit	540	73,000	140,000	580	450	540	54%	91%	135	248	0	0	0	0	0	0	0	0	98%	14%	10	2%	5%	no	SD	37	6%	1.3	0.1	0.6	4.3	1.7	2.4	2.8	3.1	Primary	Yes	Yes	0%
H -Only	H. Without HS or MC or I/A	Waquoit	350	71,000	120,000	570	450	530	59%	85%	200	337	2,600	4,300	7	12	2,400	3,200	7	9	98%	14%	10	2%	5%	no	SD	37	6%	1.3	0.1	0.6	4.3	1.7	2.4	2.8	3.1	Primary	Yes	yes	0%
I	I. Area around Willowbend	Popponessett	630	83,000	120,000	610	290	390	68%	45%	132	193	0	0	0	0	0	0	0	0	5%	0%	10	2%	23%	yes	MI/SI	0	0%	4.0	0.0	0.3	4.5	3.4	1.0	3.1	0.1	Primary	No	No	0%
I -Only	I without Willowbend	Popponessett	400	39,000	56,000	380	110	160	69%	55%	98	141	1,400	2,000	4	5	1,100	1,600	3	4	5%	0%	10	3%	23%	yes	MI/SI	0	0%	4.0	0.0	0.3	4.5	3.4	1.0	3.1	0.1	Primary	No	No	0%
J	J. Southport	Waquoit	320	2,000	150,000	10	0	10	1%	61%	7	488	0	0	0	0	0	0	0	0	0%	0%	0	0%	0%	no	SD	0	0%	1.7	0.0	0.5	4.5	1.3	1.8	3.1	2.7	Primary	No	No	0%
J-only	J. Without Southport	Waquoit	80	0	50,000	10	0	10	0%	42%	2	665	10	1,800	0	24	10	1,800	0	24	0%	0%	0	0%	0%	no	SD	0	0%	1.7	0.2	0.6	4.8	1.0	1.7	3.6	2.6	Primary	No	No	0%
K	K. Cotuit Meadows and portion of Barnstable to the east	Popponessett	100	13,000	32,000	20	10	20	40%	2%	128	324	500	1,200	5	12	440	940	4	9	84%	5%	0	0%	19%	yes	MI/SI	0	0%	3.9	0.5	0.2	5.1	3.0	0.7	3.6	0.9	Tertiary	No	No	0%
L	L. North of Johns Pond, Briarwood area	Waquoit	130	31,000	49,000	270	230	260	63%	58%	247	391	1,100	1,800	9	14	460	720	4	6	0%	0%	0	0%	59%	no	SD	49	18%	0.6	0.9	0.0	5.6	0.4	2.6	4.1	3.6	Primary	No	No	0%
M	M. North of Ashumet Pond	Waquoit	40	6,000	11,000	90	50	80	57%	62%	168	295	200	400	6	11	40	60	1	2	57%	0%	0	0%	84%	no	SD	49	54%	0.3	1.6	0.5	6.1	0.8	3.3	4.7	4.1	Primary	No	No	0%
N	N. Steeplechase	Popponessett	20	4,000	4,000	30	30	30	100%	95%	215	208	200	100	8	8	110	100	5	5	60%	0%	0	0%	31%	yes	SI/SD	0	0%	2.2	1.1	1.1	5.5	1.3	1.3	3.8	2.3	Secondary	Yes	No	100%
O	O. Stratford Ponds	Popponessett	120	3,000	22,000	10	10	10	12%	43%	23	187	0	0	0	0	0	0	0	0	90%	0%	0	0%	29%	yes	MI/SI	0	0%	3.7	0.8	0.7	5.7	2.9	1.0	4.1	1.3	Tertiary	No	No	0%
O Only	O without Stratford Ponds	Popponessett	50	0	0	10	0	0	100%	87%	10	10	20	20	0	0	10	10	0	0	90%	0%	0	0%	29%	yes	MI/SI	0	0%	3.7	0.9	0.7	5.7	2.9	1.0	4.1	1.3	Tertiary	No	No	0%
P	P. Area around Mashpee Rotary north along Great Neck Road	Both	1,130	190,000	370,000	730	490	670	51%	42%	168	327	0	0	0	0	0	0	0	0	21%	0%	56	8%	4%	yes	SI	0	0%	2.5	0.0	0.7	3.8	2.3	1.3	2.3	1.7	Primary	Yes	No	82%
P-only	P Without Mashpee Commons/South Cape/Windchime Point/I/A	Both	840	130,000	220,000	700	480	650	58%	70%	151	259	4,600	7,900	5	9	4,400	7,600	5	9	21%	0%	56	8%	4%	yes	SI	0	0%	2.5	0.2	0.5	3.8	2.3	1.3	2.3	1.7	Primary	Yes	No	82%
Q	Q. Future Wampanoag Village site north towards Town Hall	Popponessett	160	4,200	14,000	60	20	30	29%	83%	27	92	0	0	0	0	0	0	0	0	0%	0%	10	18%	30%	yes	SI/SD	0	0%	3.0	0.0	0.4	5.7	2.1	1.0	4.1	1.8	Secondary	Yes	No	100%
Q-Only	Q Without Wampanoag Village	Popponessett	140	4,200	7,400	60	20	30	57%	88%	31	54	150	270	1	2	110	190	1	1	0%	0%	10	18%	30%	yes	SI/SD	0	0%	3.0	1.1	0.4	5.7	2.1	1.0	4.1	1.8	Secondary	Yes	No	100%
R	R. Northeast of Santuit Pond	Popponessett	90	28,000	29,000	160	150	160	97%	85%	324	335	1,000	1,100	12	12	270	280	3	3	83%	0%	0	0%	74%	yes	MI/SI	27	17%	4.3	2.0	1.9	6.8	3.6	2.2	5.3	2.6	Secondary	No	No	0%
S	S. West of Santuit Pond (south picking up neighborhoods west and south of Willowbend)	Popponessett	1,260	200,000	260,000	1900	1400	1700	76%	84%	159	210	7,200	9,600	6	8	5,300	7,400	4	6	54%	12%	109	6%	23%	yes	SI	99	5%	3.2	0.4	0.0	5.3	2.6	0.6	3.7	1.1	Primary	Yes	Yes	26%
T	T. Area along Rte. 130 between Town Hall and Sandwich	Both	550	34,000	110,000	240	180	220	32%	84%	63	198	1,300	4,000	2	7	860	2,270	2	4	53%	0%	60	25%	23%	yes	SI/SD	24	10%	2.0	1.7	1.0	6.7	1.4	2.3	5.1	3.1	Secondary	Yes	No	71%
