Chapter 5

Treated Water Recharge Technologies and Alternative Sites

CHAPTER 5

TREATED WATER RECHARGE TECHNOLOGIES AND ALTERNATIVE SITES

5.1 INTRODUCTION

All wastewater treatment facilities (centralized, satellite, and cluster) require a means of recharging treated water back to the groundwater system, and the treated water recharge technology needs to be selected to minimize the impacts on nearby surface waters and groundwaters. Potential impacts of large treated water recharge flows include groundwater mounding which may cause flooding on adjacent properties and an increase in pollutant concentrations in downgradient water bodies. As a result, the following items should be considered when identifying new treated water recharge technologies and sites:

1. The treated water recharge would preferably be located outside of a contributing area to a public water supply to reduce risks to public health; reduce the perception that "drinking waters would be contaminated by wastewater;" and reduce the cost of additional treatment technologies needed to permit treated water recharge in a water supply area.

2. It is preferable to locate the treated water recharge outside of a contributing area to coastal estuaries. Even well-treated water typically has a 3 mg/L total nitrogen concentration, which can contribute to eutrophication in the embayment if the flow is large enough

3. Ideally, the recharge could flow directly to the marine waters that surround Cape Cod, thereby having the least impact on water supplies and coastal estuaries. This would typically be possible through the use of an ocean outfall, which is currently not allowed by the Massachusetts Ocean Management Act (formerly the Ocean Sanctuaries Act).

4. There is often a desire to return the treated water to the area from which it originated, either the sewer service area (political origination) or the water supply contributing area (hydrological origination).

5. Nitrogen attenuation in the watershed has been documented when treated water and groundwater recharges through freshwater systems. The regulatory community will now consider this type of nitrogen removal as part of an environmental impact analysis and strategy to meet nitrogen limits in coastal embayments. As a result, treated water recharges that cannot avoid contributing areas to water supplies and coastal embayments should be considered in areas that recharge through freshwater systems (ponds, bogs, wetlands, etc.) to take advantage of additional nitrogen removal.

6. Treated water recharges must be located where the increased hydraulic loading will not cause flooding at the site or at adjacent properties. This requires sufficient separation between the ground surface and groundwater table so the resultant "groundwater mound" caused by the recharge will not break out above the land surface. Also, the soils at the discharge site must be sufficiently permeable to pass the treated water to the groundwater system without being backed up and flooding the site.

This chapter identifies and screens potential treated water recharge technologies, and identifies potential sites for more detailed evaluation in the next phase of the project.

5.2 IDENTIFICATION OF TREATED WATER RECHARGE TECHNOLOGIES

A. **Sand Infiltration Beds.** Sand infiltration beds are open basins designed to allow treated water to flow across the bottom of the basin and percolate through the sand bed, through the unsaturated zone, and then to the groundwater (see Figure 5-1). Bed maintenance is relatively easy because the bed is exposed at the surface and the sand surface can be raked or replaced if the sand becomes plugged with fine solids. Hydraulic loading rates of 5 gallons per day per square foot (gpd/sf) of bed area are typically allowed by MassDEP unless hydraulic tests demonstrate a greater infiltration loading capacity at the specific site.

Treated water recharge in sand infiltration beds has the following advantages:

- Bed construction is relatively simple and typically less expensive than other methods.
- Operation and maintenance (O&M) is relatively easy and O&M costs are lowest.
- Hydraulic loading rates are typically higher than other recharge methods, which allow the beds to take up less area.

Treated water recharge in sand infiltration beds has the following disadvantages:

- Construction of new beds requires the clearing of large areas of land, which may have a visual and environmental impact.
- Infiltration beds do not have secondary uses, such as parking lots and recreational areas.
- Disinfection is typically required.

B. **Subsurface Infiltration.** Large–scale subsurface infiltration facilities typically utilize pump and piping systems to pressure dose infiltration areas (trenches, beds, or galleys) where the treated water percolates to the groundwater, as shown in Figure 5-2. Maintenance and cleaning of these systems is more difficult because the infiltration area is not exposed to the surface and effluent solids cannot be easily removed. Subsurface infiltration beds can have secondary uses, such as parking lots, lawns, playing fields, and recreational areas. Hydraulic loading rates of 2.5 gpd/sf (of trench or galley base plus side walls) are typically allowed by MassDEP unless hydrogeologic tests demonstrate a greater infiltration capacity at the specific site.

