Section 9
Effluent Recharge Site Screening

9.1 Overview

This section describes the effluent recharge / wastewater treatment facility site screening evaluation in Harwich. As part of the CWMP process, a site screening of available land to identify the parcels best suited to accepting wastewater effluent recharge was performed. The physical features of each parcel, as well as the ownership and designated land uses, were evaluated to determine the best candidate sites. The most feasible and appropriate sites were selected for inclusion in the scenario screening and evaluations detailed in Section 10 of this CWMP.

The analysis identified four final sites – selected out of all parcels in town – that offer the greatest potential to receive the Town's treated wastewater effluent and potentially accommodate a treatment facility.

The four final sites identified are:

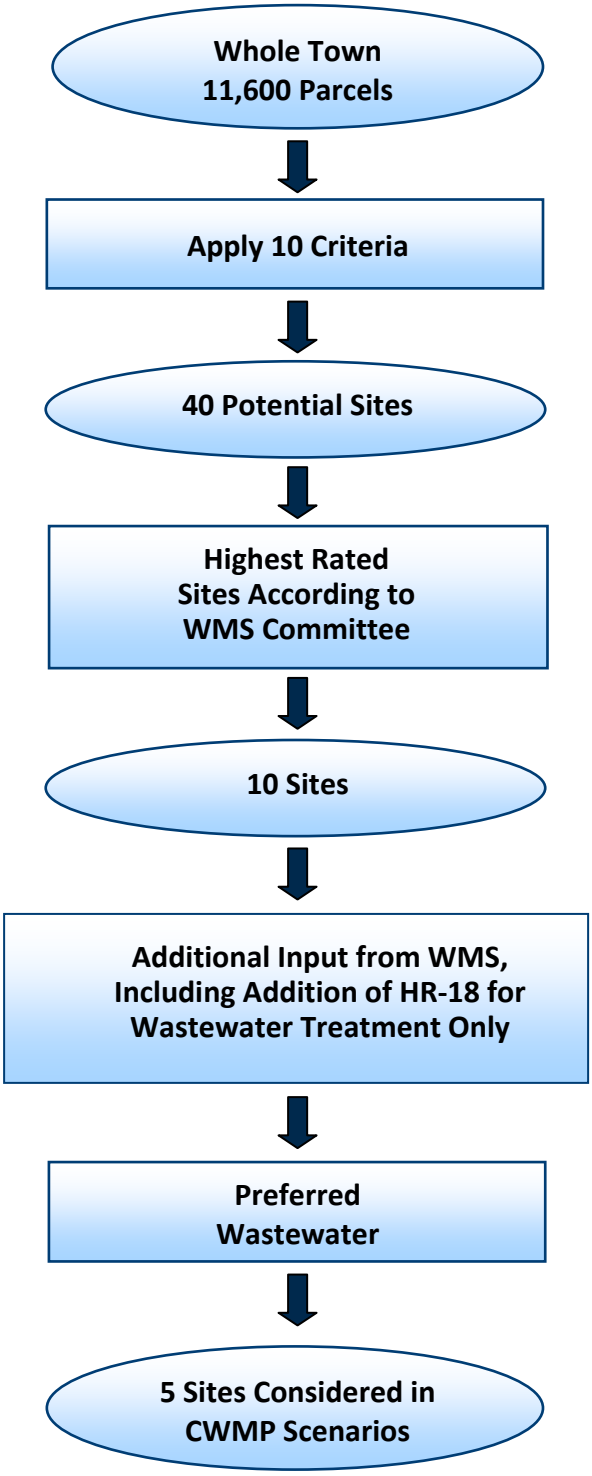
- **HR-12** – Former landfill site and current Department of Highways and Maintenance property in the Herring River watershed
- **PB-3** – Gravel pit in the Pleasant Bay watershed
- **SH- 2** – Harwich High School in the Saquatucket Harbor watershed
- **OW-2** – The Harwich Port Golf Course, located within Harwich but outside MEP listed watersheds

In addition, Site HR-18 was added to the final potential site list as a possible location for a wastewater treatment facility. This site is part of the ocean outfall scenario described in Section 10 and would not be used for effluent recharge in any capacity:

- **HR-18** – The town-owner gardens and sheep farm at 50 Sisson Road in the Herring River watershed

Identifying these five sites was done through a multi-step process (see **Figure 9-1**). The first step applied 10 site-screening criteria to all town parcels, enabling the Town to narrow the list from approximately 11,600 parcels to a more manageable number – in this case 40. Further analysis, factoring in several additional considerations, reduced the number of potential sites to 10.

Figure 9-1
Flowchart of Site Screening Selection Process



Once the ten sites were identified based on the second level of screening, they were presented to the Town for further discussion. The Town then considered eight wastewater scenarios (presented in Section 10) along with the 10 sites identified in the screening process, with the intention of narrowing the final sites down even further. The result was the selection of five sites to be carried forward in the CWMP. As discussed above, four of the sites will be considered for wastewater treatment and effluent recharge, while one site will only be considered for wastewater treatment.

Site investigations were then performed on the two best sites considered for effluent recharge. The site investigations included additional fieldwork and site visits which provided further information for town planners, engineers and other interested parties. The site investigation collected detailed field data at the HR-12 site, along with a limited amount of field data at the PB-3 site.

The data from the site investigation was then used in predictive modeling to address the following:

1. The potential ability of the site to infiltrate the treated effluent through the unsaturated zone,

2. The capacity of the aquifer to carry the infiltrated flow away from the site without causing too much mounding below the infiltration basins, or in any nearby properties.

3. In the case of HR-12, the avoidance of potentially negative impacts on the adjacent capped landfill.

Detailed information on the hydrogeologic study of the effluent recharge sites is presented in Section 11.

It is important to note that while the five most feasible sites have been determined, all 40 sites identified in the initial screening could still be revisited and remain potential sites. The sections below summarize the criteria, selection process, and resulting wastewater treatment and effluent recharge sites that are considered to be the best candidates in Harwich.

9.2 Initial Site Screening Criteria

In order to determine the most feasible location for effluent recharge within the Town of Harwich, it was necessary to evaluate all possibilities and use selection criteria to identify sites which best meet the program objectives. For the initial screening, all parcels of land within the Town boundaries were considered, and many were eliminated through a series of applied selection criteria. Criteria were established based on the needs of the program, including continued water resource and rare and endangered species protection, favorable soil and groundwater conditions, minimum parcel size, and town ownership.

Each of the ten criteria is described below and shown, respectively, as Figure 9-2 through Figure 9-11 on the following pages. Generally, all of the criteria are applied across the whole town. A few parcels were not eliminated due to exceptional circumstances. Such parcels include previously identified recharge sites, golf courses and gravel pits. Some of these exceptions are further described below.

9.2.1 Data Sources

The most up-to-date Graphic Information Systems (GIS) data available in 2009 were used to conduct the site screening analysis. The sources are listed in the following table and further described in Section 3.

Table 9-1

GIS Database Sources Utilized during Site Screening Analysis

Information	Source	Date
Color Ortho Imagery (1:5000)	MassGIS	2005
Community Boundaries	MassGIS	2002
Parcel Information	Town of Harwich, Assessors Dept	2006
Watershed Delineations	Cape Cod Commission	2008
100-yr Flood Zones	MassGIS, FEMA Q3	2007
Surficial Geology	MassGIS	2007
Wetlands Delineations	MassGIS, MassDEP	2006
Priority Habitats of Rare Species	MassGIS, NHESP	2006
Wellhead Protection Areas (Zone II)	MassGIS, MassDEP	2007
Town-Owned Lands	Town of Harwich, Assessors Dept	2006

9.2.2 Outside Zone of Contribution

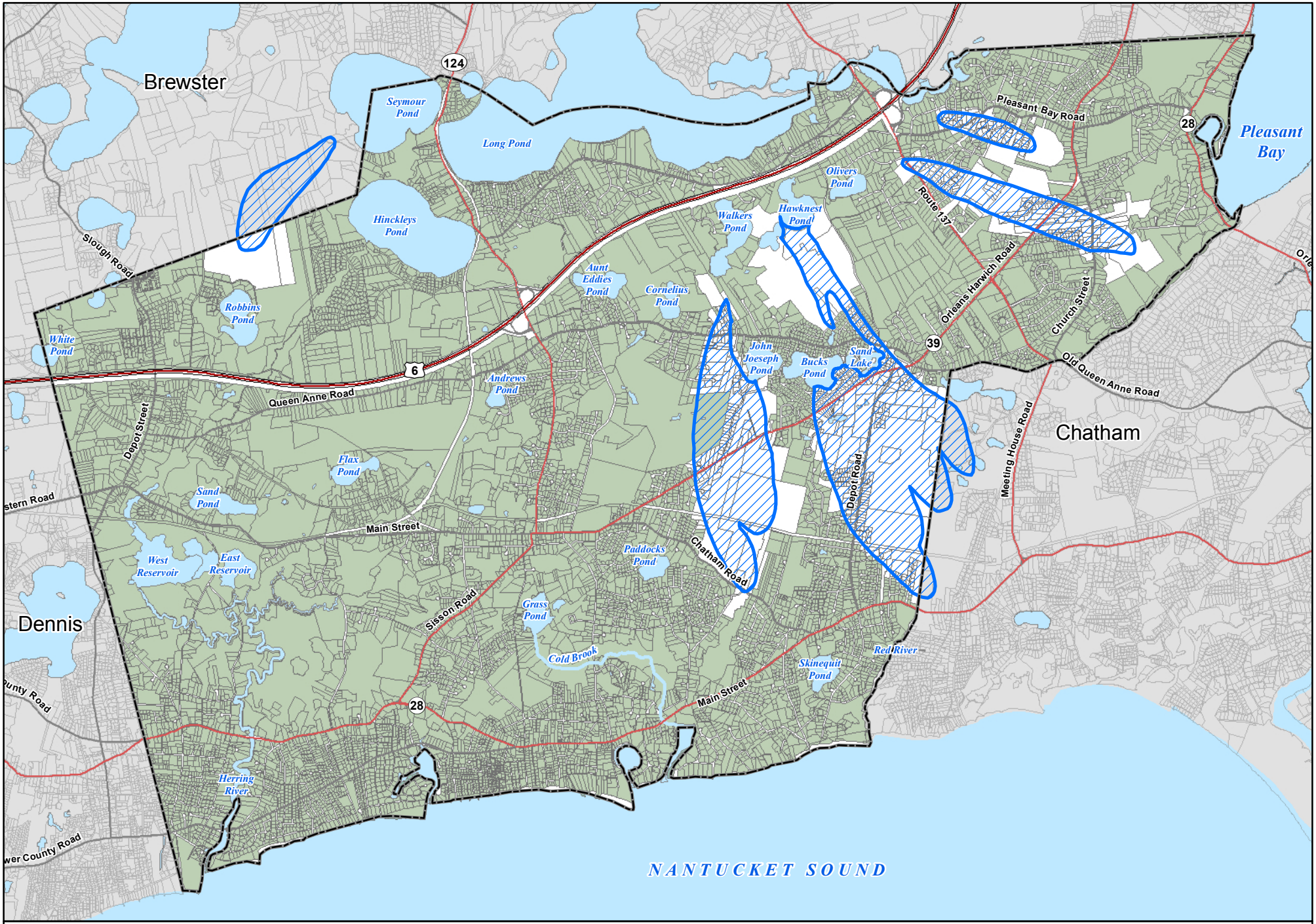
A well contribution zone is the groundwater area that regularly supplies water to a drinking water supply well. This area is calculated based on a variety of factors, including soil permeability, transmissivity within the aquifer and the rate of pumping based on past use.

The zone delineations used in this evaluation were developed by the Cape Cod Commission (CCC) and the UMass Dartmouth School for Marine Science and Technology (SMAST). SMAST calculated well contribution protection perimeters using a steady state model simulation of the area surrounding each well. Values are “based on average withdrawal rates [recorded] from 1995 through 2000 and an annual [rainfall] recharge rate of 27.75 inches/year.”

As part of this investigation, all land parcels which were located within a zone of contribution were excluded from further consideration. Note that these zones differ from the MassDEP Zone II delineations which consider the most severe pumping rates for 180 days under drought (no recharge) conditions. See Figure 9-2 for well contribution zones within Harwich.