Sand-1	-	Waquoit	80	27,000	30,000	160	150	150	90%	0%	321	357	1,000	1,100	12	13	80	90	1	1	99%	38%	6	4%	92%	no	SD	9	6%	2.4	3.9	2.5	8.7	2.8	4.5	7.1	5.4	Tertiary	No	No	0%
Sand-2	-	Waquoit	120	34,000	41,000	200	160	190	82%	0%	270	330	1,200	1,500	10	12	120	180	1	1	99%	26%	5	3%	88%	no	SD	9	5%	2.3	3.5	2.2	8.4	2.6	4.3	6.8	5.1	Tertiary	No	No	0%
Sand-3	-	Waquoit	110	27,000	35,000	180	140	180	77%	0%	245	319	1,000	1,300	9	12	790	930	7	8	34%	0%	8	4%	27%	no	SD	0	0%	2.3	3.1	1.9	8.1	2.3	3.8	6.5	4.5	Secondary	No	No	0%
Sand-4	-	both	240	47,000	61,000	340	280	330	77%	0%	200	259	1,700	2,200	7	9	570	730	2	3	39%	0%	20	6%	67%	yes	SI	31	9%	2.8	3.4	2.3	8.2	2.7	3.7	6.7	4.5	Tertiary	No	No	0%
Sand-5	-	Popponessett	300	48,000	55,000	330	250	280	86%	0%	157	181	1,700	2,000	6	7	320	380	1	1	26%	0%	6	2%	81%	yes	MI/SI	1	0%	3.5	4.2	3.2	9.2	3.7	4.5	7.5	5.4	Tertiary	No	No	0%
Sand-6	-	Popponessett	110	29,000	31,000	140	140	140	93%	0%	260	281	1,000	1,100	9	10	180	200	2	2	100%	0%	119	86%	83%	yes	MI	0	0%	4.4	5.0	4.0	9.7	4.3	5.0	8.0	5.7	Tertiary	No	No	0%
Sand-7	-	Popponessett	290	26,000	36,000	270	200	240	73%	50%	91	124	900	1,300	3	5	320	440	1	2	0%	0%	171	65%	66%	yes	SI	0	0%	0.0	3.5	2.8	8.4	3.3	3.7	6.7	4.4	Tertiary	No	No	0%
Sand-8	-	Popponessett	440	38,000	45,000	270	230	260	85%	7%	86	100	1,400	1,600	3	4	450	530	1	1	100%	0%	228	83%	67%	yes	SI	6	2%	4.1	3.5	3.1	8.8	4.0	4.0	7.1	4.5	Tertiary	No	No	0%
Sand-9	-	Popponessett	200	32,000	33,000	240	230	240	95%	0%	156	164	1,200	1,200	6	6	300	320	1	2	91%	0%	125	52%	74%	yes	MI/SI	0	0%	4.1	2.6	2.4	7.7	3.7	2.8	6.0	3.3	Tertiary	No	No	0%
Fal-1	-	Waquoit	40	650	2,500	20	0	10	26%	0%	18	68	20	90	1	2	20	90	1	2	92%	0%	12	75%	1%	yes	MI	0	0%	3.8	1.5	0.9	2.4	3.4	3.0	1.1	3.1	Secondary	No	No	0%
Fal-2	-	Waquoit	20	1,500	7,100	50	10	50	21%	0%	62	291	100	300	2	11	60	260	2	11	48%	0%	0	0%	0%	yes	SI	0	0%	3.9	1.7	0.8	2.3	3.6	3.1	1.1	3.3	Secondary	No	No	0%
Fal-3	-	Waquoit	30	2,400	3,600	30	20	20	65%	0%	93	142	90	130	3	5	90	130	3	5	0%	0%	0	0%	0%	no	SD	0	0%	3.9	1.7	1.1	2.3	3.7	3.3	1.3	3.6	Secondary	No	No	0%
Fal-4	-	Waquoit	30	600	3,800	30	0	30	15%	0%	22	151	20	140	1	5	20	140	1	5	14%	0%	0	0%	0%	no	SD	0	0%	4.0	1.9	0.8	2.2	3.7	3.3	1.1	3.3	Secondary	No	No	0%
Fal-5	-	Waquoit	10	0	2,500	20	0	20	0%	0%	0	239	0	90	0	9	0	90	0	9	0%	0%	0	0%	0%	yes	H	0	0%	4.2	2.0	0.9	2.1	3.8	3.4	1.0	3.4	Secondary	No	No	0%
Fal-6	-	Waquoit	30	0	4,300	30	0	30	0%	0%	0	162	0	160	0	6	0	160	0	6	0%	0%	0	0%	0%	yes	H	0	0%	4.2	1.9	0.9	2.1	4.0	3.4	1.0	3.6	Secondary	No	No	0%
Fal-7	-	Waquoit	30	140	3,100	20	0	20	5%	0%	5	116	10	110	0	4	10	110	0	4	0%	0%	0	0%	0%	no	SD	0	0%	4.2	1.9	1.0	2.1	3.8	3.6	1.3	3.7	Tertiary	No	No	0%
Fal-8	-	Waquoit	10	420	2,900	20	0	20	15%	0%	36	250	20	100	1	9	20	100	1	9	0%	0%	0	0%	0%	no	SD	0	0%	4.3	2.0	1.1	2.1	4.0	3.7	1.3	3.8	Secondary	No	No	0%
Fal-9	-	Waquoit	90	3,000	11,000	50	10	50	27%	0%	34	128	110	410	1	5	110	410	1	5	0%	0%	3	6%	0%	yes	SI/SD	0	0%	4.4	1.6	0.9	2.0	4.1	3.8	1.3	4.0	Secondary	No	No	0%
Fal-10	-	Waquoit	30	7,600	10,000	30	10	20	77%	0%	250	327	270	360	9	12	270	360	9	12	0%	0%	0	0%	0%	yes	MI/SI	0	0%	4.7	1.6	1.2	1.8	4.4	4.1	1.4	4.1	Secondary	No	No	0%
Fal-11	-	Waquoit	20	12,000	13,000	20	20	20	90%	0%	536	599	420	470	19	22	420	470	19	22	0%	0%	0	0%	0%	yes	MI/SI	0	0%	4.8	1.6	1.5	1.8	4.5	4.4	1.6	4.4	Secondary	No	No	0%
Fal-12	-	Waquoit	30	810	2,000	20	10	10	42%	5%	31	74	30	70	1	3	30	70	1	3	0%	0%	0	0%	0%	yes	MI/SI	0	0%	4.8	1.5	1.6	1.8	4.8	4.5	1.8	4.5	Secondary	No	No	0%
Fal-13	-	Waquoit	60	6,000	8,700	50	40	50	69%	0%	107	156	220	320	4	6	220	320	4	6	0%	0%	23	47%	0%	no	SD	0	0%	4.2	1.9	1.4	2.2	4.1	4.1	1.7	4.3	Tertiary	No	No	0%
