# SECTION 2

# EXISTING CONDITIONS

## 2.1 LAND USE AND DEMOGRAPHICS

Orleans is a predominantly residential community with a concentrated business district. Key land use and demographic data are summarized in Table 2-1 based on 2003 data supplied by the Orleans Planning Department. Figure 2-1 shows the eight zoning districts, and Figure 2-2 illustrates current land uses. The vast area of Orleans' property falls within the residential zoning districts. Commercial activity is focused in the areas along Route 6A between the Brewster and Eastham town lines. There are small areas in East Orleans, South Orleans and at Rock Harbor zoned for rural and marine businesses.

Of the 4,733 developed lots, 85% are developed residentially. Between residential neighborhoods and the apartment and condominiums in the commercial districts, there are 5,069 dwelling units including 12,622 bedrooms. The town is substantially developed; only 11% of the residential lots and 22% of the commercial parcels are vacant. A significant number of vacant lots have been set aside for conservation and other purposes and are not developable.

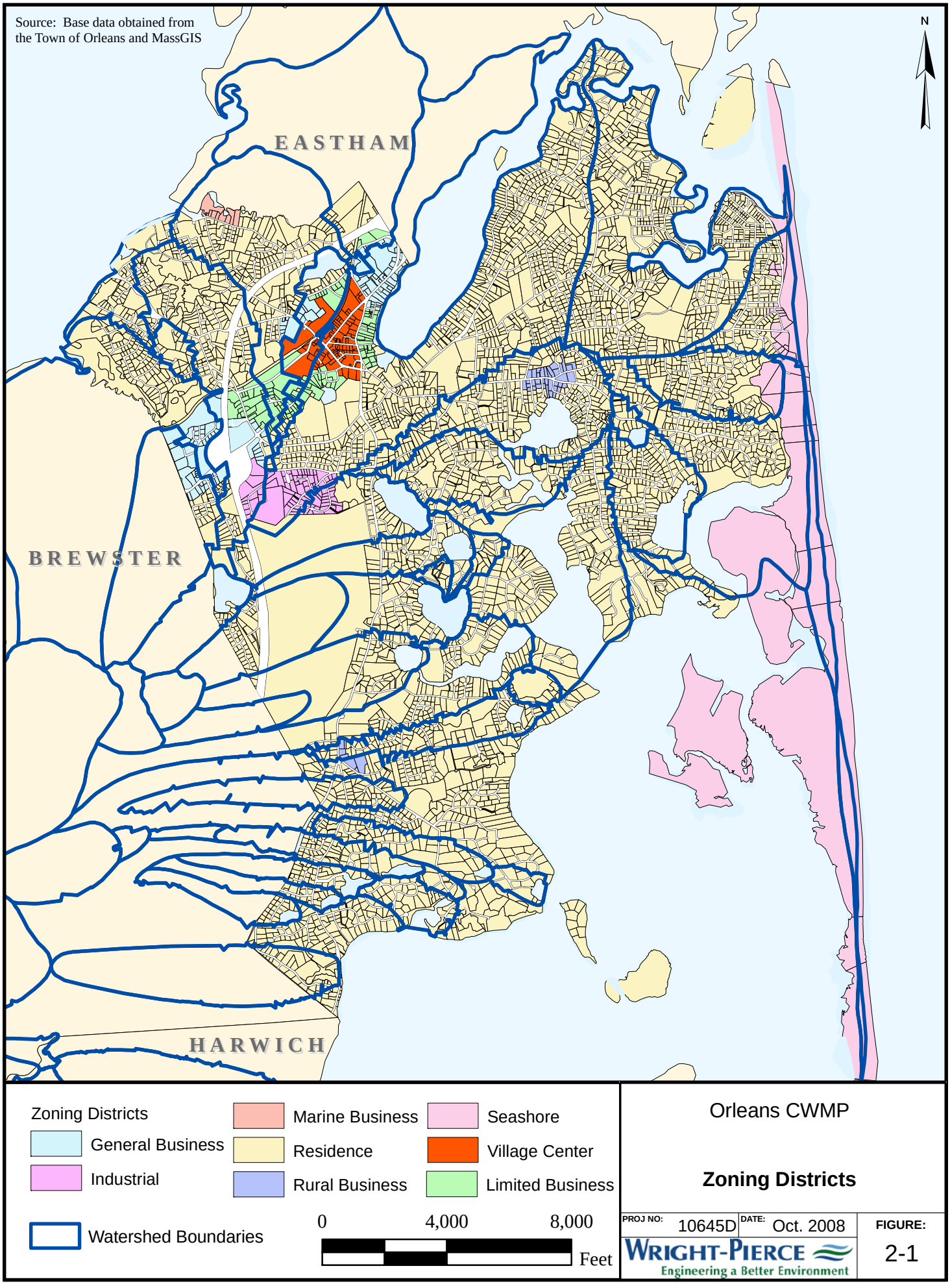
The official state and federal censuses document a permanent year-round population of approximately 7,000 people. Analysis of water use and demographic data by Town staff indicates that Orleans' current population is approximately 10,700 on an annual average basis. This figure represents the average of all months of the year, including about 6,000 in January and about 22,000 in July and August; see Figure 2-3. Town-wide, approximately 40% of the homes are occupied seasonally based on personal property tax data. About 80% of the developed residential properties are located in the Pleasant Bay and Nauset watersheds.