9.2.3 Parcel Size Greater than Five Acres

In order to account for current and future use, the minimum parcel size of land area which could be effectively utilized for effluent recharge was determined to be five acres. Therefore, this criterion eliminated all parcels less than five acres in size.



Legend

- Zone of Contribution
- Parcel Remaining After Site Screening

Site Screening Criterion 1
Zone of Contribution

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-2

CDM Smith

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One exception to this criterion was made based on land use. Gravel pits are generally smaller parcels of less than five acres. These pits often bound one another, however, and are typically located in remote areas or segments of land that are bordered by undeveloped parcels. Small bordering gravel pit parcels were grouped together to create an area of contiguous land of more than five acres. See Figure 9-3 for the outlined parcel areas which met this criterion.

9.2.4 Outside 100-year Floodplain Zones

Continuously recharging wastewater effluent requires highly permeable soils with sufficient depth to groundwater to account for groundwater mounding. Thus, areas with less permeable soils and shallow depth to groundwater are less desirable. Areas prone to flooding or which have limited soil permeability due to existing wet conditions were eliminated as part of this assessment.

The Federal Emergency Management Agency (FEMA) defines a 100-year floodplain as "an area inundated during a flood that has a 1-percent chance of being equaled or exceeded in any given year." Placing the effluent recharge zone outside of areas which have a probability of flooding will reduce the likelihood of backups in the recharge basins, odors, and worsening existing nearby flooding conditions. Figure 9-4 highlights parcels within the Town of Harwich which are outside of the 100-year floodplain.

9.2.5 Permeable Soils

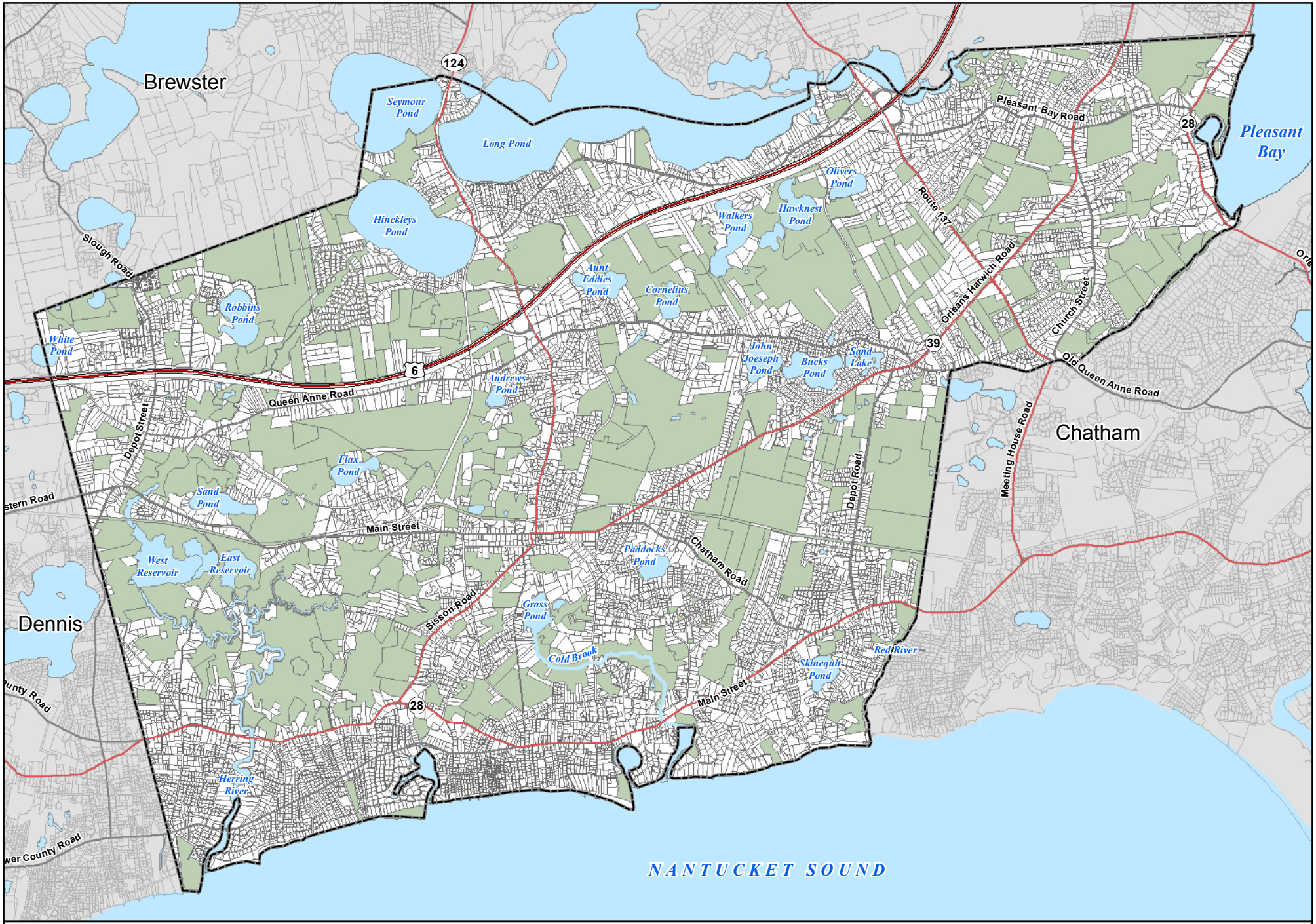
Soil permeability is one of the limiting factors which determines effective effluent recharge rates at a particular location. The higher the permeability of soil, the more water removal capacity a location can maintain. For a parcel to be a good candidate, at least five acres of the site must be outside a low-permeability soil zone. In this assessment, low-permeability soils were generally soils which formed through deposition from flowing water such as clays and silts. These soils are comprised of particles that are small and light enough to be carried by moving water, but large enough to settle out. Over time, the soils form as well sorted layers which, once settled, can be nearly impermeable.

Ideal soils for an effluent recharge site are poorly sorted, well drained sands and gravels that allow high permeability, and thus higher potential effluent recharge rates, within a 5-acre area. The parcels which met this criterion using NRCS and MassGIS soils data are shown in Figure 9-5.

9.2.6 Undeveloped Property

It is significantly more cost effective and resource efficient to develop an effluent recharge site from a parcel which is not currently developed. Developed property can be subject to zoning restrictions, tax assessments, or social issues. Thus, currently undeveloped property was surveyed as part of this investigation.

Some parcels which were not developed at the time of this assessment may not be considered developable land due to limited use restrictions, previous ownership, access, or other unspecified hazardous conditions. These parcels, when identified, were removed under this criterion. Privately owned developed sites were also excluded through this criterion due to the issues described above.



Legend

- Parcel Area is Less Than 5 Acres
- Parcel Remaining After Site Screening (Parcel Area > 5 Acres)

Site Screening Criterion 2
Minimum Parcel Size

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-3

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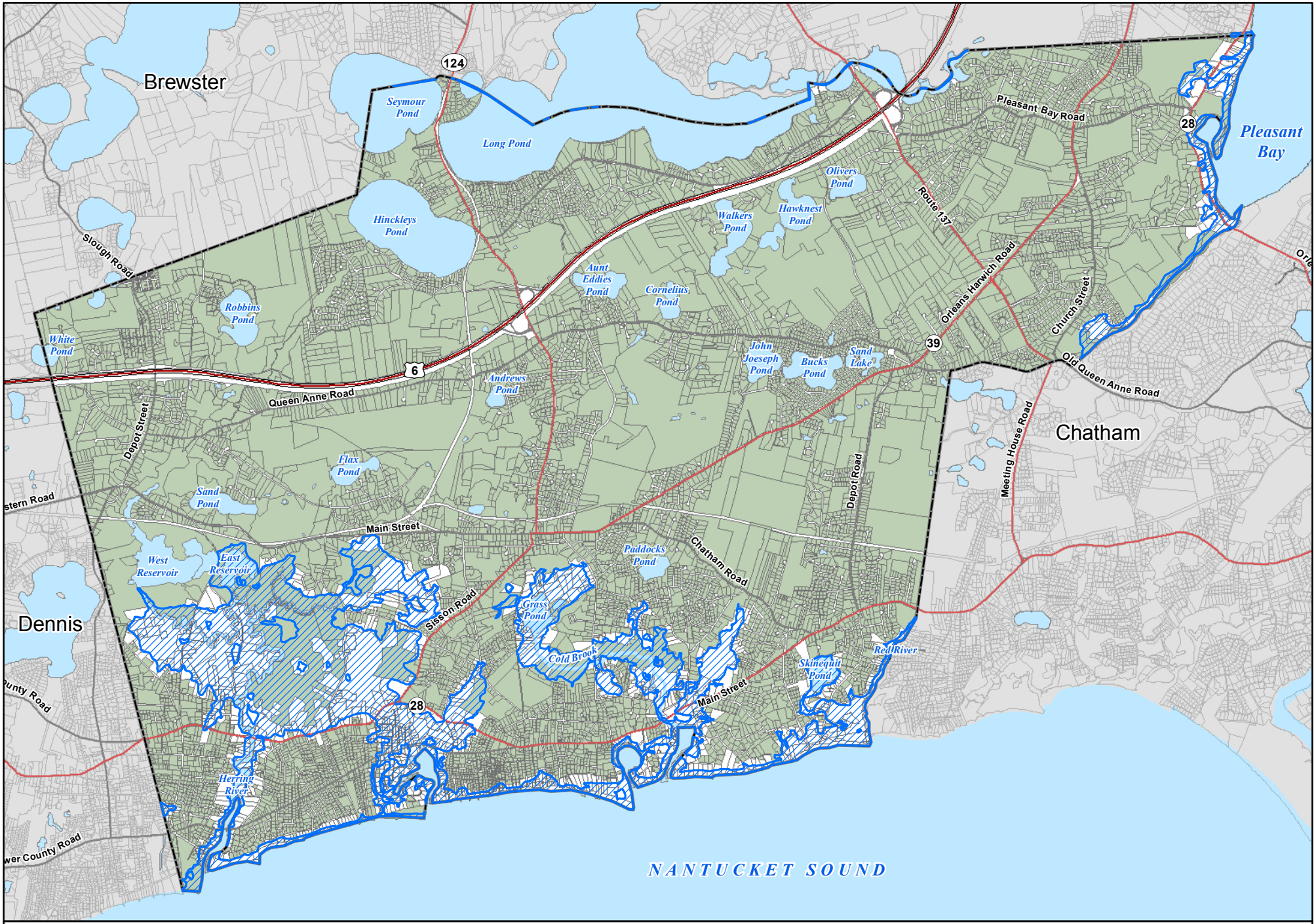