Fal-14	-	Waquoit	20	2,400	4,400	20	10	20	55%	0%	131	238	90	160	5	9	90	160	5	9	0%	0%	0	0%	0%	no	SD	0	0%	4.0	2.1	1.6	2.5	3.8	3.8	1.7	4.0	Tertiary	No	No	0%
Fal-15	-	Waquoit	130	10,000	13,000	70	50	60	75%	0%	76	102	350	470	3	4	350	470	3	4	3%	0%	0	0%	0%	no	SD	0	0%	3.6	1.4	1.2	2.6	3.6	3.3	1.4	3.6	Tertiary	No	No	0%
Fal-16	-	Waquoit	50	7,000	10,000	40	30	40	73%	0%	149	204	250	350	5	7	250	350	5	7	0%	0%	0	0%	0%	no	SD	0	0%	3.5	1.4	1.4	2.7	3.3	3.1	1.6	3.4	Tertiary	No	No	0%
Fal-17	-	Waquoit	120	7,000	13,000	50	30	50	53%	0%	58	110	240	470	2	4	240	470	2	4	0%	0%	1	2%	0%	no	SD	0	0%	3.3	1.4	1.6	2.8	3.3	3.4	1.8	3.7	Tertiary	No	No	0%
Barn 37	-	Popponessett	40	10,000	14,000	70	60	70	71%	0%	221	310	360	500	8	11	250	350	6	8	0%	0%	0	0%	30%	yes	MI/SI	0	0%	4.8	0.2	1.2	4.8	4.0	1.4	3.4	0.9	Tertiary	No	No	0%
Barn 38	-	Popponessett	280	46,000	59,000	320	280	310	77%	0%	160	209	1,700	2,200	6	8	1,300	1,700	5	6	42%	0%	0	0%	21%	yes	MI/SI	0	0%	4.8	0.4	1.3	4.7	4.0	1.5	3.4	0.7	Tertiary	No	No	0%
Barn 39	-	Popponessett	130	21,000	26,000	130	120	130	79%	0%	160	201	800	900	6	7	750	950	6	7	0%	0%	0	0%	0%	yes	SI	0	0%	4.9	1.1	1.5	3.4	4.1	1.8	2.1	1.3	Tertiary	No	No	0%
Barn 42	-	Popponessett	290	37,000	49,000	260	200	250	75%	26%	127	170	1,300	1,800	5	6	680	940	2	3	65%	0%	0	0%	30%	yes	MI/SI	0	0%	4.1	0.2	1.1	5.7	3.6	1.4	4.3	1.3	Tertiary	No	No	0%
Briarwood/Otis Trailer Village	Potential Cluster site {Part of Subarea L}	Waquoit	240	34,000	52,000	320	300	320	64%	55%	139	218	1,200	1,900	5	8	490	770	2	3	6%	0%	0	0%	59%	no	SD	72	22%	0.6	0.8	0.0	5.7	0.3	2.6	4.1	3.6	Primary	No	No	0%
Pickerel Cove	Potential Cluster site {Part of Subarea T}	Popponessett	70	6,200	8,000	60	50	60	77%	89%	84	109	220	290	3	4	80	110	1	1	0%	0%	12	21%	63%	yes	SI	24	43%	2.6	2.8	1.6	7.5	2.4	3.0	6.0	3.8	Tertiary	Yes	No	7%
Pirates Cove	Potential Cluster site {Subarea F}	Popponessett	70	13,000	14,000	150	150	150	91%	43%	191	210	450	500	7	8	450	500	7	8	0%	0%	0	0%	0%	yes	SI	0	0%	4.5	1.2	1.1	2.8	3.8	2.1	1.3	1.7	Primary	Yes	No	44%
Tri-Town Circle	Potential Cluster site {Subarea M}	Waquoit	50	6,000	11,000	90	70	90	57%	62%	128	225	230	400	5	8	40	60	1	1	50%	0%	0	0%	84%	no	SD	49	53%	0.3	1.6	0.5	6.1	0.8	3.3	4.7	4.1	Primary	No	No	0%
Santuit Pond	Potential Cluster site {Subarea R}	Popponessett	110	29,000	30,000	180	180	180	96%	77%	253	264	1,000	1,100	9	10	270	280	2	2	69%	0%	0	0%	74%	yes	MI/SI	27	15%	4.3	2.0	1.9	7.0	3.6	2.2	5.3	2.6	Secondary	No	No	0%
D1	Subset of D (Poppy Side) including D-Future	Popponessett	490	79,000	93,000	810	640	710	85%	35%	161	189	2,900	3,400	6	7	2,810	3,300	6	7	71%	18%	65	8%	0%	yes	MI/SI	0	0%	5.7	1.8	0.9	1.7	4.4	3.1	0.1	2.8	Secondary	No	No	0%
D2	Subset of D (Waquoit Side)	Waquoit	190	35,000	43,000	310	240	300	82%	62%	184	225	1,300	1,600	7	8	1,280	1,560	7	8	34%	0%	0	0%	0%	yes	MI	0	0%	4.7	1.8	0.9	1.7	4.4	3.1	0.1	2.8	Secondary	No	No	0%
S1	Subset of S (south of Falmouth Rd)	Popponessett	400	67,000	89,000	630	430	540	75%	75%	169	224	2,400	3,200	6	8	2,430	3,230	6	8	16%	0%	10	2%	0%	yes	SI	0	0%	4.5	0.7	0.9	4.0	3.3	1.0	2.6	0.9	Primary	Yes	yes	17%
S2	Subset of S (north of Falmouth Rd)	Popponessett	860	130,000	180,000	1,200	1,000	1,100	76%	88%	155	204	4,800	6,400	6	7	2,940	4,180	3	5	65%	10%	99	8%	34%	yes	SI	99	8%	4.3	2.0	1.4	6.5	2.8	1.4	4.7	1.8	Primary	Yes	Yes	22%
P1	Subset of P (north of Nathan Ellis)	Popponessett	420	72,000	110,000	330	220	320	63%	74%	172	274	2,600	4,200	6	10	2,230	3,520	5	8	3%	0%	10	3%	8%	yes	SI/SD	0	0%	3.3	0.0	0.9	4.7	1.8	0.9	3.3	1.7	Primary	Yes	No	92%
P2	Subset of P (south of Nathan Ellis)	Both	710	120,000	260,000	400	280	360	46%	66%	166	358	4,300	9,300	6	13	3,140	6,350	4	9	19%	0%	45	11%	0%	yes	SI/SD	0	0%	3.8	0.0	1.7	3.3	2.8	1.6	1.8	1.8	Primary	Yes	No	39%