As is typical on Cape Cod, there are many private roads that have not been accepted as public ways. Data from the Planning Department indicates that 45% of the town's year-round parcels and 50% of the seasonal parcels are located on private roads.

## TABLE 2-1
## SUMMARY OF LAND USE AND DEMOGRAPHIC DATA

| | MAJOR WATERSHED | | | | |
|---|---|---|---|---|---|
| | PLEASANT BAY | NAUSET SYSTEM | ATLANTIC OCEAN | CAPE COD BAY SYSTEMS | TOWN-WIDE |
| **Residential** | | | | | |
| Number of Developed Parcels | 2,015 | 1,256 | 115 | 659 | 4,045 |
| Number of Vacant Parcels | 308 | 124 | 14 | 54 | 500 |
| Total Number of Parcels | 2,323 | 1,380 | 129 | 713 | 4,545 |
| | | | | | |
| Developed Lot Area, acres | 2,143 | 1,074 | 79 | 620 | 3,916 |
| Vacant Lot Area, acres | 364 | 148 | 9 | 62 | 583 |
| Total Lot Area, acres | 2,507 | 1,222 | 88 | 682 | 4,499 |
| | | | | | |
| Number of Dwelling Units | 2,215 | 1,430 | 126 | 1,187 | 4,958 |
| Number of Bedrooms | 6,398 | 3,765 | 386 | 1,928 | 12,477 |
| Avg Size of Devel. Lot, acres | 1.06 | 0.86 | 0.69 | 0.94 | 0.97 |
| **Commercial, Industrial and Institutional** | | | | | |
| Number of Developed Parcels | 264 | 186 | 25 | 213 | 688 |
| Number of Vacant Parcels | 91 | 47 | 1 | 50 | 189 |
| Total Number of Parcels | 355 | 233 | 26 | 263 | 877 |
| | | | | | |
| Developed Lot Area, acres | 343 | 369 | 145 | 434 | 1,291 |
| Vacant Lot Area, acres | 146 | 44 | <1 | 98 | 288 |
| Total Lot Area, acres | 489 | 413 | 145 | 532 | 1,579 |
| | | | | | |
| Number of Dwelling Units | 12 | 95 | 1 | 3 | 111 |
| Number of Bedrooms | 59 | 32 | 16 | 38 | 145 |
| **Total** | | | | | |
| Number of Developed Parcels | 2,279 | 1,442 | 140 | 872 | 4,733 |
| Total Number of Parcels | 2,678 | 1,613 | 155 | 976 | 5,422 |
| | | | | | |
| Developed Lot Area, acres | 2,486 | 1,443 | 224 | 1,054 | 5,207 |
| Total Lot Area, acres | 2,996 | 1,635 | 233 | 1,214 | 6,078 |
| | | | | | |
| Total Number of Dwell. Units | 2,235 | 1,525 | 127 | 1,190 | 5,069 |
| Total Number of Bedrooms | 6,457 | 3,797 | 402 | 1,966 | 12,622 |