Subsurface infiltration facilities have the following advantages:

- Disinfection is typically not required prior to discharge unless it is in a water supply recharge area.
- Facilities are contained underground and can have a secondary use, such as parking lots and recreational areas.

They have the following disadvantages:

- Large land areas are required (larger than sand infiltration beds) due to lower hydraulic application rates.
- Pressure dosing is typically required for large systems, which adds capital and O&M costs.
- Extensive site work may be required for construction, particularly if the site is forested.
- Limited access for cleaning and maintenance which can result in high maintenance and repair costs.
- Effluent filtration is typically required to reduce the risk of plugging the subsurface beds over time. However, because effluent filtration and disinfection will likely be required by the discharge permit, this is not necessarily a limitation in this application.

C. **Spray Irrigation**. Spray irrigation facilities are typically comprised of treated water pumps, distribution piping, and a spraying system consisting of risers and spray nozzles. Treated water is pumped through various distribution lines and discharged via spray nozzles to the surrounding surface area. Figure 5-3 illustrates spray irrigation facilities. Spray irrigation systems have often been used at golf courses and in large remote fields. Application rates for non-golf course areas are typically 2 inches per acre per week. Application rates for golf courses are typically based on the turf management needs.

Treated water recharge using spray irrigation has the following advantages.

- Allows for secondary use of land (i.e., golf courses) as regulated by MassDEP.
- Provides irrigation, reducing clean water demands.
- Provides nitrogen uptake by plant life and reduces need for fertilizers at golf courses.
- Evapotranspiration reduces infiltration volume, thereby creating less potential for groundwater mounding.

Treated water recharge using spray irrigation has the following disadvantages:

- Difficult to find locations suitable for or willing to use spray irrigation.

- Limited cold weather use due to potential freezing problems.
- Spray nozzles may be subject to clogging.
- Requires secondary means of treated water recharge or storage during winter months or at times when the sites' secondary use (i.e., golfing) is needed.
- Must meet more stringent MassDEP treatment requirements for reclaimed water use.
- Large areas are needed.

D. **Well Injection.** Well injection involves the recharge of treated water to groundwater by pumping the treated water through wells that extend into permeable and saturated geologic strata, as shown in Figure 5-4. When discharged into saturated strata, this type of discharge can be compared to the reverse of extracting water from a well.

Wells can be designed to recharge a range of flows depending on site conditions such as depth to groundwater and geological conditions. A potential concern with well injection is the mounding of groundwater in low elevation areas. As a result, well injection requires testing prior to design and construction. This would include hydraulic conductivity tests, hydrogeologic surveys, and pilot testing.

Well injection for treated water recharge has been implemented on a limited basis throughout the United States, and there is limited information on the proper siting, design, construction, and operation of the wells. A pilot test for this technology at the Hyannis Water Pollution Control Facility (WPCF) as part of the 2007 WWFP evaluations indicated that injection wells can become plugged with biological growth if the effluent is not chlorinated and/or the water is not treated to a high level. Discussions with MassDEP indicate minimal support for the development of this technology because it often utilizes chlorination, which can create secondary impacts to the groundwater such as the formation of disinfection byproducts that can pose potential health risks.

Treated water recharge with well injection has the following advantages:

- The land area required would be much less than the area required for infiltration beds, subsurface infiltration, and spray irrigation.
- The treated water recharge would be occurring below the surface, causing minimal surface disruption.

- Recharge points (wells) could be spread over a large area to minimize groundwater mounding.

It has the following disadvantages:

- TOC removal is needed to minimize plugging in the wells and to meet MassDEP regulations.
- Relatively unproven technology in Massachusetts, with only minimal recent testing in Barnstable at the Hyannis WPCF.
- Energy costs for pumping are higher.
- Limited performance data is available.
- Extensive pilot testing would typically be required.

E. **Wick Well Technology.** Wick technology is a relatively new approach to treated water recharge. Wick technology entails the use of larger (3- to 6-foot diameter) wells dug into the aquifer. The wells are filled with stone; treated water is recharged over (or adjacent to) the stone to infiltrate via gravity flow into the underlying aquifer. Figure 5-5 illustrates a wick well setup. There are two wick well installations in southeastern Massachusetts.

Treated water recharge with wick wells has similar advantages and disadvantages to injection wells. Advantages include:

- The land area required would be much less than the area required for infiltration beds, subsurface infiltration, and spray irrigation.
- The discharge would occur below the surface, causing minimal surface disruption.
- Discharge points (wells) could be spread over a large area to minimize groundwater mounding.