TABLE 4-22: MATRIX RANKING (ROUNDED)

GENERAL INFORMATION									WASTEWATER GENERATION						DRINKING WATER SUPPLY			WATERSHED				PROXIMITY TO INFRASTRUCTURE								OTHER		
Subarea ID	Subarea Description	Primary MEP Watershed	Subarea Size (acres)	Existing gpd	Future gpd	Total number of parcels	Number "existing" developed	Number of developed / developable parcels	Percent of flow existing vs. at future (weight)	Est. Census Occupancy by planning area (% year round) (weight)	Existing Gal/Ac (Weight)	Future Gal/Ac (weight)	Est. Existing Attenuated load (kg/y per acre) (weight)	Est. Future attenuated load (kg/y per acre) (weight)	Percent of Subarea in Zone II (weight)	Percent of Subarea in USGS Well Recharge Area (weight)	Estimated Percent on Private Wells (weight)	Watershed Attenuation (weight)	In Subwatershed to Shellfish Propogation (weight)	Embayment Habitat Quality (weight)	Number of upgradient properties within 300ft Fresh Water (P) (weight)	Proximity to JBCC (weight)	Proximity to "Closest" Existing WWTF (weight)	Proximity to "Closest" Potential New WWTF (weight)	Proximity to Potential Recharge - New Seabury (weight)	Proximity to Potential New Recharge - Back Road (weight)	Proximity to Potential New Recharge - Site 4 (weight)	Proximity to Potential New Recharge - Site 6 WWTF (weight)	Proximity to Potential New Recharge Willowbend (weight)	BONUS (Within Mashpee River Watershed up to +5, Summerwood Condos, etc +5)	VALUE TOTAL	RANK
								Points per Category	5	5	5	5	5	5	5	10	5	10	5	10	5	3	4	3	3	2	2	1	2	up to 10+	100	
GENERAL INFORMATION									WASTEWATER GENERATION						WATER SUPPLY			WATERSHED				INFRASTRUCTURE								OTHER		
{alpha#}	{Desc.}	{Poppy / Waquiot / Both}	{#}	{#}	{#}	{#}	{#}	{#}	WEIGHT						WEIGHT			WEIGHT				WEIGHT								WEIGHT	RANK	
H -Only	H. Without HS or MC or I/A	Waquoit	350	71,000	120,000	570	450	530	3	5	2	3	2	2	5	1	1	10	5	10	1	2	4	3	0	1	1	0	0	5	66	1
G	G. Mashpee Village	Waquoit	30	13,000	20,000	0	0	0	4	5	3	4	3	5	2	0	0	10	5	10	0	2	4	2	0	1	1	0	1	0	62	2
H	H. Areas south of Johns Pond including the High School	Waquoit	540	73,000	140,000	580	450	540	3	5	1	2	0	0	5	1	1	10	5	10	1	2	4	3	0	1	1	0	0	5	60	3
S	S. West of Santuit Pond (south picking up neighborhoods west and south of Willowbend)	Popponessett	1,260	200,000	260,000	1,900	1,400	1,700	4	5	2	2	1	2	3	1	1	8	0	7	1	1	4	3	0	0	2	0	1	6	54	4
P-only	P Without Mashpee Commons/South Cape/Windchime Point/I/A	Both	840	130,000	220,000	700	480	650	3	4	2	2	2	2	2	0	1	10	0	8	0	2	4	3	1	1	1	1	1	4	54	4
P1	Subset of P (north of Nathan Ellis)	Popponessett	420	72,100	110,000	330	220	320	4	4	2	2	2	2	1	0	1	9	0	9	0	1	4	3	0	1	2	0	1	5	53	6
J-only	J. Without Southport	Waquoit	80	140	50,000	10	0	10	1	3	1	5	1	5	0	0	0	10	5	10	0	2	4	3	0	2	1	0	0	0	53	6
S1	Subset of S (south of Falmouth Rd)	Popponessett	400	67,000	89,000	630	430	540	4	4	2	2	2	2	1	0	1	10	0	7	0	0	3	3	1	0	2	0	2	6	52	8
N	N. Steeplechase	Popponessett	20	4,200	4,100	30	30	30	5	5	2	2	2	2	4	0	0	7	0	9	0	2	2	2	0	1	1	0	1	5	52	8
P	P. Area around Mashpee Rotary north along Great Neck Road	Both	1,130	190,000	370,000	730	490	670	3	3	2	3	0	0	2	0	1	10	0	8	0	2	4	3	1	1	1	1	1	4	50	10
E	E. Area around Holland Mills Estates, Great Hay Acres, and Southcape Resorts	Waquoit	90	16,000	22,000	100	60	90	4	4	2	2	2	2	5	0	0	10	0	4	0	1	2	3	2	0	0	1	0	5	49	11
P2	Subset of P (south of Nathan Ellis)	Both	710	120,000	260,000	400	280	360	3	4	2	3	1	2	1	0	1	10	0	8	0	1	4	2	1	0	1	1	1	2	48	12
S2	Subset of S (north of Falmouth Rd)	Popponessett	860	130,000	180,000	1,230	1,010	1,130	4	5	2	2	1	1	4	1	1	7	0	7	1	0	2	2	0	0	1	0	1	6	48	12
D	D. Areas surrounding and including the Keeter Property (not including outside watershed area)	Both	690	110,000	140,000	1,030	810	920	5	3	2	2	2	2	4	1	1	10	0	7	0	0	2	3	2	0	0	1	0	0	47	14
T	T. Area along Rte. 130 between Town Hall and Sandwich	Both	550	34,500	110,000	240	180	220	2	5	1	2	1	1	3	0	2	8	0	9	1	2	2	2	0	1	1	0	0	4	47	14
M	M. North of Ashumet Pond	Waquoit	40	6,300	11,100	90	50	80	3	4	2	2	1	1	3	0	0	2	5	10	3	3	2	3	0	2	0	0	0	0	46	16
L	L. North of Johns Pond, Briarwood area	Waquoit	130	31,000	49,000	270	230	260	4	3	2	3	1	2	0	0	0	4	5	10	1	3	3	3	0	2	0	0	0	0	46	16
J	J. Southport	Waquoit	320	2,200	150,000	10	0	10	1	4	1	4	0	0	0	0	0	10	5	10	0	2	4	3	0	1	1	0	0	0	46	16
D1	Subset of D (Poppy Side) including D-Future	Popponessett	490	79,000	93,000	810	640	710	5	2	2	2	2	2	4	2	1	10	0	6	0	0	2	3	2	0	0	1	0	0	46	16
Q-Only	Q Without Wampanoag Village	Popponessett	140	4,200	7,400	60	20	30	3	5	1	1	1	1	1	0	1	7	0	9	0	1	2	3	0	1	2	0	1	5	45	20
Fal-13	-	Waquoit	60	6,000	8,700	50	40	50	4	0	1	2	1	2	0	0	3	10	5	10	0	0	2	2	2	0	0	1	0	0	45	20
Tri-Town Circle	Potential Cluster site {Subarea M}	Waquoit	50	6,300	11,100	90	70	90	3	4	1	2	1	1	3	0	0	2	5	10	3	3	2	3	0	2	0	0	0	0	45	20