Legend

100 - Year Floodplain Boundary

Parcel Remaining After Site Screening

Site Screening Criterion 3
100-year Flood Zone

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-4

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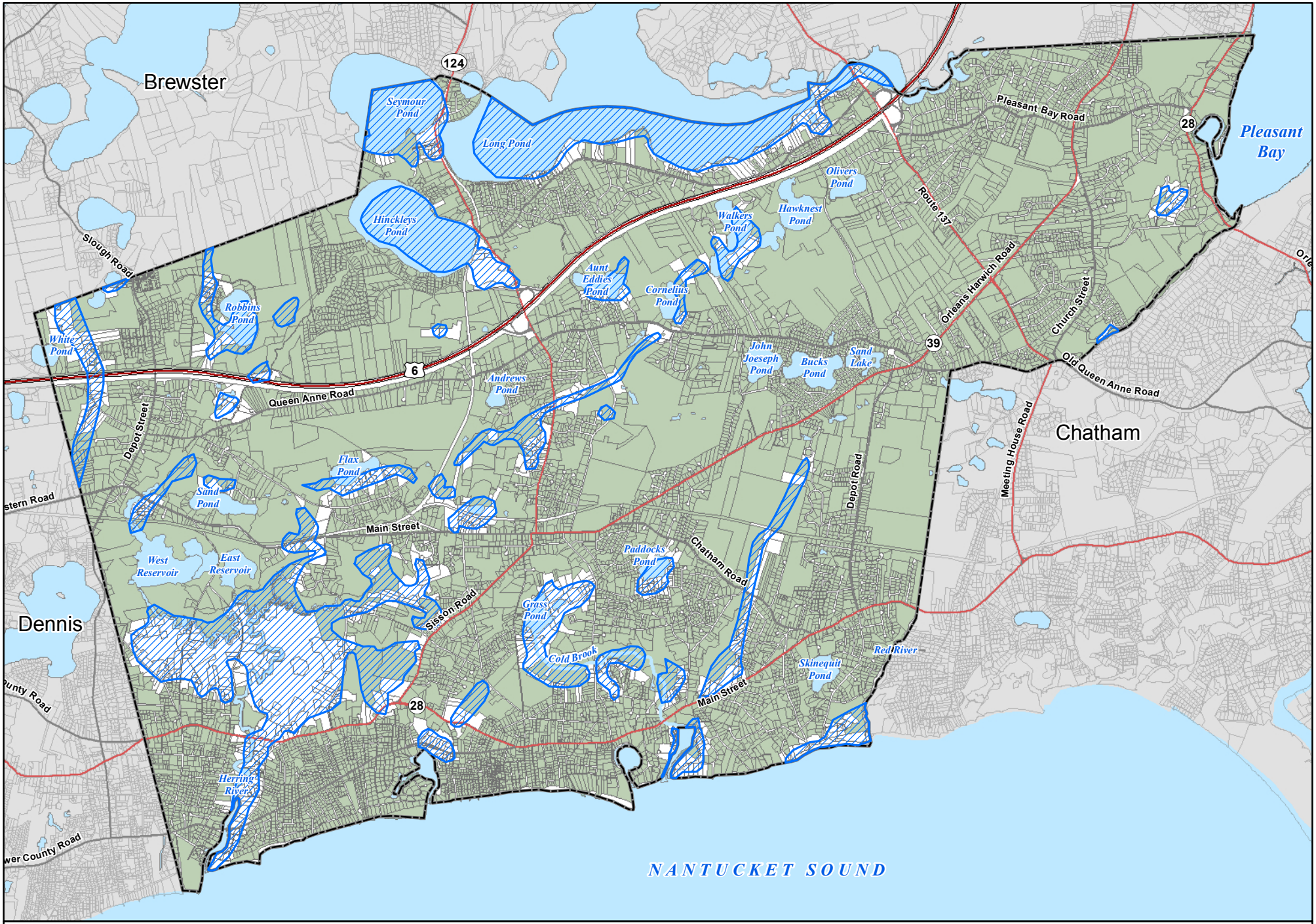

Legend

- Low Permeability Soils
- Parcel Remaining After Site Screening

Site Screening Criterion 4
Soil Permeability

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-5

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Undeveloped town-owned land under the jurisdiction of the water department was excluded from consideration due to restrictions for well zones of contribution, as specified in Section 9.2.1 above. As water demand increases from Town resources, and as conditions change, restricting development in current water department land allows for potential future use. Protected conservation land was also excluded from consideration, as well as cemeteries, however most other town-owned parcels were retained. See Figure 9-6 for a map which outlines the parcels identified in this investigation.

9.2.7 Outside Wetlands

As described in Section 9.2.4 above, soil permeability is a key component to effective effluent recharge sites. Wetlands are typically areas where soils are fully saturated either seasonally or permanently. MassDEP defines wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Wetlands behave similarly to ponds, slowing groundwater flow, and leaving water to pool and stagnate on the surface. An ideal site would include a minimum of five acres of land which is not classified as wetlands and instead, as described in Section 9.2.4, contains soils that are highly permeable. Parcels which were identified as acceptable following this assessment are shown in Figure 9-7.

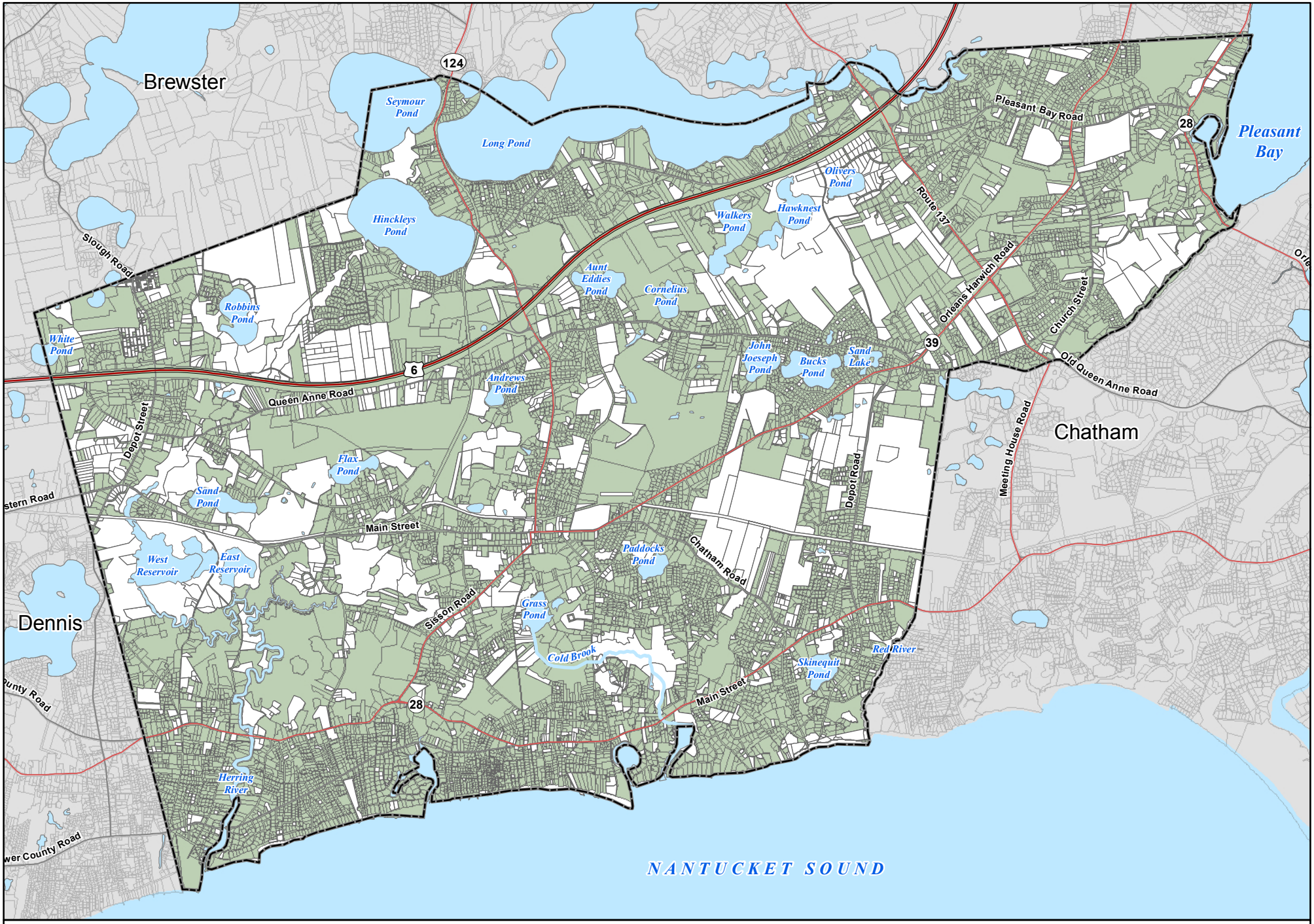
9.2.8 Favorable Depth to Groundwater

Estimated depth to groundwater is another measure of the capacity of receiving soils to accept effluent recharge. Portions of land which are not wetlands but maintain a high groundwater table may only be able to infiltrate a limited volume of additional water. Because wastewater effluent volume will be variable and groundwater mounding will occur as a result of effluent recharge, selecting a site with a minimum depth to groundwater of at least 5 feet below the ground surface will provide a reasonable buffer for this screening level of analysis.

Under this assessment, parcels where the estimated depth to groundwater was less than five feet were eliminated. The depth to groundwater calculations for parcels within the Town of Harwich were developed by CDM Smith in 2008 with information from USGS and MassGIS. Figure 9-8 shows all parcels within Harwich which maintain average depth to groundwater of at least 5 feet below ground surface.

9.2.9 Outside Priority Habitat Areas

Priority habitat areas refer to the geographical boundaries of known state-listed rare plant and animal species. Parcels which contain priority habitat areas would be subject to the Massachusetts Endangered Species Act (MESA) and regulatory review by the Natural Heritage and Endangered Species Program (NHESP) under the Massachusetts Division of Fisheries and Wildlife. NHESP defines priority habitats as "the geographic extent of Habitat for State-listed Species as delineated by the Division pursuant to 321 CMR 10.12."



Legend

- Developed or Undevelopable Town-Owned Parcel
- Parcel Remaining After Site Screening

Site Screening Criterion 5
Undevelopable Town Owned Property

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 9-6

CDM Smith

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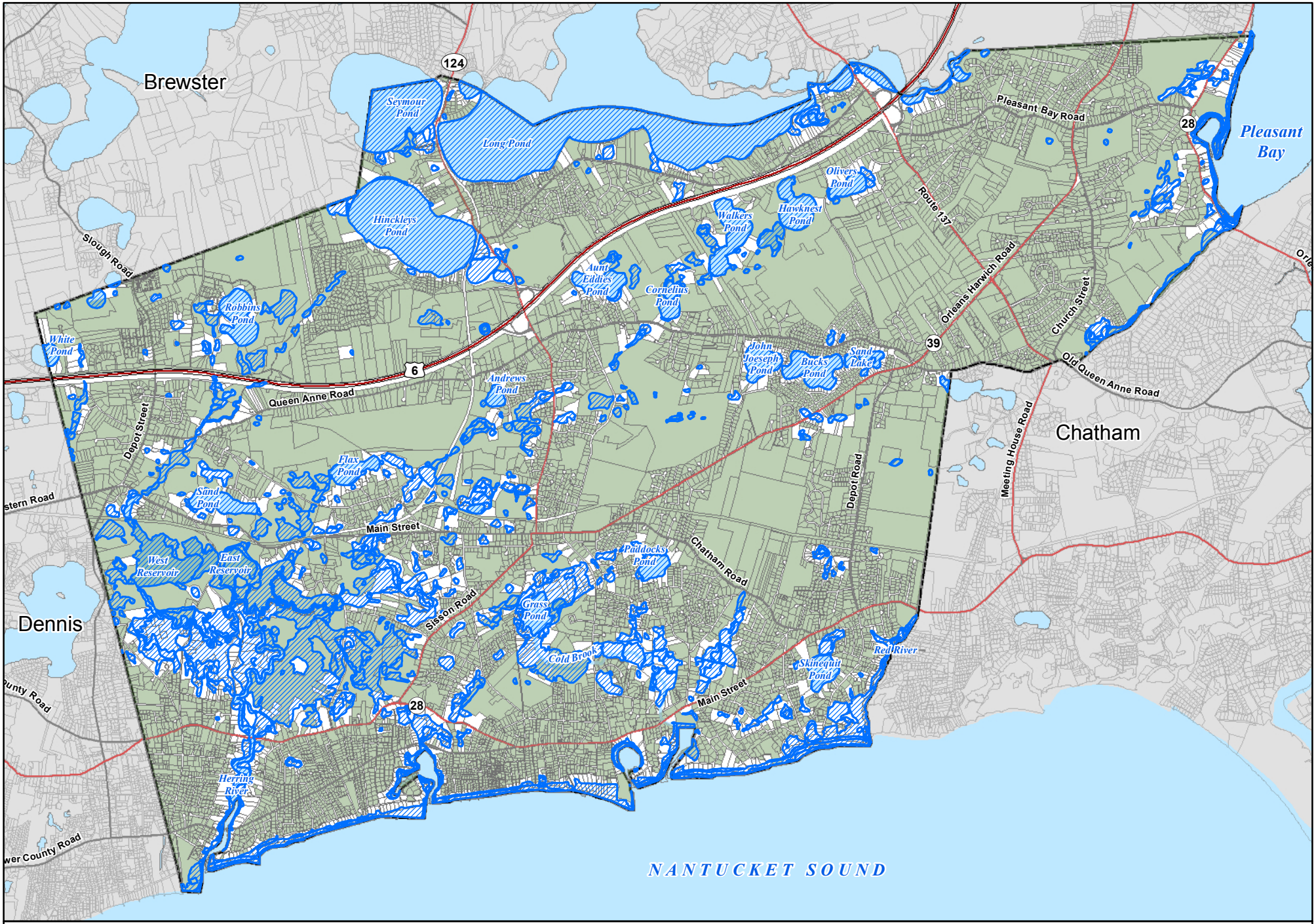