Disadvantages include:

- TOC removal is needed to minimize plugging in the wells and to meet MassDEP regulations.
- Relatively unproven technology in Massachusetts. Limited performance data is available.

A variation of this technology can be used to increase the capacity of sand infiltration beds. If the beds are limited with their infiltration capacity, wick wells can be installed in the beds to convey the water through the soil layers that have lower transmissivity. The upper layers of the bed will still be used for infiltration and initial filtering, and the filtered water will find the wick wells that will act as a drain to the basin. There is one wick well installation of this type in Southeastern Massachusetts.

F. **Drip Irrigation.** Drip irrigation is a subsurface version of spray irrigation. Subsurface piping is laid out approximately 6 to 12 inches below the surface in areas to be irrigated (see Figure 5-6). Recharge of treated water occurs through emitters that are spaced 12 to 24 inches apart; the laterals are spaced at 12- to 24-inch intervals. Water is pumped through the lines under pressure and is discharged slowly through the emitters. The intent of the system is to recharge the water into the root zones of the plants where an irrigation and nutrient-uptake benefit can occur.

Advantages include:

- Can be used in rolling terrain conditions.
- Is associated with water reuse because water can be recharged into the root zone of plants or crops.
- Ease of construction if the application is in a large vegetated area with fine-grained soils (few rocks).
- Low delivery rate to minimize water table elevation impacts.

Disadvantages include:

- Difficult to monitor emitter performance.
- Periodic backflushing is required.
- May not operate or be practical in very cold conditions.
- Facilities must be protected from damage from heavy vehicles.

G. **Ocean Outfall.** This alternative involves the siting, construction, and operation of an ocean outfall for effluent disposal into Nantucket Sound or Cape Cod Bay. The Massachusetts Ocean Sanctuaries Act prohibits the discharge of any municipal wastewater into an ocean sanctuary (both of these water bodies are identified as ocean sanctuaries). The legislation is strictly imposed and a variance would require action by several state departments and officials. A variance would be given only if it was shown that ocean disposal of wastewater was the only feasible way to protect the public health. Most likely, special state legislation would be needed to gain approval of this type of discharge.

This technology would recharge the treated water to the marine waters surrounding Cape Cod, thus having the least impact on drinking water supplies and coastal embayments. If the effluent was highly treated and properly sited, it could have minimal impact on the off-shore marine environment.

Several members of the scientific institutions in Woods Hole have expressed that a well-treated effluent discharged beyond the near-shore environment would have less of an impact to the marine environment than a discharge to the groundwater system that flows through a coastal embayment and adds to eutrophication in that embayment before flowing to the off-shore environment. Research has indicated that even though it has practical water quality benefits, it may not be approved by the various regulatory agencies and environmental groups that would need to approve it.

Treated water recharge with an ocean outfall has the following advantages:

- The land area required would be much less than the area required for infiltration beds, subsurface infiltration, and spray irrigation.
- The effluent discharge would be outside of any watershed and would greatly reduce nitrogen loading impacts (eutrophication) to coastal embayments.
- Total organic carbon (TOC) removal probably would not be required for an ocean outfall discharge, therefore, a cost savings could be attained while protecting public health water supplies.
- Proven technology.

It has the following disadvantages:

- Special legislation required, possibly at the federal level.

- Extensive design and permitting requirements depending on the location of the discharge.
- Possible high public opposition.
- Potential reduction in aquifer recharge.
- Reserve area may be required.
- Effluent disinfection is required.
- Requires a long force main to reach a discharge point.

H. **Wetland Restoration.** In recent years, the innovative technology/management concept of wetland restoration has been considered as a treated water recharge technology. It is the conversion of abandoned cranberry bogs or previously modified wetlands to more diverse wetland settings that can accommodate and will benefit from increased hydrologic flow. It has the primary purpose of improving water quality of the groundwater flowing through the wetland and restoring hydrologic balance to areas that have been impacted by drinking water withdrawals. It can provide natural nitrogen attenuation and thereby protect down-gradient marine waters. It can also provide improved wildlife habitat and improved open-space and recreational areas.

This concept has significant regulatory permitting challenges due to national, state, regional, and local wetland protection regulations that have been written to stop any modifications in wetlands. However, many regulators, municipalities, and citizen groups are recognizing the water-quality and wildlife habitat benefits of converting previously disturbed, monoculture cranberry bogs to more diverse wetland settings.