Briarwood/Otis Trailer Village	Potential Cluster site {Part of Subarea L}	Waquoit	240	34,000	52,000	320	300	320	4	3	1	2	1	1	1	0	0	4	5	10	2	3	3	3	0	2	0	0	0	0	45	20
Fal-11	-	Waquoit	20	12,000	13,000	20	20	20	5	0	4	4	4	5	0	0	0	10	0	5	0	0	2	2	2	0	0	1	0	0	44	24
Q	Q. Future Wampanoag Village site north towards Town Hall	Popponessett	160	4,200	14,400	60	20	30	2	5	1	1	0	0	1	0	1	7	0	9	0	1	4	3	0	1	2	0	1	5	44	24
Sand-1	-	Waquoit	80	27,000	30,000	160	150	150	5	0	3	3	1	1	5	4	1	1	5	10	1	2	1	1	0	0	0	0	0	0	44	24
Sand-3	-	Waquoit	110	27,000	35,000	180	140	180	4	0	2	3	2	2	2	0	1	7	5	10	0	2	1	2	0	1	0	0	0	0	44	24
F	F. Pirates Cove	Popponessett	50	13,000	14,000	160	140	150	5	3	2	2	2	2	0	0	0	10	0	7	0	0	2	2	1	0	1	1	1	2	43	28
Pirates Cove	Potential Cluster site {Subarea F}	Popponessett	70	13,000	14,000	150	150	150	5	3	2	2	2	2	0	0	0	10	0	7	0	0	2	2	1	0	1	1	1	2	43	28
Sand-2	-	Waquoit	120	34,000	41,000	200	160	190	5	0	2	3	1	1	5	3	1	1	5	10	1	2	1	2	0	0	0	0	0	0	43	28
Fal-16	-	Waquoit	50	6,900	9,500	40	30	40	4	0	1	2	2	2	0	0	0	10	5	10	0	1	2	2	1	0	0	1	0	0	43	28
O Only	O without Stratford Ponds	Popponessett	50	470	470	10	0	0	5	5	1	1	1	1	5	0	0	7	0	6	0	1	3	3	0	0	2	0	1	0	42	32
B	B. Areas to the east and west of the existing New Seabury facility	Waquoit	220	53,000	75,000	530	440	490	4	2	2	3	2	3	1	0	0	10	0	4	0	0	4	3	3	0	0	1	0	0	42	32
Fal-3	-	Waquoit	30	2,400	3,600	30	20	20	4	0	1	1	1	2	0	0	0	10	5	10	0	1	2	2	2	0	0	1	0	0	42	34
Fal-14	-	Waquoit	20	2,400	4,400	20	10	20	3	0	1	2	1	2	0	0	0	10	5	10	0	1	2	2	2	0	0	1	0	0	42	34
Fal-15	-	Waquoit	130	9,700	12,900	70	50	60	4	0	1	1	1	1	1	0	0	10	5	10	0	1	2	2	1	0	0	1	0	0	41	36
Fal-4	-	Waquoit	30	560	3,800	30	0	30	1	0	1	2	1	2	1	0	0	10	5	10	0	0	2	3	2	0	0	1	0	0	41	36
D2	Subset of D (Waquoit Side)	Waquoit	190	35,000	43,000	310	240	300	5	4	2	2	2	2	2	0	0	10	0	4	0	0	2	3	2	0	0	1	0	0	41	36
K	K. Cotuit Meadows and portion of Barnstable to the east	Popponessett	100	13,000	32,000	20	10	20	2	1	1	3	1	2	5	0	0	8	0	6	0	1	3	3	0	0	2	0	2	0	40	39
Fal-17	-	Waquoit	120	6,700	12,800	50	30	50	3	0	1	1	1	1	0	0	1	10	5	10	0	1	2	2	1	0	0	1	0	0	40	39
Fal-2	-	Waquoit	20	1,500	7,100	50	10	50	2	0	1	2	1	3	3	0	0	10	0	8	0	1	2	3	2	0	0	1	0	0	39	41
I -Only	I without Willowbend	Popponessett	400	39,000	56,000	380	110	160	4	3	1	1	1	1	1	0	1	8	0	6	0	1	4	3	0	0	2	0	2	0	39	41
Fal-8	-	Waquoit	10	420	2,900	20	0	20	1	0	1	2	1	2	0	0	0	10	5	10	0	0	2	2	2	0	0	1	0	0	39	41
R	R. Northeast of Santuit Pond	Popponessett	90	28,000	29,000	160	150	160	5	5	3	3	1	1	5	0	0	3	0	6	1	0	2	2	0	0	1	0	0	0	38	44
A	A. Seconsett Island	Waquoit	40	10,000	13,000	90	80	80	5	3	2	3	2	3	0	0	0	10	0	3	0	0	2	2	2	0	0	1	0	0	38	44
Barn 39	-	Popponessett	130	21,000	26,000	130	120	130	4	0	2	2	2	2	0	0	0	10	0	8	0	0	2	2	1	0	1	1	1	0	38	44
Fal-1	-	Waquoit	40	650	2,500	20	0	10	2	0	1	1	1	1	5	0	4	10	0	4	0	1	2	3	2	0	0	1	0	0	38	44
I	I. Area around Willowbend	Popponessett	630	83,000	120,000	610	290	390	4	3	1	2	0	0	1	0	1	8	0	6	0	1	4	3	0	0	2	0	2	0	38	44
Fal-7	-	Waquoit	30	140	3,100	20	0	20	1	0	1	1	1	1	0	0	0	10	5	10	0	0	2	3	2	0	0	1	0	0	38	44
Barn 38	-	Popponessett	280	46,000	59,000	320	280	310	4	0	2	2	1	2	3	0	0	8	0	6	0	0	4	2	0	0	1	0	2	0	37	50
Fal-10	-	Waquoit	30	7,600	9,900	30	10	20	4	0	2	3	2	3	0	0	0	10	0	5	0	0	2	2	2	0	0	1	0	0	36	51
Barn 42	-	Popponessett	290	37,000	49,000	260	200	250	4	2	1	2	1	1	4	0	0	7	0	6	0	0	4	2	0	0	1	0	1	0	36	51
C	C. Monomoscoy Island	Waquoit	70	12,000	18,000	220	130	160	4	3	2	2	2	2	0	0	0	10	0	2	0	0	2	3	2	0	0	1	0	0	35	53
Barn 37	-	Popponessett	40	9,800	14,000	70	60	70	4	0	2	3	2	2	0	0	0	7	0	6	0	0	4	2	0	0	1	0	2	0	35	53
O	O. Stratford Ponds	Popponessett	120	2,700	22,000	10	10	10	1	3	1	2	0	0	5	0	0	7	0	6	0	1	3	3	0	0	2	0	1	0	35	53
Santuit Pond	Potential Cluster site {Subarea R}	Popponessett	110	29,000	30,000	180	180	180	5	4	2	2	1	1	4	0	0	3	0	6	1	0	2	2	0	0	1	0	0	0	34	56
Pickerel Cove	Potential Cluster site {Part of Subarea T}	Popponessett	70	6,200	8,000	60	50	60	4	5	1	1	1	1	0	0	2	4	0	7	3	1	1	2	0	1	0	0	0	0	34	56
Fal-9	-	Waquoit	90	3,000	11,300	50	10	50	2	0	1	1	1	1	0	0	1	10	0	9	0	0	2	3	2	0	0	1	0	0	34	56
Sand-8	-	Popponessett	440	38,000	45,000	270	230	260	5	1	1	1	1	1	5	0	5	3	0	7	1	0	1	1	0	0	0	0	0	0	33	59
Sand-9	-	Popponessett	200	32,000	33,000	240	230	240	5	0	2	2	1	1	5	0	3	3	0	6	0	0	1	2	0	0	0	0	0	0	31	60
Fal-12	-	Waquoit	30	810	2,000	20	10	10	3	1	1	1	1	1	0	0	0	10	0	6	0	0	2	2	2	0	0	1	0	0	31	60
Sand-7	-	Popponessett	290	26,000	36,000	270	200	240	4	3	1	1	1	1	0	0	4	3	0	7	0	3	1	1	0	0	0	0	0	0	30	62
Sand-6	-	Popponessett	110	29,000	31,000	140	140	140	5	0	2	2	1	1	5	0	5	2	0	4	0	0	0	1	0	0	0	0	0	0	28	63
Sand-4	-	both	240	47,000	61,000	340	280	330	4	0	2	2	1	1	2	0	1	3	0	7	1	1	1	2	0	0	0	0	0	0	28	63
Sand-5	-	Popponessett	300	48,000	55,000	330	250	280	5	0	2	2	1	1	2	0	1	2	0	6	1	1	0	1	0	0	0	0	0	0	25	64
Fal-5	-	Waquoit	10	0	2,500	20	0	20	0	0	0	2	0	2	0	0	0	10	0	0	0	0	2	3	2	0	0	1	0	0	22	66
Fal-6	-	Waquoit	30	0	4,300	30	0	30	0	0	0	2	0	2	0	0	0	10	0	0	0	0	2	3	2	0	0	1	0	0	22	66