Legend

- Wetlands
- Parcel Remaining After Site Screening

Site Screening Criterion 6
Wetlands

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-7

CDM Smith

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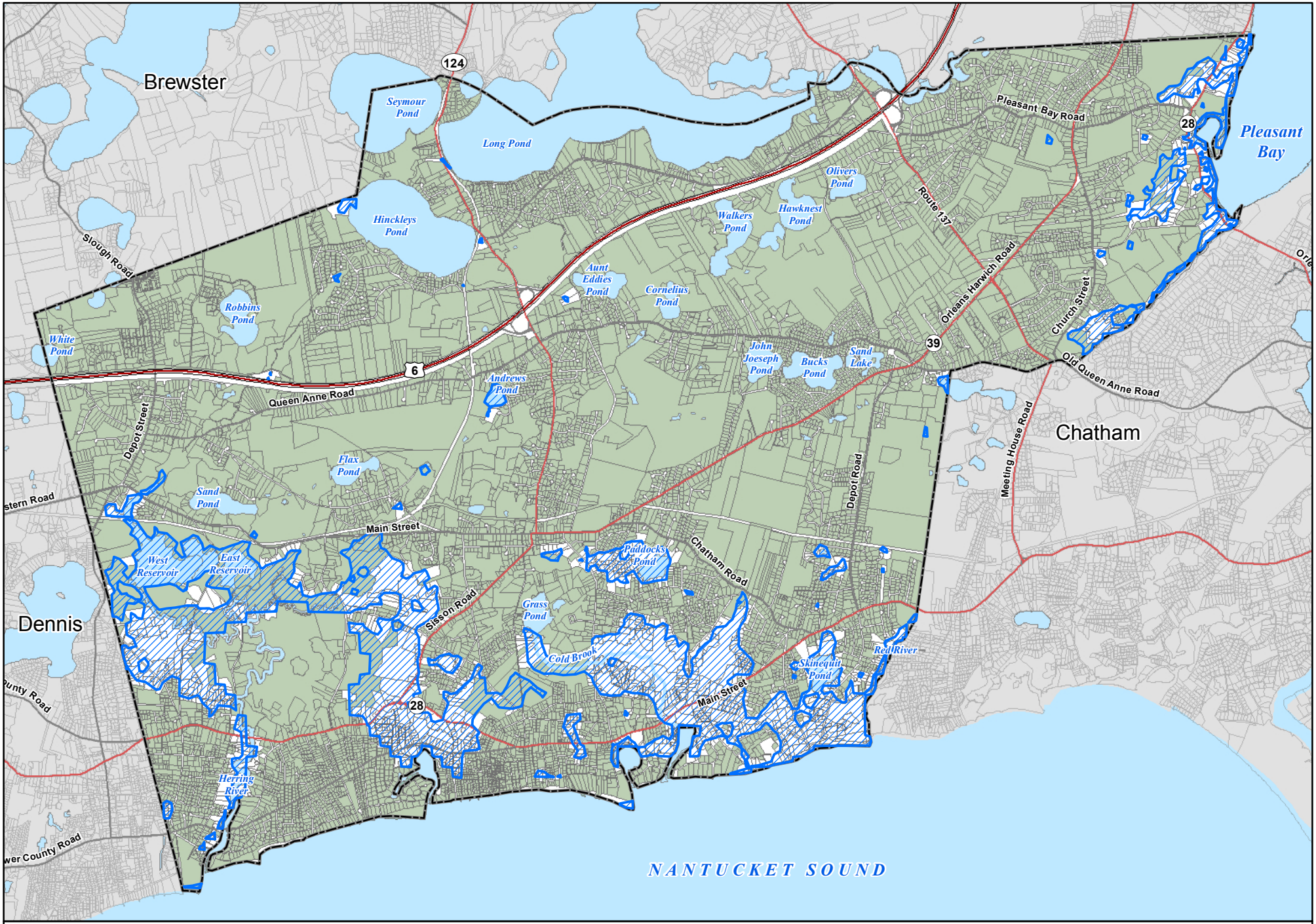

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Parcels identified as being within a Priority Habitat of Rare Species zone were noted, but not excluded as potential effluent recharge sites in this analysis. Depending on the species and the extent of the habitat on the subject site, the existence of a priority habitat could eliminate a candidate site from the screening. Figure 9-9 shows all parcels located outside of Priority Habitat areas.

9.2.10 Outside Municipal Wellhead Protection Zone II

Wellhead protection zones are designated areas that are conservatively delineated to provide buffer space around the contribution zone for a public drinking water well. A Wellhead Protection Zone II, as defined by MassDEP, is "an area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation)."

Parcels within a Wellhead Protection Zone II area were noted as part of the initial screening, however, not excluded from this search. Sites that met other criteria but did not meet this criterion were evaluated to determine which portion of the property was outside the wellhead protection zone. See Figure 9-10.

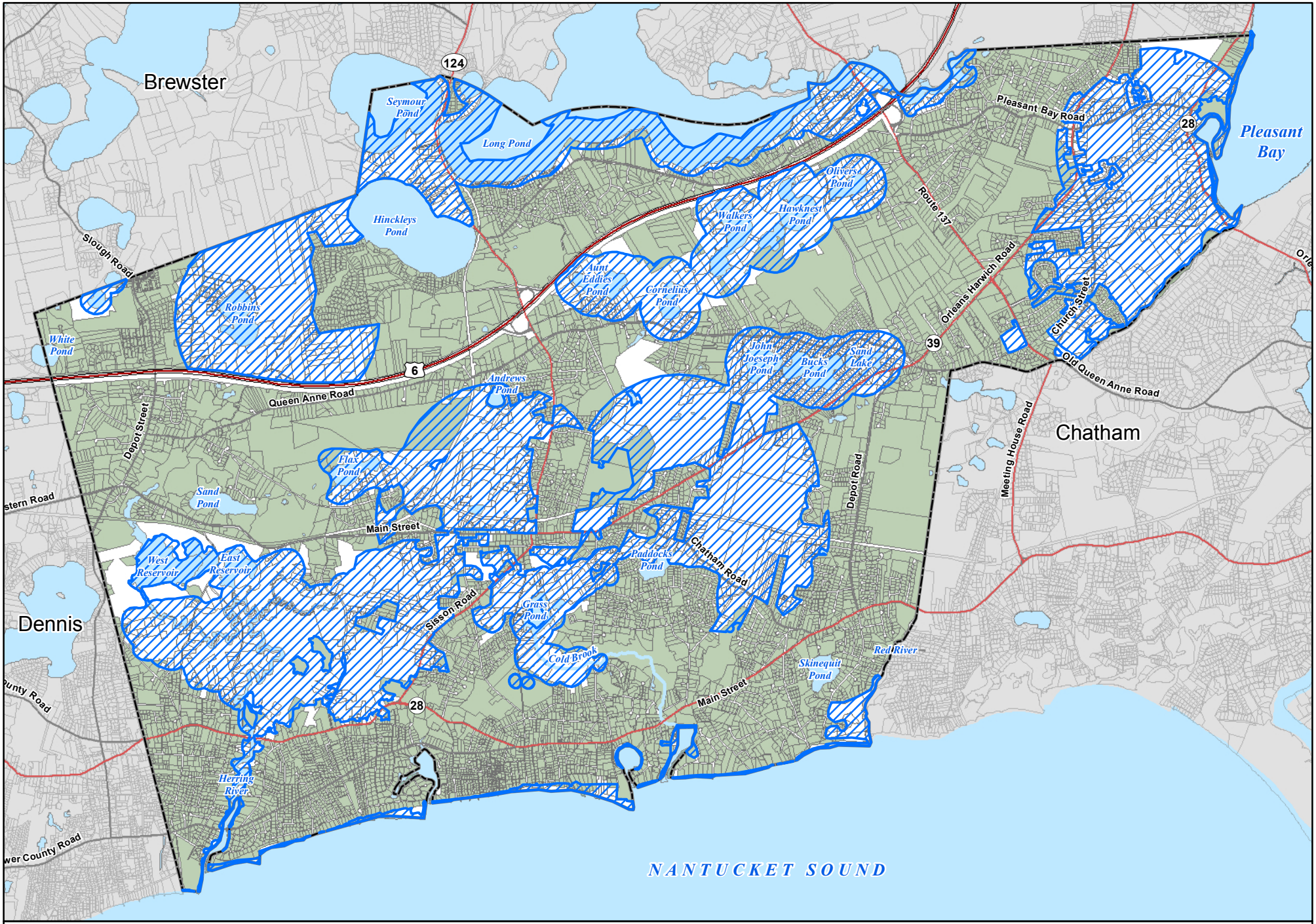
9.2.11 Town-owned Property

Property owned by the Town of Harwich was preferred in this assessment. Parcels already owned by the Town provide a significant financial, logistical, and legal advantage due to the relative ease by which access, development, and permitting could be obtained. If a parcel was privately owned, the Town would have to go through a legal process to obtain or purchase the property before it could be permitted and developed. Such processes may take months or years to complete, depending on the relationship with the owner, and may be expensive depending on the value of the parcel. For this criterion, acceptable town owned properties do not include cranberry bogs, conservation/protected lands, water department lands or cemeteries. For these reasons, parcels owned by the Town of Harwich were identified as particularly advantageous sites for effluent recharge. These properties are shown on Figure 9-11.

9.3 Initial List of Potential Effluent Recharge Sites

Using the ten criteria described, the initial screening reduced the approximately 11,600 parcels in Harwich to forty potential sites. Following this initial screening step, more investigation was necessary to ensure all reasonable locations were considered for further assessment.

Large parcels which initially did not meet criteria, generally because a portion of the property was located in a protected area, were further assessed for criteria eligibility. For parcels where at least 50 percent or five acres of land area met the criteria, parcel eligibility was adjusted. For instance, if half of the land in a 20-acre parcel is located in a wetland, the site was still considered eligible to meet that criterion because ten of the twenty acres were located outside the wetland. Table 9-2 shows the criteria analysis for each of the forty sites as well as the estimated acreage available for effluent recharge for all listed parcels. The amount of recharge modeled by the USGS for some of the sites in a previous evaluation performed in 2006 is noted in the table footnote.



Legend

- NHESP Priority Habitats of Rare Species
- Parcel Remaining After Site Screening

Site Screening Criterion 8
NHESP Areas

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 9-9

CDM Smith

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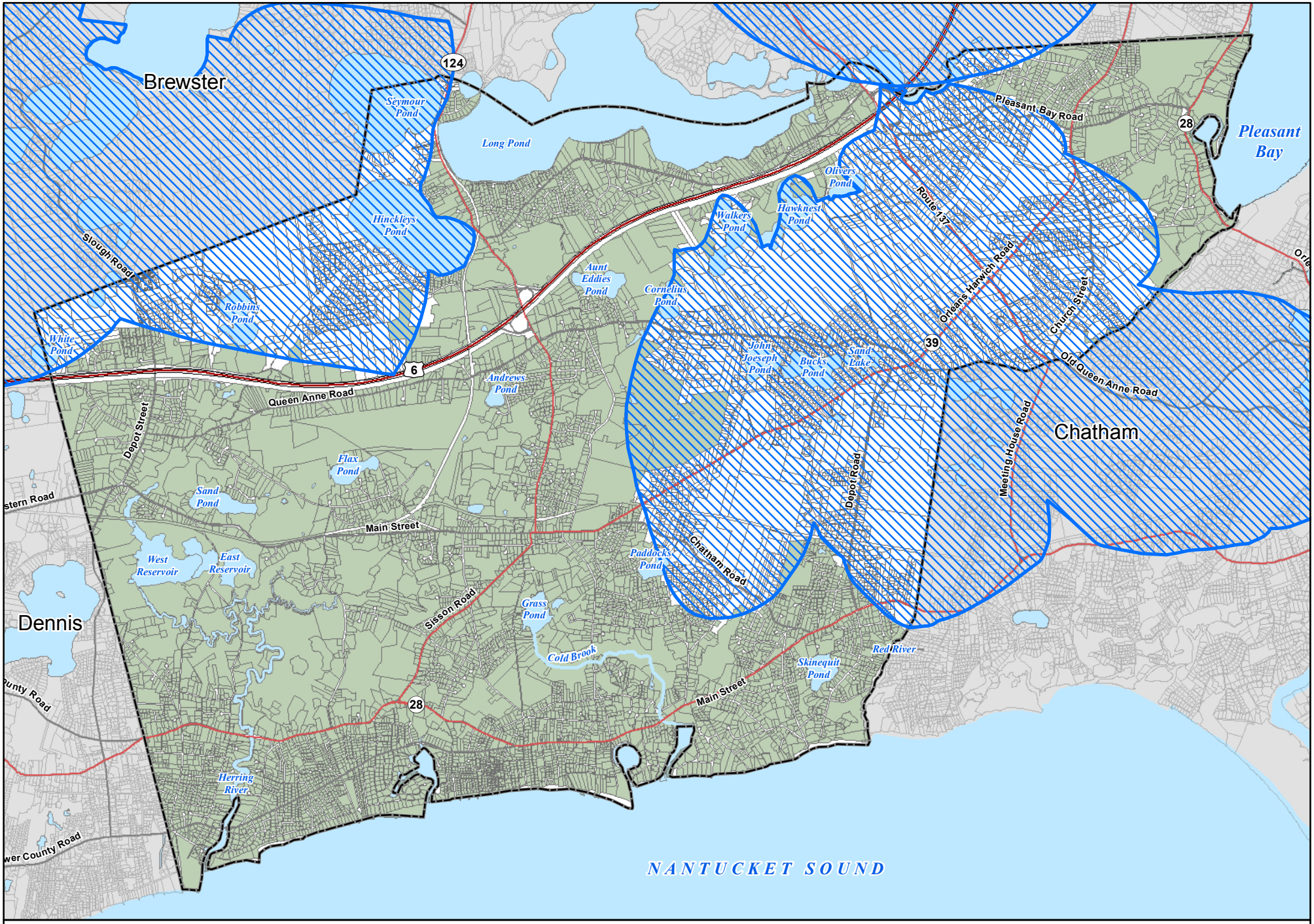