The concept has been developed and promoted by the Massachusetts Estuaries Project (MEP) as a way to increase natural nitrogen attenuation in the watershed. It is also being considered as a way to reintroduce highly treated wastewater into watersheds that have been impacted by water withdrawals. Also, the CCWPC is developing ways to streamline the state and federal approval process.

This alternative introduces well treated water (with minimal nitrogen and phosphorous) into the subsurface through a leaching area that is adjacent to a constructed wetland/pond. The constructed wetland/pond is adjacent to a cranberry bog or natural wetland. The subsurface flow will make its way through the wetland/pond and then into the bog/natural wetland. A general schematic of this process is shown in Figure 5-7.

The benefits of wetland restoration include the following:

- Clearing of land is minimal; no change in land use would result.
- Additional nitrogen and phosphorus attenuation in the constructed wetland/pond.
- Potentially high ecosystem benefits.

The disadvantages include:

- Regulatory hurdles are likely.
- Disinfection is required.
- Complexity of design.
- Potential long-term maintenance and monitoring requirements.

5.3 SCREENING OF TREATED WATER RECHARGE TECHNOLOGIES

The screening of treated water recharge technologies is based on a general description of each technology, the respective advantages and disadvantages, and the screening criteria established in Chapter 2 of this report. A summary of treated water recharge technologies and a side-by-side comparison of screening criteria are included in Table 5-1. The following text provides a brief discussion of the screening process.

Sand infiltration beds are a simple and reliable effluent discharge technology with relatively low operating costs.

Subsurface infiltration facilities are well understood and reliable. These facilities are constructed below ground and therefore have minimal visual impacts, reduced potential for odors, and can provide secondary use of the land. However, treated water recharge in subsurface infiltration facilities has higher land area requirements, and the facilities are not easily cleaned. Therefore, the life of the facilities will be dependent on the quality of the effluent.

Spray irrigation and drip irrigation are simple and reliable treated water recharge technologies. In addition, they can provide nitrogen uptake and removal.

Treated water recharge through well injection has relatively low land requirements and construction costs. Well injection has the potential of plugging at the injection point due to build-up of fine solids and biofouling. MassDEP resistance to support and permit this technology reduces its feasibility.

Treated water recharge through wick wells is a variation of well injection and has similar advantages and disadvantages. Both operational experience and regulatory acceptance of this technology are being gained in Massachusetts, and more complete acceptance is contingent on long-term demonstration of effectiveness.

Ocean outfalls have minimal land requirements and groundwater impacts. Regulatory and public approval of an ocean outfall may be difficult to attain; but due to possible cost savings and drinking water supply protection, the CAC would like to evaluate this alternative in greater detail.

Wetland restoration and nitrogen attenuation concepts are being evaluated on Cape Cod and include evaluation and modeling of very site-specific considerations. If they prove to be feasible and acceptable to the regulatory community, they could be low cost methods to discharge highly treated water, recharge impacted portions of the watershed, and attenuate nitrogen in the groundwater. Concepts of this technology may be considered for recharge near wetland areas.

The following treated water recharge technologies are recommended for further evaluation:

1. Sand infiltration beds.

2. Subsurface leaching.

3. Spray irrigation and drip irrigation.

4. Wetland restoration (as appropriate sites are available).

5. Well injection and wick well technology as allowed by MassDEP.

6. Ocean outfall technology.

5.4 WASTEWATER TREATMENT ISSUES AND REQUIREMENTS FOR TREATED WATER RECHARGE AT NEW REMOTE SITES

As the Town considers developing new treated water recharge sites, potential future discharge limits must be considered. The following issues should also be given consideration:

1. Recharge greater than 10,000 gpd needs to meet treatment requirements to protect the groundwater/drinking water and to protect the surface waters where the groundwater emerges (such as a pond, stream, wetland, or estuary). The treatment requirements are set by the MassDEP groundwater discharge permitting program (and regulators) as described in the Draft Needs Assessment Report Section 3.2B.10. At a minimum, the treated water must meet the groundwater quality standards which are based on drinking water standards. These standards require nitrogen removal to concentrations less than 10 mg/L.

2. Treated water that is recharged into subsurface leaching or irrigation facilities must have low suspended solids to avoid plugging the soil infiltration system and requiring costly repairs. Effluent filtration would reduce this potential.

3. Treated water recharges upgradient of freshwater ponds and lakes would likely need phosphorus removal to avoid the creation of a phosphorus plume that could migrate to the freshwater body and cause eutrophication.