- Whether the Subarea was within a subwatershed to shellfish propagation;
- Embayment Habitat Quality (based on MEP habitat impairment levels); and
- Estimated number of upgradient properties within 300 feet of a fresh water body.

Infrastructure proximity information included proximity to:

- Joint Base Cape Cod;
- "Closest" existing WWTF (straight-line distance);
- "Closest" potential new WWTF (straight-line distance); and
- Potential new recharge facility (straight-line distance):
  - New Seabury
  - Back Road
  - Site 4
  - Site 6
  - Willowbend

Other considerations:

- Additional points were provided to Subareas that included properties of special interest:
  - Summerwood Condominiums
  - Lakeside Estates
  - South Cape Resort
  - Sea Oaks Condominiums
- Additional points were also provided to Subareas within the Mashpee River Watershed south of Mashpee-Wakeby Pond.

Table 4-20 identifies the point per category assigned to each "Subarea" and "Cluster" area evaluated as part of the matrix.

Table 4-21 then presents the demographics of each "Subarea" and "Cluster" area related to the characteristics summarized above.

Table 4-22 then presents the matrix results when the point system identified in Table 4-20 is applied to the data presented in Table 4-21. This data is then sorted from highest point total to lowest. In addition, several sensitivity analyses were performed to evaluate the change in matrix results if any one of the following criteria wasn't considered (not shown in table):

- Infrastructure
- Shellfish propagation
- Seasonality

However, the results typically did not change the highest or lowest ranked Subareas and typically only impacted those in the middle. Two of these results are depicted in Figures 4-6 and 4-7 with the first showing the matrix results and potential prioritization of areas when considering all factors, and the second when not considering the impact of shellfish propagation.

Figure 4-6 and Figure 4-7 display the matrix results and the sensitivity analysis when removing shellfish from consideration. The Sewer Commission expressed interest in seeing the impact on the Subarea rankings if shellfish watersheds were not considered. Since shellfish—as a nitrogen removal approach relative to TMDL compliance—does not have a long-term performance record, its influence on the matrix results was of interest. The changes in these figures show the shifting of possible priorities as a result of not using shellfish and do not represent a shift or reduction in nitrogen loads.

Both results show no change in the areas south of Johns Pond (Subareas G and H) which remain the highest priority, primarily due to their location within the Quashnet River Watershed. The western side of the Popponesset Bay Watershed also remained a highly ranked area, primarily due to its proximity to the Mashpee River Watershed, amongst other factors including proximity to existing "private" infrastructure or proposed municipal facilities. Most of Sandwich and the areas (in Falmouth and Mashpee) around the proposed shellfish propagation (areas around Hamblin and Jehu Ponds) also remained lower ranked. However, the area north of Joint Base Cape Cod in Sandwich maintained a higher rank than the rest of Sandwich because of its location within the sensitive Quashnet River watershed.

4.8 Conclusion

As was discussed in the DRP/DEIR, after the evaluations were completed the following recommendations/changes were made in modifying Option 1A in the Draft Recommended Plan.

- Use of shellfish aquaculture as a direct environmental mitigation approach, with the fallback being traditional sewering as outlined in Option 1A.
- Use of JBCC as a treatment and recharge facility and regional solution to address portions of the Waquoit Bay watershed, with Back Roads site as a fallback location.
- PRB and bog restoration should be considered in the Adaptive Management "toolbox" but are not formally proposed in the plan.
- More centralized facilities were recommended over smaller cluster facilities in addressing TMDLs.
- Existing WWTFs:
  - Continued use of Mashpee Commons with shellfish versus relocating that recharge to Site 4
  - High School treated and recharged at JBCC
  - Southport would remain treated and recharged onsite
  - Willowbend expanded recharge areas
  - All other facilities would be monitored and require improvements only if necessary based on Adaptive Management and monitoring results.

Chapter 5 presents the summary of the Draft Recommended Plan as presented in the June 2014 report.

5 Summary of Draft Recommended Plan

5.1 Introduction

This Chapter provides the summary of the Draft Recommended Plan as presented in the last report and also a summary of the impacts if "No Action" is taken within the Project Planning Area (PPA).

As part of the development of the Recommended Plan, a summary of a "No Action" Alternative is used to present the impacts if a community proceeds without addressing the needs identified during the planning process, and provides a simple point of comparison to the Recommended Plan.

This Chapter simply presents the Draft Recommended Plan whereas Chapter 6 builds from this plan and the comments received through the project review process to establish the Final Recommended Plan for this project.

5.2 No Action Alternative

As part of the development of the Recommended Plan (RP) as part of the EIR process, a "No Action" Alternative is considered; this alternative establishes an initial baseline of the project and summarizes the potential impacts if the Town were to proceed without implementing any recommended improvements to address its nitrogen reduction needs through an approved CWMP/RP/EIR. This "Alternative" presents a possible scenario if the Town were to continue to address its wastewater needs through its existing (and currently proposed/approved) private cluster treatment systems, its High School facility, individual I/A systems, and traditional septic systems/cesspools. It also assumes under this "Alternative" that the portions of the adjacent towns within the PPA would continue with individual onsite units and the package wastewater treatment facilities located within Barnstable (Cotuit Meadows) and the Forestdale School in Sandwich. The Town of Mashpee would also continue with its existing pursuit of modest expansion of shellfish aquaculture through its local Shellfish Constable, implementation of Best Management Practices with stormwater infrastructure projects, and Mashpee's new fertilizer bylaw. Adjacent communities would also proceed with their stormwater BMPs and fertilizer management approaches (if developed, like Falmouth).

The Town would also continue with expansion/growth in those areas where approved subdivisions and developments exist on the planning department "books" and would likely see an increase in new package/cluster type treatment systems. The majority of which, under existing MassDEP regulations, would simply be required to achieve less than 10 mg/L total nitrogen in their effluent within the Town's sensitive watersheds. Town Zoning "Special Permits" for some facilities do require achieving 5 mg/L total nitrogen. While that is a vast improvement over traditional septic systems/cesspools and most I/A systems, this would not achieve the TMDLs currently established for Waquoit Bay East and Popponesset Bay.

The impacts of nutrients and pathogens on coastal waters, fresh surface waters, drinking water supplies, and other natural resources are well documented. Without addressing these needs, Mashpee (and their neighboring communities of Barnstable, Falmouth, and Sandwich) will continue to lose natural and economic resources, including declines in the fin-fishing and shellfishing habitats, loss of property values, continued algal blooms in coastal embayments and freshwater ponds, beach and shellfish closures, and

potential declines in tourism as the aesthetic impacts continue to impair the Town's (and region's) water resources (coastal, fresh, and drinking).

At this time, the financial implications of the No Action Alternative are unknown; however, the financial impacts may include:

- Reduced property values and revenues from bay-front properties.
- MassDEP Consent Order to achieve the TMDLs and associated fines for not doing so in a timely manner.
- Reduced commercial shellfish income.
- Potential litigation either with groups like Conservation Law Foundation (CLF) as has been threatened in the region or others calling for the cleaning up of the bays.
- Reduced income to local businesses due to reduced attractiveness of Town to tourists and seasonal residents and retirees with accompanying loss of jobs.
- Costs associated with the Regional 208 Planning process, whether they result in implementation approaches, regulatory mandates, or possible fines for not addressing the TMDLs in accordance with the regional plan. Although the implementation of the 208 Plan would be a positive step, it has been identified that this process will not be preparing plans for each town; therefore the towns will still have to proceed with their own actions.
- Loss of future funding for projects through SRF or other means.

5.3 Summary of Draft Recommended Plan

The evaluations summarized in the DRP/DEIR and in Chapter 4 of this Report formed the Draft Recommended Plan as outlined below.