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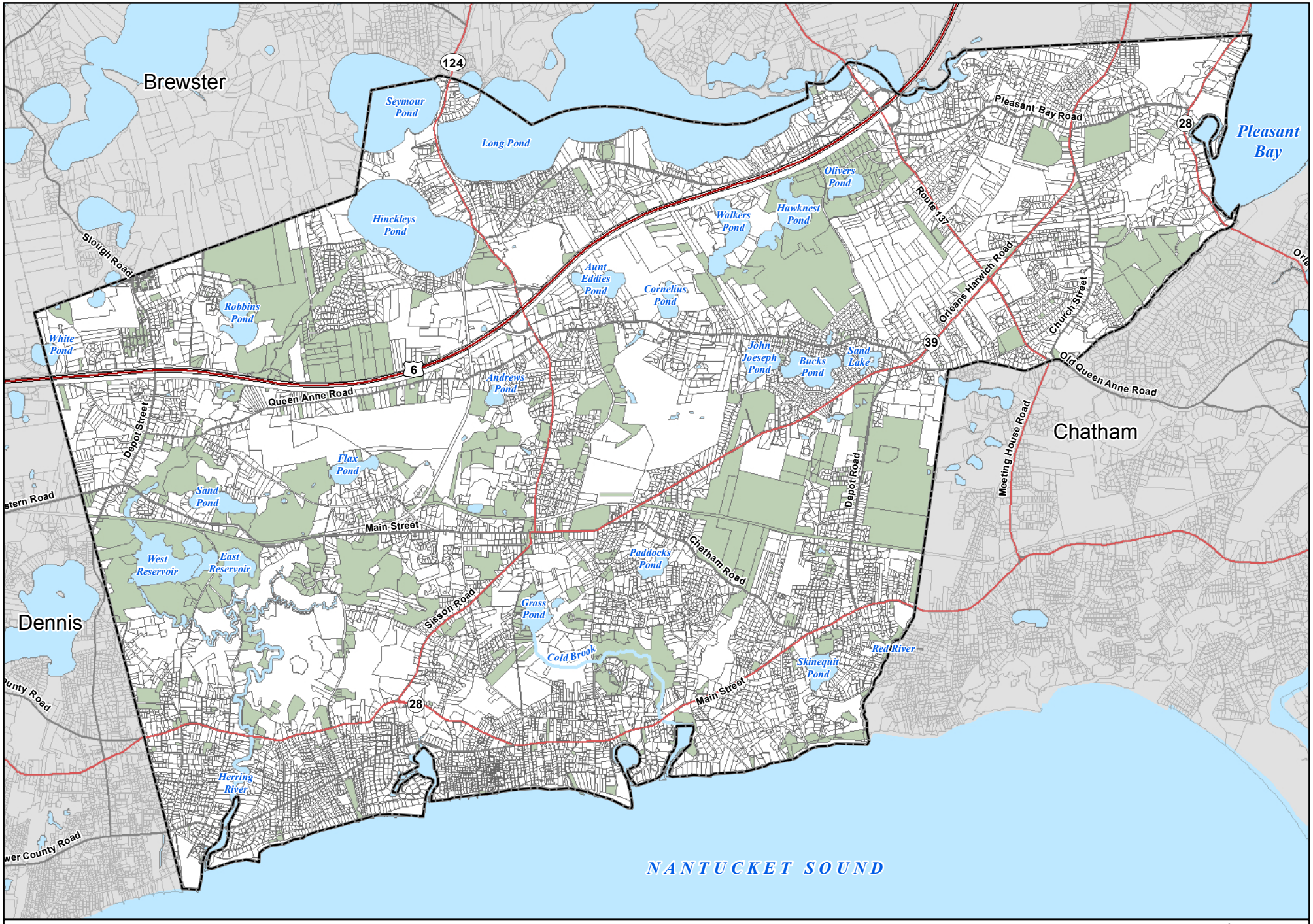

Legend

Parcel Remaining After Site Screening (Town Owned Land)

Site Screening Criteria 10
Town Owned Parcels

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-11

CDM Smith

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Table 9-2
Preliminary Effluent Recharge Site Screening Criteria Analysis

Number	Site Number	Outside Municipal well Contribution Zones	Parcel Size > 5 acres	Outside 100 Year Flood Plain	Permeable Soils	Un-Developed Property	Note	Outside of Wetlands	Favorable Depth to GW	Outside of Priority Habitat	Outside of a Zone II	Town Owned	# of Criteria Met	Acres	Notes
Herring River Watershed Sites															
1	HR-1	X	X	X	X	X	Gravel Pit	X	X	X	X	NO	9	54	
2	HR-2	X	X	X	X	NO	Structures / Woods	X	X	X	NO	NO	7	5	
3	HR-3	X	X	X	X	NO	Structures / Woods	NO	X	NO	NO	NO	5	14	
4	HR-4	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	X	NO	7	11	
5	HR-5	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	NO	NO	6	10	
6	HR-6	X	X	X	X	X	Undeveloped Woods	X	X	NO	X	X	9	14	
7	HR-7	X	X	X	X	X	Undeveloped Woods	X	X	NO	NO	X	8	39	
8	HR-8	X	X	X	X	NO	Structures / Woods	X	X	X	NO	X	8	5	
9	HR-9	X	X	X	X	NO	Structures / Woods	X	X	NO	NO	NO	6	18	
10	HR-10	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	NO	NO	6	24	
11	HR-11	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	X	X	X	9	68	
12	HR-12	X	X	X	X	NO	Structures / Woods (Old Dump)	X	X	X	X	X	9	134	(1)
13	HR-13	X	X	X	X	X	Woods	X	X	X	X	NO	9	6	
14	HR-14	X	X	X	X	X	Woods	X	X	X	X	NO	9	6	
15	HR-15	X	X	X	X	X	Woods	X	X	X	X	X	10	8	
16	HR-16	X	X	NO	X	X	River Flats	NO	NO	NO	X	X	6	66	
17	HR-17	X	X	X	NO	X	Old Dump	X	NO	NO	X	X	7	22	(1)
18	HR-18	X	X	X	NO	NO	Structures / Woods (Sisson Road)	NO	NO	NO	X	X	5	30	(1)
19	HR-19	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	NO	X	X	8	17	
20	HR-20	X	X	X	X	NO	Structures/Woods (Area Undev. Behind Comm. Ctr.)	X	X	X	X	X	9	14	
Outside Watershed															
21	OW-1	X	X	X	X	NO	Woods / Parking (Beach Club)	X	X	X	X	X	9	6	
22	OW-2	X	X	X	X	NO	Fields - Golf course	X	NO	X	X	NO	7	58	(1)
23	OW-3	X	X	X	X	X	Woods / Gravel Pit	X	X	NO	X	NO	8	27	
24	OW-4	X	X	X	X	X	Woods	X	X	NO	NO	X	8	9	
25	OW-5	X	X	X	X	NO	Structures / Woods	X	X	NO	NO	NO	6	6	
Saquatucket Harbor Watershed Sites															
26	SH-1	X	X	X	X	NO	Golf Course	X	X	NO	NO	X	7	193	
27	SH-2	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	NO	X	X	8	86	(1)
28	SH-3	X	X	X	X	NO	Sports Fields / Woods	X	X	NO	X	X	8	18	
29	SH-4	X	X	X	X	X	Woods	X	X	NO	X	NO	8	13	
30	SH-5	X	X	X	X	NO	Homes (Harwich Housing Authority)	X	X	X	X	X	9	9	
31	SH-6	X	X	X	X	X	Woods	X	X	X	NO	NO	8	7	
Pleasant Bay Watershed Sites															
32	PB-1	X	X	X	X	X	Woods	X	X	NO	NO	X	8	26	
33	PB-2	X	X	X	X	X	Woods	X	X	NO	NO	X	8	12	
34	PB-3	X	X	X	X	X	Gravel Pit / Woods (East Harwich Site)	X	X	X	NO	NO	8	117	(2)
35	PB-4	X	X	X	X	X	Woods	X	X	X	NO	NO	8	10	
36	PB-5	X	X	X	X	X	Woods	X	X	X	NO	NO	8	18	
37	PB-6	X	X	X	X	NO	Building	X	X	X	NO	X	8	6	
38	PB-7	X	X	X	X	X	Woods	X	X	X	X	NO	9	7	
39	PB-8	X	X	X	X	X	Woods	X	X	X	X	NO	9	5	
40	PB-9	X	X	X	X	NO	Golf Course	X	X	NO	X	NO	7	80	

Sites Highlighted in Blue are the Final Five Sites Selected For Additional Evaluations in the CWMP

Effluent Recharge - Modeled by United States Geological Survey (USGS) in a Previous Evaluation Performed in 2006