4. Treated water recharge into Zone II areas will need to meet the requirements of 341 CMR 5.10(4A). Effluent limits for this type of discharge would need to meet the following treatment and design standards:

pH..6 to 9
BOD concentration ....<30 mg/L
Turbidity ....<5 Nephelometric turbidity units (NTU)
Fecal coliform content ....<200 colonies/100 ml
TSS concentration..................<10 mg/L

TN concentration ....<10 mg/L
Total organic carbon ....<3 mg/L for travel times greater than two years

These standards are typically met with reverse osmosis or nanofiltration membrane treatment, or with granular activated carbon adsorption.

Treated water recharges in a Zone II area with less than a two-year travel time to a public water supply would need to meet, at a minimum, the following, more stringent treatment and design standards:

pH..6 to 9
BOD concentration ....<10 mg/L
Turbidity ....<2 NTU
Fecal coliform content ....Median of no detectable colonies/100 ml and no single sample to exceed 14 colonies/100 ml
TSS concentration..................<5 mg/L
TN concentration ....<5 mg/L
Total organic carbon ....<1 mg/L

These standards are typically met by membrane treatment with reverse osmosis or nanofiltration.

These standards (TOC <1 mg/L) also apply to any Zone II recharge that recharges directly into the saturated zone.

These requirements and issues will need to be incorporated into the individual site evaluations.

5.5 SITE IDENTIFICATION FOR TREATED WATER RECHARGE AND NEW TREATMENT FACILITIES

A. **Introduction.** The selection of new wastewater treatment and treated water recharge sites is a long and detailed process that will occur in the Detailed Evaluation Phase (Phase IV) of this project. This section identifies preliminary efforts to identify preliminary sites for these facilities.

A Site Identification Working Group was convened to assist in this site identification process, and it consisted of the following individuals:

- Lindsay Counsell, Barnstable Landbank Committee
- Tom Cambareri, Cape Cod Commission and Barnstable Water Quality Task Force
- Alisha Stanley, Barnstable GMD and Property Management Director
- Dale Saad, Barnstable DPW
- Nathan Weeks, GHD Inc.
- Maura Callahan, Callahan Consulting

The Site Identification Group met several times to explore the issues, review GIS maps that illustrated the issues and topics associated with individual sites, and to develop a preliminary list of sites to augment and evaluate in the next phase of this project.

B. **Wastewater Treatment Sites.** The main focus of the Site Identification Working Group was the identification of treated recharge water recharge sites, but there was also consideration of the usefulness of the various sites for new cluster or satellite treatment systems. Chapter 4 (section 4.9E) identified siting requirements and minimum space considerations of a cluster or satellite WWTF. Ideally, these facilities should be located on a large site to insulate the facility from surrounding residential properties. They can be located on small sites (illustrated on Figures 4-26 through 4-30) but they must be carefully planned and designed to minimize aesthetic impacts such as odor generation, pump and blower noises, and facility lights.

These sites need to have good access to construct them and allow operations staff to visit the site periodically.

Ideally the site should be located close to the neighborhoods that produce the wastewater; but it is not uncommon for the wastewater to be pumped long distances to the treatment facility. The current wastewater collection in Barnstable Village and its conveyance to the Hyannis WPCF is a local example.

Many of the sites identified by the Site Identification Working Group could be suitable for treatment facilities. Also, many of the vacant developable properties (as discussed in the following section) could be suitable for cluster of satellite treatment systems.

C. **Site Identification as Part of the 2007 Wastewater Facilities Plan.** There was extensive evaluation of potential recharge sites during the Wastewater Facility Planning Project that is summarized in Appendix 5-1. (This appendix is Chapter 6 of the 2007 WWFP/FEIR and associated attachments to that chapter.) That process is now dated, and it did not have involvement from the current CAC. Also, it was completed before MassDEP's new TOC removal requirement. That planning process evaluated several sites that are illustrated on Figure 5-8 and are briefly summarized below.

1. **Existing Hyannis WPCF Site (Site A).** The Town has approval to recharge at this site up to 4.2 mgd. If groundwater monitoring indicates there is a potential threat to the environment, an Adaptive Use Management Planning effort will be initiated to locate and or/implement additional recharge sites. It is hoped that the 4.2 mgd flow limit can be increased once the effects of recharging 4.2 mgd is monitored and shown to not cause impacts

2. **6.9 Acre Site.** This site was evaluated in detail, and the 2007 WWFP and FEIR approved this site for up to 0.5 mgd of recharge. The Town has proceeded to construct a pipeline to the site when Route 132 was being expanded. The town plans to proceed with implementation depending on the availability of other sites.