Figure 5-1 highlights those Subareas to be addressed for nitrogen removal through the following methods:

1. Shellfish Aquaculture:
    a. Begin propagation and monitoring Contributing Subareas influenced:
        i. A through F
        ii. Fal-2 through Fal-11
    b. Begin the adaptive management approach as the Town/District prepares for traditional infrastructure approaches.
    c. Begin near-term nitrogen removal implementation in Jehu Pond, Hamblin Pond, Popponesset Bay, Shoestring Bay, Ockway Bay, and Mashpee River.
    d. Serves the following watersheds:
        i. Mashpee River, Ockway Bay, Shoestring Bay, and Popponesset Bay.
        ii. Jehu Pond, Great River, Hamblin Pond (possibly also Red Brook and Lower Red Brook), and Little River.
    e. Significant collection system cost savings possible if monitored and can be maintained as a long-term solution.
    f. Hamblin/Jehu, Great/Little River, and Red Brook Subareas include:
        i. A, B, C, D, E, F-2 through F-11, and part of P.

g. If proven effective, this option could address or allow later phasing of all these areas:
    i. Ockway/Mashpee River/Popponesset Bay/Shoestring Bay Subareas including:
        a) D (D1, D2), I, N, O, P, Q, S, and T.
        b) Barn -37, Barn -39, Barn -42
        c) Could address most of Subarea D, potential reduction of initial infrastructure implementation of harder to address areas.

h. Findings indicate that the areas within these watersheds could be phased later or eliminated, reducing collection and treatment—fallback would be the traditional infrastructure outlined below.

2. Wastewater Treatment at Joint Base Cape Cod:
    a. Begin negotiations for use of Joint Base Cape Cod WWTF.
    b. Potential expansion:
        i. Mashpee Subareas H (including High School), L, and M; 0.20 mgd.
        ii. Sandwich Subareas Sand-1, -2, and -3; 0.1 mgd.
        iii. No change to open sand beds.
        iv. Future consideration (potential WWTF additional expansion):
            a) Falmouth areas Fal-13 to Fal-17 (potentially to be recharged outside watershed; 0.05 mgd; needed recharge capacity of 0.07 mgd).
            b) No change to open sand beds (within capacity with one bed out of service).
    c. Expansion of the existing 0.36 mgd capacity (average annual) Carrousel® WWTF, expanded to add another parallel train of equal size and an additional second clarifier.
    d. Provides potential regional solution.
    e. Can be achieved with adding a third train to the existing WWTF, appears to have recharge capacity per CH2MHill Report.
    f. Significant cost savings over new treatment and recharge facilities at Back Road site for Subareas G (including new facility), H (including High School), L, J (including Southport), and M (which would be required for all these areas if the nitrogen load remains within the watershed).
    g. Allows Southport facility to remain under current operation and recharge at its current location.
    h. Allows Mashpee Village at 5 mg/L to remain and potentially the I/A systems (Bridges at Mashpee) adjacent to High School.

3. Wastewater Treatment at Proposed New Facilities:
    a. Site 4 to serve Subareas: F, S1, S2, and T:
        i. Estimated total 0.39 mgd (average annual).
        ii. Phased to pick up portions of S adjacent to Falmouth Road first.
        iii. Recharge at Site 4.
        iv. Fallback recharge area at Willowbend Golf Course.
        v. Treatment performance dependent on recharge location:
            a) Initially 5 mg/L TN at Site 4
            b) Within watershed (Site 4 or Willowbend golf course), as low as 3 mg/L TN

b. Back Road Site as a backup to Joint Base Cape Cod (see item 2)
    i. Sand-1, Sand-2, and Sand-3 would need to be addressed in their watersheds with nitrogen treated to 3 mg/L, be recharged outside the watershed, or possibly connect to a regional facility at Back Road.
c. Site 6 to serve Subareas identified under shellfish propagation (except Subarea B):
    i. Estimated 0.27 mgd (average annual).
    ii. Later year project as shellfish performance is monitored.

4. Wastewater Treatment at Existing WWTF with Needed Improvements/Expansions/Modifications:
    a. New Seabury—expand recharge capacity, potential future expansion of Subarea B (as fallback to shellfish):
        i. Existing capacity = 0.3 mgd.
        ii. Potential expanded recharge capacity from other treatment locations (Mashpee Commons, Windchime Point, and Site 6) = 0.71 mgd maximum month (drip irrigation in addition to existing recharge capacity) at Site 7 and golf course areas.
        iii. No initial expansion needed until new facilities are constructed at Site 6 or modeling shows shellfish program will not meet TMDLs with continued recharge from Mashpee Commons and Windchime Point.
    b. Willowbend—expand recharge capacity, as fallback for Site 4 WWTF, improved future performance to 3 mg/L TN:
        i. Existing recharge capacity = 0.13 mgd.
        ii. Potential expanded recharge capacity = 0.8 mgd maximum month (drip irrigation) hydraulic capacity.
        iii. Potential extension of service to pick up Subarea I (0.05 mgd).
        iv. Evaluate performance needs in conjunction with shellfish results.
    c. Mashpee Commons:
        i. Existing capacity = 0.18 mgd.
        ii. Potential expansion = 0.33 mgd (average annual).
        iii. Subareas P (and N as required).
        iv. Performance = less than 5 mg/L TN.
        v. Recharge locally under shellfish program.
        vi. If shellfish are not successful, may need to relocate recharge to Site 7/New Seabury.
    d. Mashpee High School—either abandon facility/convert to pumping station or pump treated effluent in both cases to Joint Base Cape Cod or Back Road Site (fallback).
    e. Cotuit Meadows:
        i. Potential extension of service area to pick up less than 5,000 gpd from adjacent areas.
    f. Wampanoag Village:
        i. Potential extension of service area to pick up approximately 7,000 gpd from adjacent areas. The expansion is required to offset 237 lbs N/yr produced by the housing

development. In addition, the constructed treatment plant has significant capacity in excess of that needed for Wampanoag Village and the 237 lbs N/yr GWDP requirement, regarding which the Town and Tribe have begun discussions about extending the collection system served by the facility to include Town Hall and the surrounding area.

5. Wastewater Treatment at Existing WWTF: Operating under existing permit, consider upgrade to improve performance (3 to 6 mg/L TN) based on shellfish results and other adaptive management programs:
   a. Forestdale School
   b. Mashpee Village, Subarea G (to be constructed); if JBCC is not an option for other Subareas within the Quashnet River watershed, flow from this facility must be treated to 3 mg/L TN and recharged at Back Road Site.
   c. Southport—if JBCC is not an option must be recharged at Back Road Site.
   d. South Cape Village.
   e. Stratford Ponds.
   f. Windchime Point.
6. Coordination with Adjoining Towns within the planning area with recharge outside the watershed (collection, treatment, and recharge):
   a. Barnstable: Barn-37, -39, -42 outside watershed (0.08 mgd average annual).
   b. Falmouth: Fal-13 through -17 (0.05 mgd average annual)—see JBCC option.
   c. Sandwich: Sand-4, -5, -6, and -8 (0.19 mgd average annual).
7. No change of the following current practices (average flows):
   a. Mashpee I/A facilities (0.02 mgd).
   b. Mashpee septic systems (0.27 mgd).
   c. Sandwich septic systems (0.13 mgd).
   d. Barnstable septic systems (0.07 mgd).
   e. Falmouth septic systems (0.01 mgd).
8. Coordination with the Following Future Demonstration Projects/Evaluations:
   - PRB Options (following Falmouth demonstration efforts).
   - Wetland restoration projects.
9. Coordination with the Cape Cod 208 Planning Efforts.