(1) **320,000 gpd** Was modeled at this site by USGS in 2006

(2) **80,000 gpd** Was modeled at this site by USGS in 2006

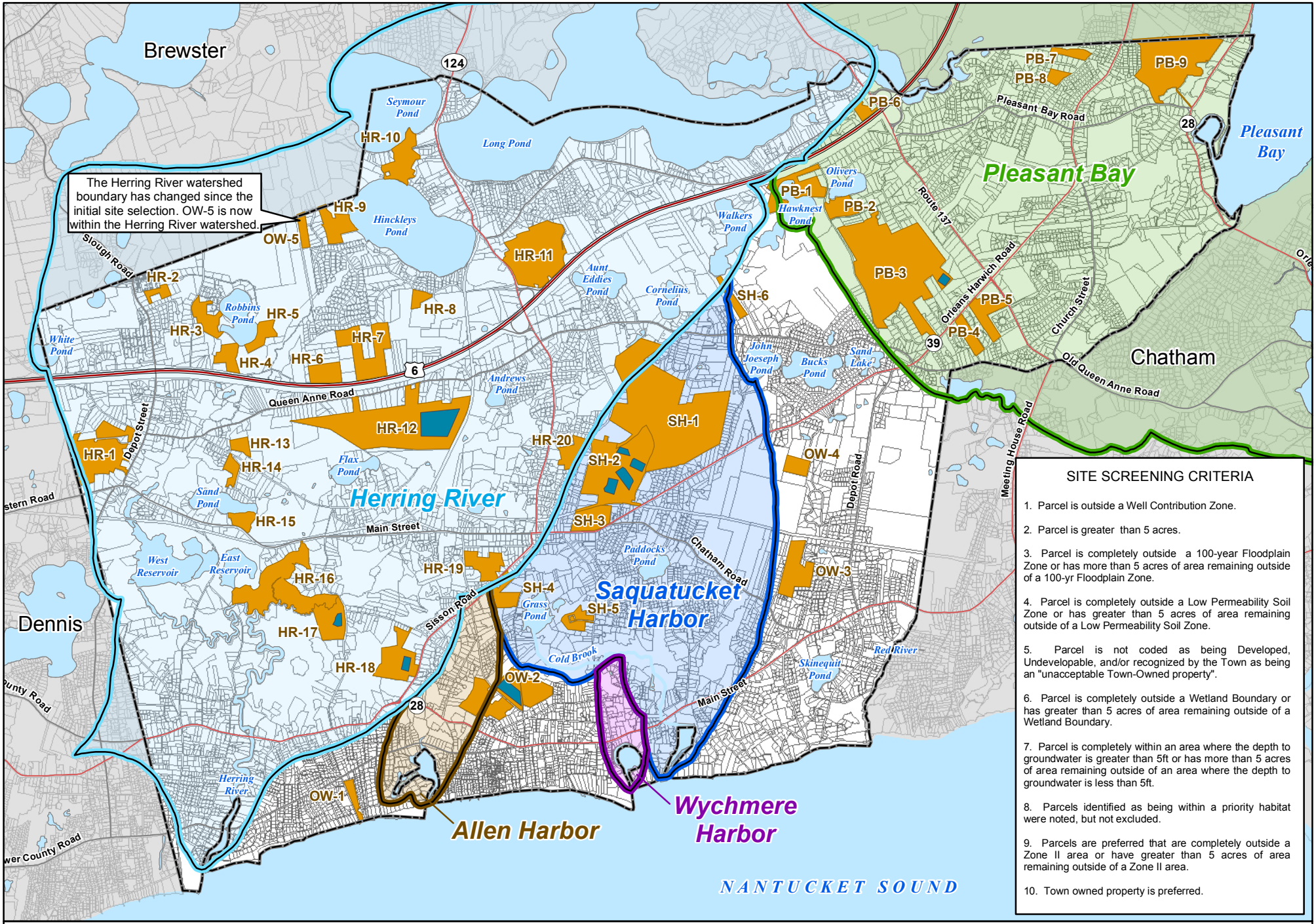
The subsections below outline the forty listed sites which were determined through the initial site screening process as meeting at least five of the ten criteria. The identified sites are organized by designated MEP watershed. Parcels are identified with a prefix acronym which distinguishes the associated watershed location, along with a reference number (e.g. a site in Herring River could be HR-1). No sites were identified in the Allen Harbor or Wychmere Harbor watersheds. Refer to Figure 9-12 for a map showing all 40 sites along with the MEP watershed boundaries.

9.3.1 Herring River Watershed

Herring River, located in the northwestern portion of the Town, is the largest MEP watershed in Harwich. The watershed is a series of surface water resources including several ponds, two reservoirs, and the Herring River Estuary. The watershed includes portions of the Town of Brewster to the north and a small portion of the Town of Dennis to the west. The Mid-Cape Highway (Route 6) bisects the northern portion of the watershed.

Half of the forty potential wastewater recharge locations determined through the initial site screening criteria assessment are located within the Herring River watershed. The following is a description of each site. For further information, refer to Table 9-2 which outlines the criteria qualifications for all forty sites.

- Site **HR-1** is a group of 30 privately-owned adjacent parcels located on Depot Street in the northwestern portion of Harwich. Most of the site is zoned for general industrial use and it is primarily used as a gravel pit. This site passed 9 out of 10 site screening criteria.
- Site **HR-2** is a privately-owned property located in north Harwich. It passed seven of the 10 site screening criteria but is located in a Zone II wellhead protection area.
- Site **HR-3** is a privately-owned property located in north Harwich. It passed 5 out of 10 site screening criteria but is located within a Zone II wellhead protection area, a Priority Habitat area, and a defined wetlands zone.
- Site **HR-4** is a privately-owned property in north Harwich. It passed 7 of the 10 site screening criteria but is within a Priority Habitat zone, and a portion of the parcel is within a Zone II wellhead protection area.
- Site **HR-5** is a privately-owned property in north Harwich. It passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and Zone II wellhead protection area.
- Site **HR-6** is composed of two adjacent town-owner properties in north Harwich. It passed 9 of the 10 site screening criteria, but it is within a Priority Habitat zone.
- Site **HR-7** is composed of five adjacent town-owner properties in North Harwich. It passed 8 of the 10 site screening criteria, but is partially within a Priority Habitat zone and partially inside a Zone II wellhead protection area.
- Site **HR-8** is a town-owner property in north Harwich. It passed 8 of the 10 site screening criteria, however a portion of the property is within a Zone II wellhead protection area.



SITE SCREENING CRITERIA

1. Parcel is outside a Well Contribution Zone.
2. Parcel is greater than 5 acres.
3. Parcel is completely outside a 100-year Floodplain Zone or has more than 5 acres of area remaining outside of a 100-yr Floodplain Zone.
4. Parcel is completely outside a Low Permeability Soil Zone or has greater than 5 acres of area remaining outside of a Low Permeability Soil Zone.
5. Parcel is not coded as being Developed, Undevelopable, and/or recognized by the Town as being an "unacceptable Town-Owned property".
6. Parcel is completely outside a Wetland Boundary or has greater than 5 acres of area remaining outside of a Wetland Boundary.
7. Parcel is completely within an area where the depth to groundwater is greater than 5ft or has more than 5 acres of area remaining outside of an area where the depth to groundwater is less than 5ft.
8. Parcels identified as being within a priority habitat were noted, but not excluded.
9. Parcels are preferred that are completely outside a Zone II area or have greater than 5 acres of area remaining outside of a Zone II area.
10. Town owned property is preferred.

Legend

- Allen Harbor
- Herring River
- Pleasant Bay
- Saquatucket Harbor
- Wychmere Harbor
- Parcel Remaining After Final Site Screening
- Previously Identified Potential Recharge Site (2006)

Initial Site Screening Summary

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-12

CDM Smith

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- Site **HR-9** is composed of two adjacent privately-owned properties in north Harwich. It passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and a Zone II wellhead protection area.
- Site **HR-10** is a privately-owned property in north Harwich which passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and inside a Zone II wellhead protection area.
- Site **HR-11** is the Cape Cod Regional Technical High School located at 351 Pleasant Lake Avenue. This town-owner 68.7-acre site passed 9 of the 10 screening criteria but is mostly developed, limiting available recharge space to subsurface areas below existing ballfields.
- Site **HR-12** is a town-owner property located adjacent to the former town landfill and the current location of Harwich Highways and Maintenance Department. A solid waste transfer station is located in the western portion of the property. This 137.6-acre site is south of the Mid-Cape Highway (Route 6) near Queen Anne Road. It is zoned for general industrial use and passed 9 of the 10 screening criteria. A portion of the site is within a Priority Habitat zone.
- Site **HR-13** is a privately-owned property in north Harwich which passed 9 of the 10 site screening criteria.
- Site **HR-14** is a 6.4-acre privately-owned property located on Deacons Folly Road, north of Sand Pond, which passed 9 of the 10 site screening criteria.
- Site **HR-15** is an undeveloped area on Great Western Road, south of Sand Pond. The 8-acre site passed all 10 screening criteria.
- Site **HR-16** is adjacent to HR-17 and passed 6 of 10 screening criteria. However, this parcel is within a 100-year flood zone, consists of shallow depth-to-groundwater, and is within a Priority Habitat zone.
- Site **HR-17** is an abandoned burn dump on Lothrop Road. The property passed 7 of the 10 screening criteria but was found to be within a Priority Habitat zone.
- Site **HR-18** is the location of the town-owner gardens and sheep farm on Sisson Road. It passed 5 of the 10 site screening criteria, however it is located within a delineated wetland area, is coded as protected/ conservation land in the Assessors index, and is within a Priority Habitat zone.
- Site **HR-19** is the Harwich Elementary School on South Street in central Harwich. This 17.4-acre site passed 8 of 10 screening criteria. The site has limited available capacity due to existing infrastructure, and effluent recharge would be limited to subsurface areas below existing ballfields. It is located near the Saquatucket Harbor and Allen Harbor watersheds.
- Site **HR-20** is the town-owner Harwich Community Center on Oak Street. The site passed 9 of 10 site screening criteria and is near the Saquatucket Harbor watershed. Effluent recharge would be limited to beneath the new ball fields.

9.3.2 Outside Watershed Sites

The following sites are located within the Town of Harwich, but not located within any of the MEP designated watersheds.

- Site **OW-1**, located near the Allen Harbor and Herring River watersheds, is owned by the Town. The narrow 6.2-acre site off Earle Road has beach access and a public parking lot on a small portion of the parcel. A small portion of the property is within a Priority Habitat zone. This site passed 9 of the 10 site screening criteria.
- Site **OW-2** is comprised of two privately-owned parcels and includes the Harwich Port Golf Course on South Street. The site passed 7 of the 10 site screening criteria, is privately owned, and is close to the Allen Harbor, Saquatucket Harbor, and Wychmere Harbor watersheds. Effluent recharge would be beneath the golf course fairways.
- Site **OW-3** is a privately-owned property which borders the Saquatucket Harbor watershed. It passed 8 of the 10 site screening criteria but is within a Priority Habitat zone and partially inside a Zone II wellhead protection area.
- Site **OW-4** is a town-owner property which borders the Saquatucket Harbor watershed. It passed 8 of 10 site screening criteria but is within a Priority Habitat zone and Zone II wellhead protection area.
- Site **OW-5** is a privately-owned property in north Harwich, partially located within the Herring River watershed. It passed 6 of 10 screening criteria but is within a Priority Habitat zone and inside a Zone II wellhead protection area.

9.3.3 Saquatucket Harbor

The Saquatucket Harbor (SH) watershed is located in central Harwich. The watershed includes Paddocks Pond and Grass Pond, in addition to small surface water streams and the Bank Street Bogs (Cold Brook), which may be enhanced in the future and utilized for additional nitrogen removal. The Saquatucket Harbor watershed is also the site of Harwich High School (now Monomoy Regional High School). There are six parcels for consideration in this watershed.

- Site **SH-1** is comprised of two adjacent properties owned by the Cranberry Valley Golf Course. While this parcel is partially located within a Zone of Contribution and a Priority Habitat area, it was retained because current site use allows for effluent recharge while maintaining golf course activities. This parcel passed 7 of 10 site screening criteria.
- Site **SH-2** is comprised of two adjacent town-owner properties, including Harwich High School (now Monomoy High School) and the athletic fields. This 103-acre site passed 8 of 10 site screening criteria, though a small portion is within a Priority Habitat zone and within a Zone II wellhead protection area. Because of the existing infrastructure and new school construction, effluent recharge would be limited to beneath existing and future recreational fields.
- Site **SH-3** passed 8 of 10 site screening criteria, though a large portion is located within a Priority Habitat zone.

- Site **SH-4** is a privately-owned property located in central Harwich. It passed 8 of 10 site screening criteria but is within a Priority Habitat zone.
- Site **SH-5** is town-owner property in central Harwich. It passed 9 of 10 site screening criteria, though a small portion of the property is located within a Priority Habitat zone.
- Site **SH-6** is a privately-owned property partially located within the Saquatucket Harbor watershed. This parcel passed 8 of 10 site screening criteria, though it is within a Zone II wellhead protection area, and half of the property is within a Priority Habitat of Rare Species zone.

9.3.4 Pleasant Bay

The Pleasant Bay (PB) watershed is in the eastern portion of Harwich and extends to the adjacent communities of Orleans, Brewster, and Chatham. The Pleasant Bay watershed is comprised of river valley estuaries, barrier beaches and islands, salt marshes, and flats which exchange tidal waters with a large lagoonal estuary. The Pleasant Bay sub-embayment is bounded by Harwich and Brewster to the southwest and northwest, respectively, Orleans and Little Pleasant Bay to the North, and Chatham to the south.