Source: Orleans Planning Department, 2003 data

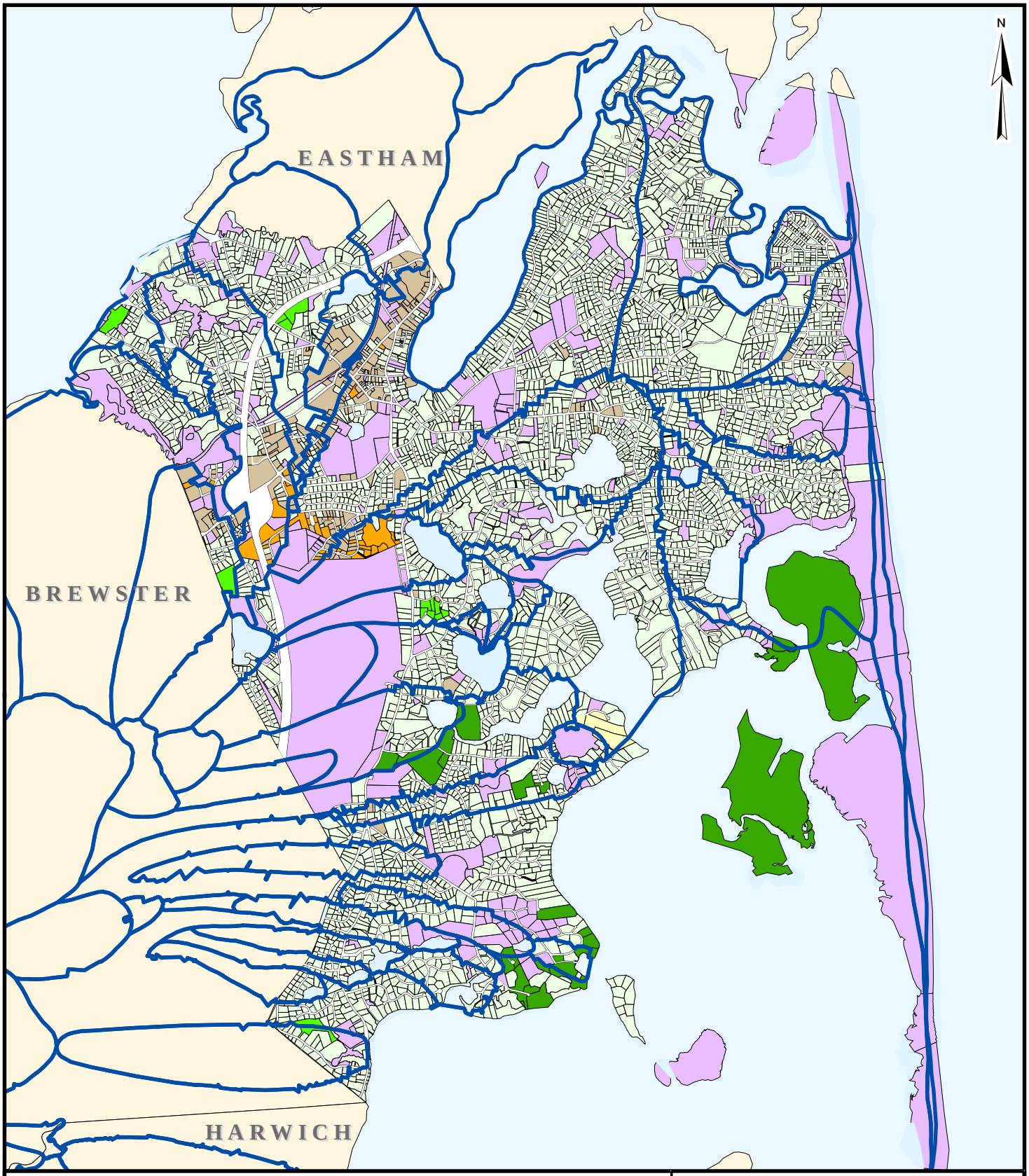



Orleans CWMP

**Zoning Districts**

| PROJ NO: | 10645D | DATE: | Oct. 2008 | FIGURE: |
|---|---|---|---|---|
| WRIGHT-PIERCE Engineering a Better Environment | | | | 2-1 |