3. **Cape Cod Community College (Site D).** This site was evaluated in detail and Town staff has met with the College President and the Board of Directors' Building and Grounds Subcommittee to review wastewater management issues.

4. **Airport Site (Site C).** This site is still considered a viable site, but it has several complicating issues, including:

    - Federal Aeronautical and Aviation (FAA) restrictions that would make effluent recharge on this site impractical.
    - The site has a relatively shallow distance to the groundwater.
    - Public water supply wells are located downgradient with a relatively short travel time.

5. **Lorusso Site (Site E).** This site is still a viable site, but has the following limitations:

- Relatively small size
- Power line easement that limits the extent of infiltration facilities at the site.

6. **Hospital Abandoned Cranberry Bog Site (Site W1). This site would use an** innovative wetland restoration concept to re-establish the watershed base flow that is currently being removed by the upgradient water supply wells at approximately 1.3 mgd.

The site is located on Cape Cod Hospital property in the Town of Yarmouth and discussions have been initiated with the following stakeholders:

- Town of Yarmouth staff.
- USDA Natural Resources Conservation Service staff, who have been working with the hospital to restore the cranberry bog to a more natural wetland area as required by a USEPA consent order on the discontinued cranberry operation.
- Cape Cod Commission staff.

7. **Makepeace Abandoned Cranberry Bog Site (Site W2).** This site and recharge concept are similar to the Hospital Bog site and concept except that it is located in the Town of Barnstable and in an area that is planned for significant environmental mitigation. The site is located at the upper reaches of the Stewart's Creek watershed where the following mitigation actions are planned and/or have been initiated:

- Enlargement of the opening of Stewart's Creek to Nantucket Sound to restore tidal exchange.
- Dredging of portions of Stewart's Creek.
- Sewering of properties around Stewart's Creek
- Conversion of the 725 Main Street property (an abandoned gas station) to an open space and parkland.

These sites were reviewed by the Site Identification Working Group and were identified as sites that should be considered in the future for the CWMP Project.

D. **New Sites Considered for Treated Water Recharge.** The Town GIS was used to identify Wastewater Facility Site considerations as illustrated on Figure 5-9. The main considerations and specific sites illustrated on the map include:

- Public water well sites
- Vernal pools
- The areas within marine watersheds
- Residentially developable properties
- Commercially developable properties
- The areas within the Zone II areas
- The sites identified as part of the 2007 WWFP
- Wetland areas
- 21E sites (these are properties that may have had a release of hazardous materials)
- The DPW Solid Waste Division (SWD) property
- The Hyannis WPCF site
- The Marstons Mills Middle School (MMMS) site
- Fire District (Village) boundaries
- Town boundaries
- Government owned land and open space. These are properties that are owned by the Town or other tax-exempt entities and include the following types of properties:
  - School properties
  - Land trust and conservation properties
  - General Municipal
  - Town recreation
  - County, State, and Federal lands
  - Fire District lands

  These properties are colored tan on Figure 5-8.

Based on review of these considerations and properties, the following sites were identified as a high priority for further evaluation:

- Hyannis WPCF
- 6.9 acre site located near Route 6 and Route 132 intersection
- Cape Cod Community College

- Solid Waste Division (SWD) site in Marstons Mills
- Two properties that are adjacent to the SWD site
- Wakeby Road site that is privately owned

The following additional sites were identified and reviewed:

- Hyannis Airport site
- Marstons Mills Middle School site
- Cape Cod Golf Course site: this is a landbank property co-owned with Mashpee
- Route 28/Cotuit Bog/Little River site
- Cotuit School on Old Oyster Road
- Audubon/Bumps River site
- Town forest site
- Private property off Oak Street
- Marstons Mills East School
- Loruso site (Site E) identified in 2007 WWFP
- Hospital Bog site (Site W1) identified in 2007 WWFP
- Sheriff Ranch site
- Race Lane/ Air Force site
- Old Barnstable Fairgrounds site
- Town beach areas/parking lots

After initial review and prioritization of the sites by the Site Identification Working Group, it was decided to wait until the CWMP Citizens Advisory Group was engaged in the CWMP Project before additional efforts proceeded to further identify and evaluate sites. This effort is planned to start again in the detailed evaluations of Phase IV. In addition to the screening criteria identified in Chapter 2, considerations for remote siting of treated water recharge facilities include distance from the treatment facility, proximity to sensitive embayments, and proximity to zones of contribution to public water supplies. Input from the water purveyors should be sought early in the site selection process.