- Site **PB-1** is a town-owner property which passed 8 of 10 site screening criteria, however it is located within a Zone II wellhead protection area and a Priority Habitat zone.
- Site **PB-2** is a town-owner property which passed 8 of 10 site screening criteria, but is located within a Zone II wellhead protection area and a Priority Habitat zone.
- Site **PB-3** is composed of 15 adjacent privately-owned properties. The site is currently used as a gravel pit and passed 8 of the 10 site screening criteria, but it is within a Zone II wellhead protection area.
- Site **PB-4** is a privately-owned property which passed 8 of the 10 site screening criteria but is within a Zone II wellhead protection area.
- Site **PB-5** is composed of two adjacent privately-owned properties which passed 8 of the 10 site screening criteria, however they are located within a Zone II wellhead protection area.
- Site **PB-6** is a town-owner property which passed 8 of 10 site screening criteria, but is partially located within a Priority Habitat zone.
- Site **PB-7** is a privately-owned, undeveloped property in northeastern Harwich located on Halls Way, south of the Captain's Golf Course. This 7.3-acre site passed 9 of the 10 screening criteria.
- Site **PB-8** is a privately-owned property in the Pleasant Bay watershed. It passed 9 of 10 site screening criteria.
- Site **PB-9** is the privately-owned Cape Cod National Golf Course. The site passed 7 of the 10 site screening criteria but includes a portion of a Priority Habitat zone.

9.4 Recommended 10 Sites and HR-18

Input from the WMS, the Planning Department and other town representatives was sought at this stage to help further screen the 40 sites down to a feasible number that could be considered for detailed evaluation. Factors considered included environmental impacts, land-use patterns, proposed future development and institutional knowledge.

All of the criteria used to identify the 40 sites were applied with equal weighting. However, further discussions with the Committee and town representatives indicated that sites falling within a Zone II area to a municipal well or sites that are privately owned should not be rated as highly as sites outside of Zone II areas or town-owned sites. Both of these criteria would have the potential to increase the cost to utilize a given site for effluent recharge. It was also felt that it was important to identify sites within or near each of the major watersheds in town, as this would benefit the development of potential scenarios to deal with sewersheds within each watershed.

Utilizing the above guidance, the identified sites meeting the highest number of the 10 initial criteria (number met noted in parenthesis) are briefly discussed below with the recommendation to either carry into the next phase, or to drop at this stage.

- HR-1 (9): This privately owned site is a gravel pit operation located on the Dennis and Harwich town line. The site is well buffered from residential development. It may provide an opportunity for a regional alternative with Dennis. A portion of the site may have low permeability soils, but its large area may allow for location of infiltration basins on the eastern portion. The site is located about 2,000 linear feet upgradient of Reservoir Pond. This site was carried forward.

- HR-6 (9) and HR-7 (8): Both sites are town owned and located north of Route 6. The sites are in a Priority Habitat area and at the perimeter of an existing Zone II area. The sites are well buffered from residential areas since they abut the highway. The heavily wooded sites are combinations of several town owned parcels which were acquired for conservation purposes. The two sites were carried forward.

- HR-11 (9): This site is where Cape Cod Regional Technical School is located north of Route 6. The majority of the site is built upon and any recharge area would be limited to subsurface areas beneath parking lots and fields. This site was eliminated.

- HR-12 (9): This town-owned site is controlled by the Division of Highways and Maintenance and consists of a heavily wooded 20 acre section to the east where potential infiltration basins could be located. To the west of the site is the town's former capped landfill, and in the middle of the site is where the town is mining material for town projects. The site is located about a 1,000 feet upgradient of some cranberry bogs in the upper reaches of the eastern branch of the Herring River. This site was carried forward.

- HR-13 (9): This site is privately owned and relatively small versus other available sites in this watershed. This site was eliminated.

- HR-14 (9): This site is privately owned and relatively small versus other available sites in this watershed. The site is about a 1,000 feet upgradient from Sand Pond. This site was eliminated.

- HR-15 (10): This site is town owned and relatively small versus other available sites in the watershed. It is also surrounded within 1,000 feet by Sand Pond to the north and Reservoir Pond to the south. This site was eliminated.
- HR-20 (9): This site houses the Harwich Community Center, and the Town recently constructed ball fields in the wooded area behind the building and parking lots. Similar characteristics can be found at the sites to the east (SH-1 and SH-2). This site was eliminated.
- OW-1 (9): This site is a very narrow parcel surrounded by dense residential developments. It is part of a town-owned beach parking lot which would limit the recharge to subsurface systems. This site was eliminated.
- OW-2 (7): This site is the Harwichport Golf Course, which is privately owned. The majority of the course area has shallow depth to groundwater and recharge would be limited to subsurface recharge systems. However, it is the site located closest to the Allen and Wychmere Harbor watersheds and does have the potential for water reuse options during the growing season. This site was carried forward.
- SH-1 (7): This site is the town owned Cranberry Valley Golf Course, which is located on the perimeter of a Zone II to a municipal well. For that reason, the area of focus is the western portion of the site near the driving range. Subsurface recharge systems could be used beneath the driving range or adjacent fairways or water features added in those areas. It also has the potential for water reuse options during the growing season. This site was carried forward.
- SH-2 (8): This site is the Harwich High School parcel. The site contains several ballfields where subsurface recharge could be utilized or wooded areas which could be similarly used for new ballfields. Harwich and Chatham are now constructing the Monomoy Regional High School on this site which would need to be coordinated, and a portion of the site is identified as Priority Habitat area. This site was carried forward.
- SH-3 (8): This site is a town-owned recreation facility site and former water tower location. A large portion of the site is still densely wooded, and it has been identified as a Priority Habitat area. This site was carried forward.
- SH-5 (9): This site is the Harwich Housing Authority and is essentially built out with only limited subsurface recharge sites available. This site was eliminated.
- PB-3 (8): This site is a large privately owned gravel pit area located near East Harwich Center. The site is located within a Zone II to a municipal well. Sufficient area outside mined locations appears to exist to allow infiltration basin recharge to be utilized. This appears to be the best site in the Pleasant Bay watershed and thus was carried forward.
- PB-7 (9): This site is privately owned near the Brewster town line and a subdivision plan has been filed for it. The site is surrounded by densely developed residential areas. This site was eliminated.

- PB-8 (9): This site is also located near the Brewster town line and is completely surrounded by dense residential developments. The site is relatively small versus other available sites in the watershed. It also has the potential for water reuse options during the growing season. This site was eliminated.

- PB-9 (7): This site is partially located in Harwich and partially in Brewster and is the privately owned Cape Cod National Golf Course. The site is relatively high in elevation allowing for sufficient depth to groundwater for subsurface recharge systems that could be installed under some of the fairways. This site was carried forward.

At this stage in the selection process, the Town also considered a wastewater treatment site for an ocean outfall scenario. The HR-18 site, a town-owned property, was selected as a potential wastewater treatment site only. The site does not have to pass as many of the criteria as an effluent recharge site. This site was selected for its location near the proposed ocean outfall in Section 10.

- HR-18 (5) is the location of the town-owner gardens and sheep farm on Sisson Road. It passed 5 of the 10 site screening criteria, however it is located within a delineated wetland area, is coded as protected/conservation land in the Assessor's index, and is within a Priority Habitat zone. This site should be carried forward because it is a town-owned site and is only being considered for a wastewater treatment facility. If this site is utilized, all effluent will be sent to an ocean outfall, minimizing the impacts to sensitive resources on and around this site.

Table 9-3 summarizes the effluent recharge site screening analysis final screening (10 Recharge Sites + 1 WWTF site) noted above. Key environmental criteria are shown in the table.

Figures 9-13 through 9-22 show aerial views of the sites and the areas to be considered for effluent recharge.

9.5 Further Evaluation of Ten Recharge Sites

Further assessment was conducted on the final 10 effluent recharge sites presented in Table 9-3 to assess the size, available acreage, and effluent recharge rates for each location. In this assessment, consideration was made as to which criteria were met in order to determine the feasibility of effluent recharge. The amount of acreage and the type of effluent recharge for each site provides an initial estimate of the site's potential capacity to receive effluent flow.

9.5.1 Available Acreage

The initial estimates of available land area were based on the site screening criteria and input from the Town based on current and anticipated future uses of the site. The available acreage is only a planning level estimate that will need to be further refined during actual site investigations, including hydrogeological evaluations.

Table 9-3
Final Effluent Recharge/WWTF Site

	Site Number	Note	Watershed	Outside of a Priority Habitat?	Outside of a Zone II	Town Owned	Acres	Estimated Available Acreage	Recharge Type (IB), (SUB)	Potential Theoretical Recharge Capacity (gpd)
Recommended Sites										
1	**HR-1**	Gravel Pit	Herring River	X	X	NO	54	5.4	IB	756,000
2	**HR-6**	Undeveloped Woods (HR-6)	Herring River	NO	X	X	14	10.3	IB	1,442,000
3	**HR-7**	Undeveloped Woods (HR-7)	Herring River	NO	NO	X	39	14.2	IB	1,988,000
4	**HR-12**	Structures / Woods (Old Dump)	Herring River	X	X	X	134	20.0	IB	2,800,000
5	**Hr-18**	Structures / Woods (Sisson Road)	Herring River	NO	X	X	30	2.3	NONE	No Recharge Proposed
6	**OW-2**	Fields - Golf course	Outside Watershed	X	X	NO	58	6.9	SUB	276,000
7	**SH-1**	Golf Course (SH-1)	Saquatucket Harbor	NO	NO	X	193	4.3	IB	602,000
8	**SH-2**	Bldgs. / Sports Fields (SH-2)	Saquatucket Harbor	NO	X	X	86	12.0	SUB	480,000
9	**SH-3**	Sports Fields / Woods (SH-3)	Saquatucket Harbor	NO	X	X	18	3.4	SUB	136,000
10	**PB-3**	Gravel Pit / Woods (East Harwich Site)	Pleasant Bay	X	NO	NO	117	10.0	IB	1,400,000
11	**PB-9**	Golf Course	Pleasant Bay	NO	X	NO	80	1.6	SUB	64,000

Potential recharge estimated is based on: 140,000 gpd/acre for Infiltration basin (IB) and 40,000 gpd/acre for subsurface (SUB). These must be confirmed in the field.

Sites Highlighted in Blue are the Final Five Sites Selected For Additional Evaluations in the CWMP

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Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-6

Figure 9-14

CDM Smith

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Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-7

Figure 9-15

CDM Smith

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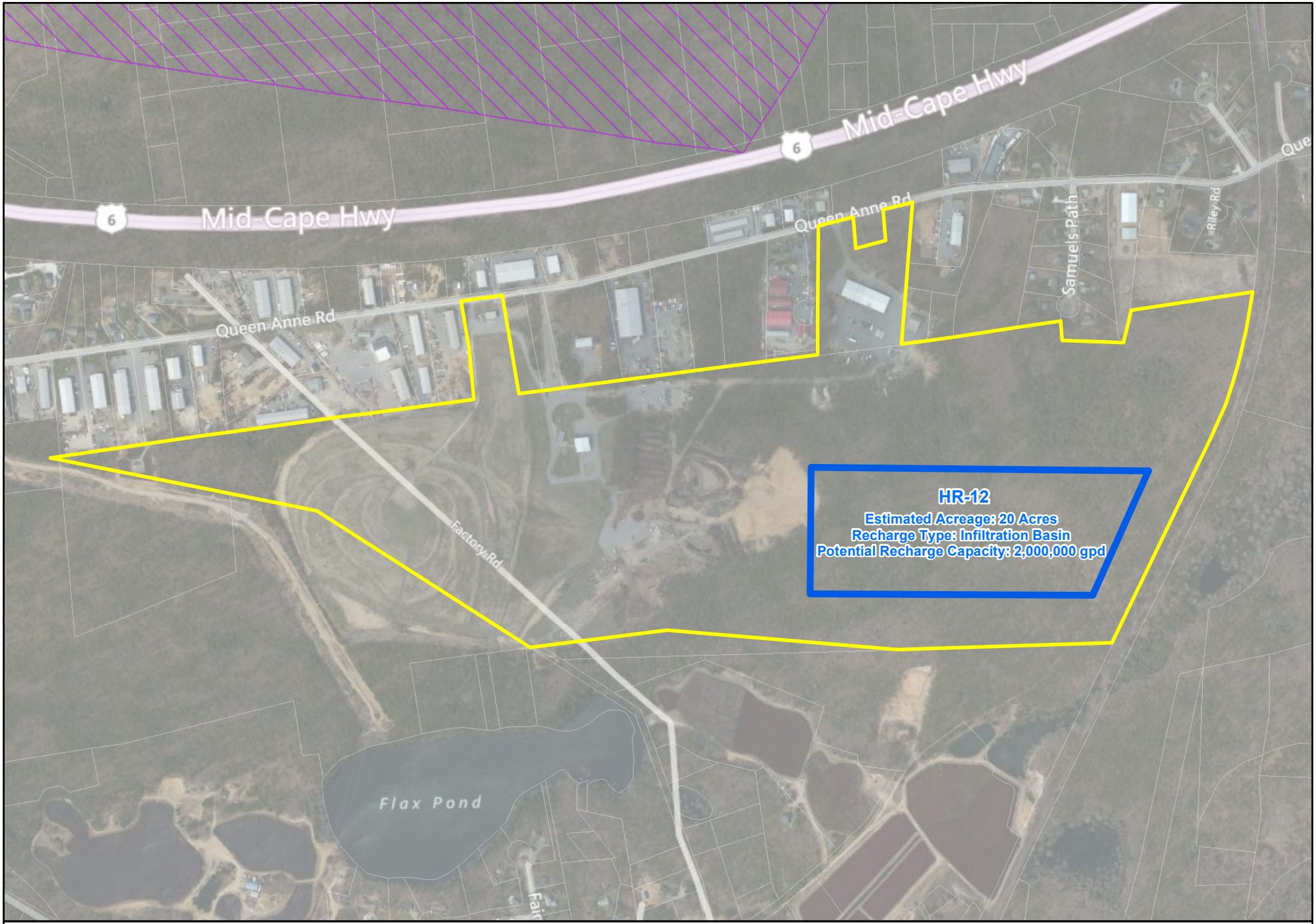