5.4 Draft Recommended Plan Cost Summary

The following section presents the summary tables outlining the estimated flows and costs as presented as part of the June 2014 Draft Recommended Plan/Draft Environmental Impact Report. Table 5-1 presents a summary of the Draft Recommended Plan with and without shellfish aquaculture.

Table 5-1 Summary Table—Draft Recommended Plan To Achieve TMDLs (Average Annual Flows, gpd)[1]

Treatment and Recharge Location (treated/recharged flows- not capacity)	Recommended Plan (without Shellfish Aquaculture)		Recommended Plan (with Shellfish Aquaculture)	
	Treatment	Recharge	Treatment	Recharge
Existing Facilities				
Joint Base Cape Cod[2]	300,000	300,000	300,000	300,000
Southport WWTF	160,000	160,000 [7]	160,000	160,000 [7]
Mashpee Commons [3]	330,000	NS/Site 7	180,000	180,000
South Cape Village	12,000	12,000	12,000	12,000
New Seabury (and expanded recharge)	180,000	780,000	180,000	180,000
Willowbend (and expanded recharge)	120,000	500,000	120,000	120,000
Windchime Point	22,000	22,000	22,000	22,000
Stratford Ponds	30,000	30,000	30,000	30,000
Cotuit Meadows	37,000	37,000	37,000	37,000
Wampanoag Village	15,000	15,000	15,000	15,000
Proposed Facilities				
Site 4[3]	390,000	Willowbend	100,000	100,000
Back Road Site (Alternate to JBCC) [8]	*200,000*	*200,000*	*200,000*	*200,000*
Site 6	260,000	NS[9]/Site 7	Not Used	Not Used
Mashpee Village	20,000	20,000 [7]	20,000	20,000
Sand-1, -2, -3 (Alternate to JBCC)	*100,000*	*100,000*	*100,000*	*100,000*
Outside Watershed				
Sandwich Outside Watershed (Sand-4, 5, 6, 8)	190,000	190,000	[4,5]	[4,5]
Falmouth Outside Watershed	50,000	50,000[6]	50,000	50,000[6]
Barnstable Outside Watershed	80,000	190,000	[4,5]	[4,5]
Onsite and I/A Systems				
Existing I/A and Septic Systems (all Towns)	500,000	500,000	500,000	500,000
Total (JBCC option)	2,700,000	2,700,000	1,700,000	1,700,000

Notes:

1. Flows are future average annual flows. Values rounded to two significant figures.
2. JBCC flows only reflect added flows from the PPA not total facility capacity.
3. Secondary recharge from Site 4 may shift to Willowbend in future and Mashpee Commons would need to be recharged at Site 7 with no shellfish.

4. Under shellfish aquaculture, shellfish potentially address flows that would have gone to Sites 4, 6, and out of the watershed from Barnstable, Mashpee, and Sandwich.
5. Town of Mashpee may look to create MOUs with Barnstable and Sandwich to help support the shellfish aquaculture program, which would help cover "fair share" considerations of nitrogen loadings from those neighboring communities on Popponesset Bay.
6. Joint Base Cape Cod is one potential location.
7. If JBCC is not available, needs to be recharged at Back Road Site.
8. Does not include Southport or Mashpee Village, which would have to be recharged (at 3 mg/L TN) at this location if JBCC is not available.
9. New Seabury.

Costs for the Draft Recommended Plan with and without shellfish aquaculture are presented below. These costs are presented as total capital costs and a total present worth value of the project when considering long-term operations and maintenance costs. The costs do not reflect phasing; however it is presumed that the first phase (discussed in Chapter 9) is the Recommended Plan with shellfish. This phase would include those improvements to JBCC, Site 4, and associated collection system in conjunction with the shellfish program outlined in the 2014 DRP/DEIR.

The project costs related to neighboring communities are also included to provide a rough estimate of the total impact of the project. These costs are presented with the understanding that they are dependent on how each of these communities will address the nitrogen removal needs of these estuaries. The costs assume a traditional approach for simplicity and will be dependent on site availability (for those areas where flow needs to be removed from the watershed); memorandums of understanding (to be developed/completed) between the various communities regarding use of joint facilities; system and watershed nitrogen loading responsibility; and will ultimately depend on the actual build-out conditions experienced in each community. Therefore, adaptive management and long-term monitoring and modeling results will be critical in the determination of each community's contribution.

Table 5-2 presents the total capital cost for both the first phase of the Draft Recommended Plan based on shellfish aquaculture managing the bulk of the nitrogen removal in the embayments, and a total capital cost if shellfish and other adaptive management approaches are not considered. If shellfish aquaculture and other adaptive management approaches are not considered, a strictly traditional infrastructure approach is applied. These cost values in Table 5-2 represent an estimated 2017 dollar value. Additional capital expenditure including efforts in neighboring communities will be required to meet the TMDLs within Quashnet River, Mashpee River and possibly Shoestring Bay.

Table 5-3 presents an estimate of costs related to TMDL compliance with shellfish aquaculture based on the following:

- Shellfish aquaculture performance based on existing conditions and MEP results.
- Aquaculture supported by traditional infrastructure to manage existing conditions.
- Projected future conditions that could occur with increased development and growth in approved areas as presented throughout the CWMP/WNMP process.

In addition, if a traditional infrastructure approach is used to address the entire issue, the project will need to be phased with the costs spread over 20 to 40 years. The resulting costs would be subject to

associated inflation and the total project costs would also have to consider any funding opportunities that could be applied for financing purposes (for example SRF loans of 0- or 2-percent). Those costs are also presented in Table 5-3.

Table 5-2 Estimated Total Capital Cost of Draft Recommended Plan Phase 1 [1, 2]

Estimated Capital Costs	Recommended Plan Phase 1 with Shellfish Aquaculture
Shellfish Aquaculture (year one startup)	$1,500,000
Collection System	$25,000,000
Treatment System [3, 4, 5]	$21,000,000
Recharge Facility [3, 4]	$1,500,000
Total	$49,000,000

Notes:

1. Values rounded to two significant figures, and include allowances for fiscal, legal and engineering services, and contingency.
2. Values based on an ENR index year of 2017.
3. Treatment costs include new facilities and improvements/upgrades to existing facilities.
4. Estimated costs with shellfish aquaculture presume that existing and future loads are managed through this adaptive management approach, and Joint Base Cape Cod is available and no additional recharge capacity is required at JBCC.

Table 5-3 Estimated Total Capital Cost of Entire Draft Recommended Plan With and Without Shellfish [1, 2, 6]

Estimated Capital Costs	Recommended Plan with Shellfish Aquaculture	Recommended Plan without Shellfish Aquaculture
Shellfish Aquaculture (year 1)[7]	***$1,500,000***	***$0***
Town of Mashpee Estimate		
Collection System	$110,000,000	$180,000,000
Treatment System [5]	$28,000,000	$66,000,000
Recharge Facility	$5,100,000	$13,000,000
Mashpee Total	***$140,000,000***	***$260,000,000***
Neighboring Towns Estimate (Barnstable, Falmouth, Sandwich)		
Collection System	$26,000,000	$72,000,000
Treatment System [3, 4, 5]	$8,700,000	$23,000,000
Recharge Facility [3, 4]	$300,000	$ 2,000,000
Neighboring Town Total	$35,000,000	$97,000,000
Total	***$180,000.000***	***$360,000,000***