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-12

Figure 9-16

CDM Smith

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Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary OW-2

1 inch = 600 feet

0 300 600 Feet

Figure 9-17

CDM Smith

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Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-1

1 inch = 600 feet
0 300 600 Feet

Figure 9-18

CDM Smith

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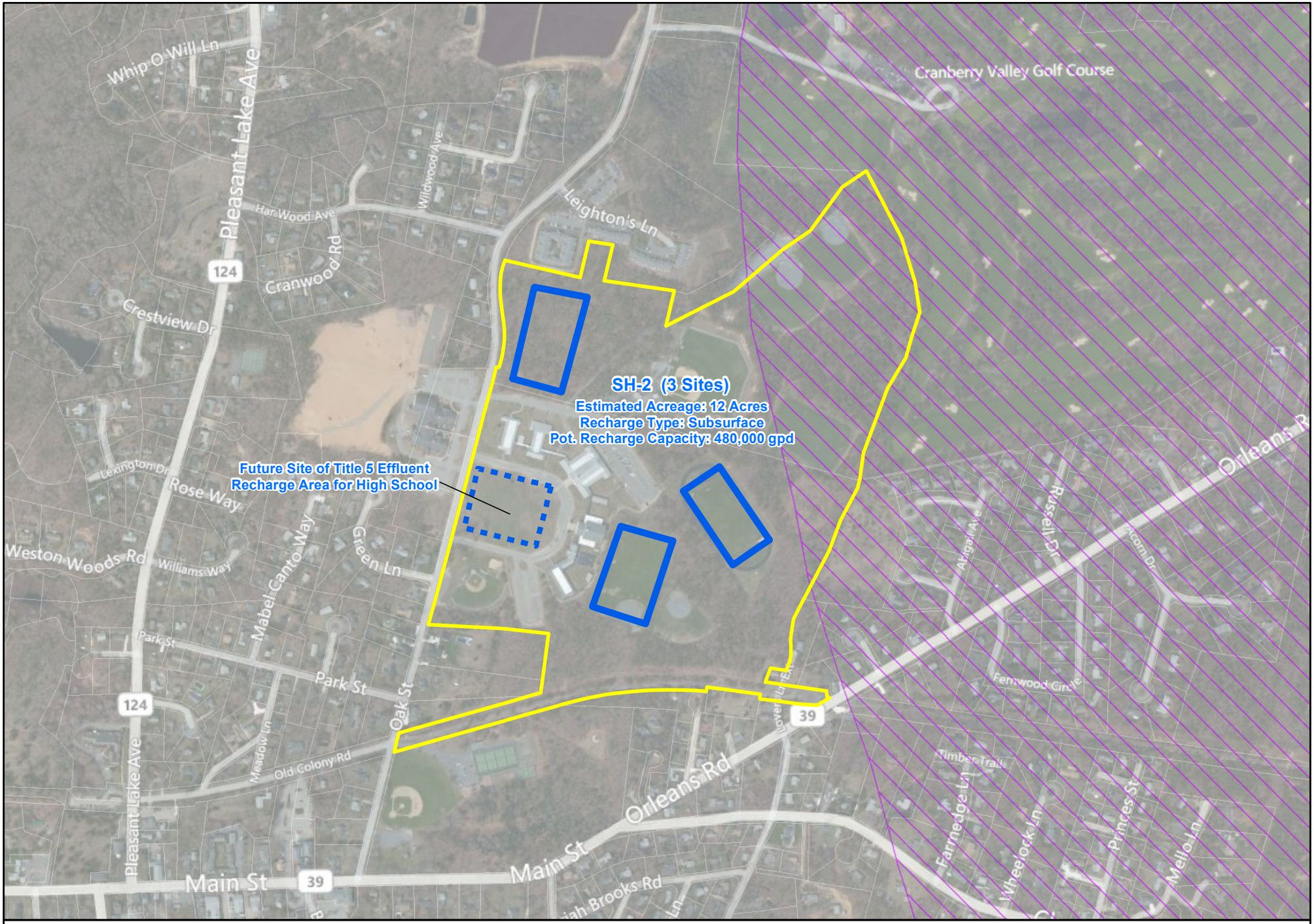

Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-2

1 inch = 600 feet
0 300 600 Feet

Figure 9-19

CDM Smith

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Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-3

1 inch = 600 feet

0 300 600 Feet

Figure 9-20

CDM Smith

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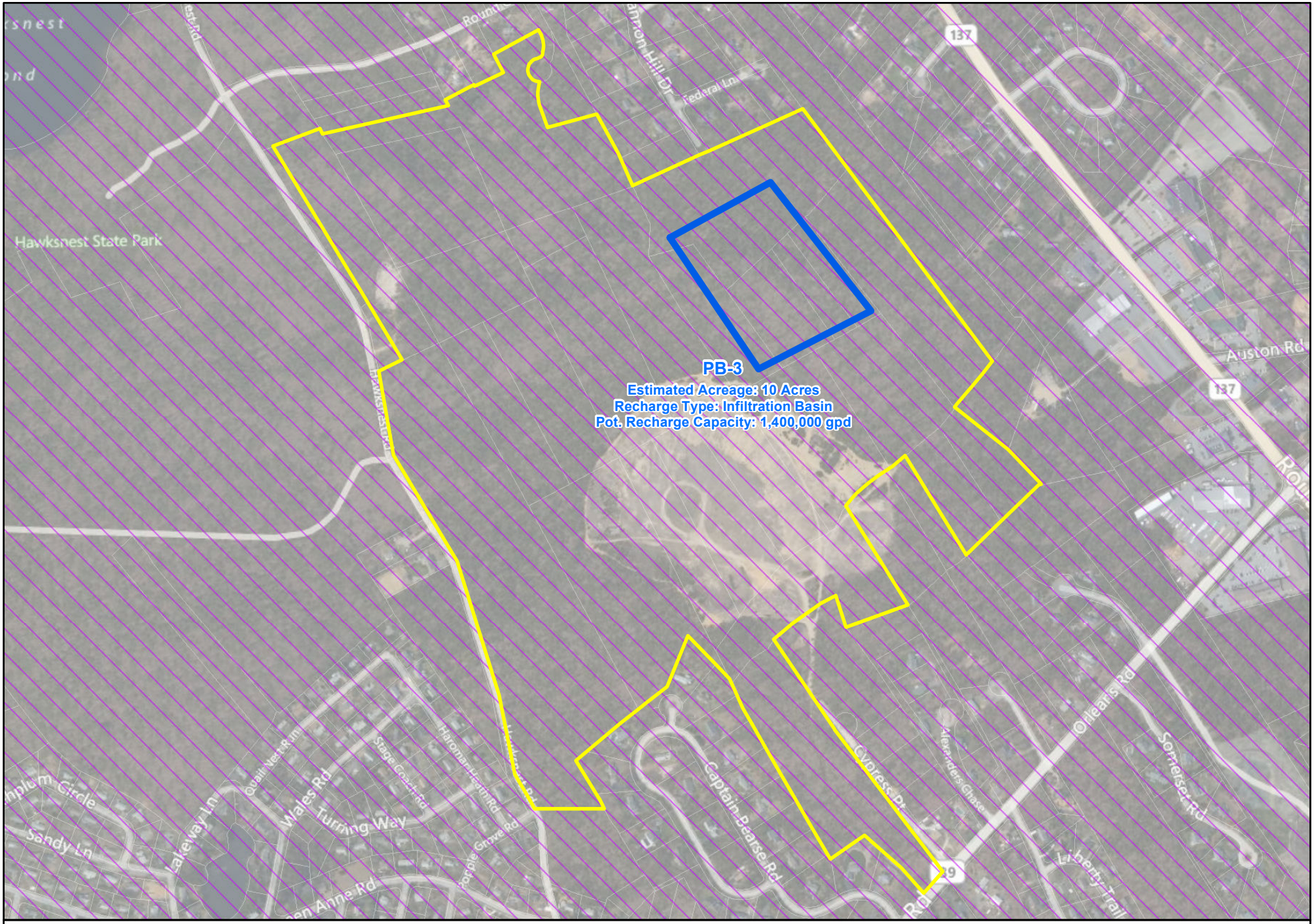

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site PB-3

Figure 9-21

CDM Smith

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9.5.2 Estimated Recharge Rate

The estimated infiltration rate for a site using open infiltration basins for recharge is expected to be in the range of 3 to 5 gallons per day per square foot (gpd/ft^2) of basin area. Using an average loading rate of 4 gpd/ft^2, amounts to approximately 174,000 gpd/acre. However, in order to conservatively account for basin berms, access roads, and other infrastructure within each acre, in addition to natural variations within the soil, the available land area per acre has been adjusted to 34,850 ft^2, or 80% of the 43,560 ft^2 within an acre. Therefore, as a planning-level estimate, one acre is estimated to receive approximately 140,000 gpd.

$$\text{Unit Loading}_{\text{Inf. basin}} = \frac{4\ \text{gpd}}{\text{ft}^2} X \frac{1\ \text{ft}^2\ \text{useable area}}{1.25\ \text{ft}^2\ \text{total area}} X \frac{43{,}560\ \text{ft}^2}{\text{acre}} = 140{,}000\ \frac{\text{gpd}}{\text{acre}}$$

Note: The 1/1.25 (80%) factor in this equation is used to account for berms, access roads, etc.

Unit Loading for Subsurface Recharge

In order to assess unit loading for subsurface recharge, the leaching field is assumed to be a trench system rather than an infiltration bed (IB) system. Each trench is assumed to be approximately 3 feet wide by 2 feet high by 100 feet long in a configuration to allow for 100 percent redundancy.

Trench systems are less efficient with space and require more land per gallon of recharge than infiltration bed systems. Base loading at a rate of 1 gpd/ft^2 equates to approximately 40,000 gpd of wastewater effluent per acre of disposal area. Although the infiltration rate is significantly lower than for open basins, the advantage of subsurface systems is the ability to locate other uses such as ballfields on top of the recharge areas.

Shown in the far-right column of Table 9-3 is a potential theoretical recharge rate for the 10 top-rated sites. The type of recharge assumed (open infiltration basin or subsurface recharge) and the resulting capacity are noted.

9.6 Selection of Top Five Sites for Further Investigation

Based on the information in Table 9-3 and the need to select sites in as many of the different MEP watersheds as possible, to accommodate the different options for sewering described in Section 10, the ten top sites were narrowed to four preferred sites: HR-12, OW-2, SH-2, and PB-3. As described previously, HR-18 was also retained, to be considered for wastewater treatment only, and not effluent recharge.

Site investigations were then performed on the two best sites considered for effluent recharge. These two sites, PB-3 and HR-12, were chosen based on the physical features of each parcel, as well as the ownership and designated land uses at each site. The site investigations discussed in Section 11 evaluate the sites' potential to accept effluent recharge and include additional field work and site visits. Specifically, the site investigations collected detailed field data at the HR-12 site, along with a limited amount of field data at the PB-3 site.