Thursday, September 11, 2008 8:05:59 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-1.mxd




## Land Use

- Watershed Boundaries
- Residential
- Commercial
- Industrial
- Agricultural
- Recreational
- Chapter 61
- Public Service

0 4,000 8,000 Feet

Source: Parcel data obtained from the Orleans Planning Dept. Watershed boundaries from MEP.

Orleans CWMP

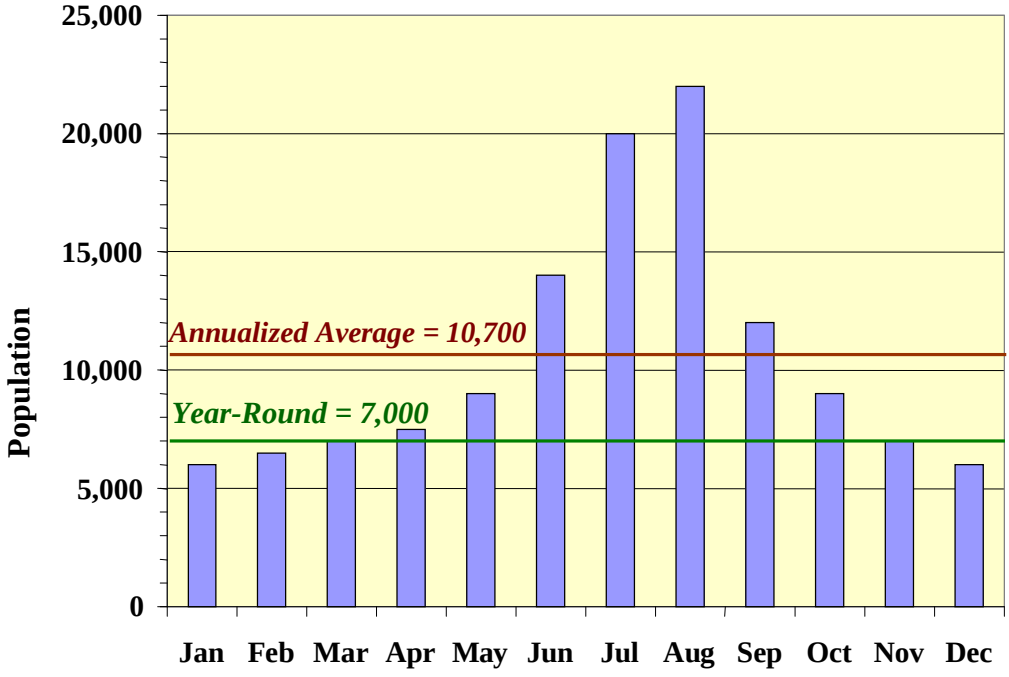
**Land Use**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-2 |

WRIGHT-PIERCE
Engineering a Better Environment

Thursday, September 11, 2008 8:06:49 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-2.mxd

**FIGURE 2-3**
**MONTHLY VARIATION IN RESIDENT POPULATION**




Source: Orleans Planning Dept.

## 2.2 ENVIRONMENTALLY SENSITIVE AREAS

Identification of environmentally sensitive areas (ESAs) is an integral part of the CWMP. Based on review of available Massachusetts Geographic Information System (MassGIS) and Town files, maps, and relevant documents, this summary of ESAs identifies those issues that should be considered when developing the CWMP. These ESAs constitute significant natural resources that may warrant additional investigation and/or protection when considering the effects of nitrogen loading and/or potential wastewater management options across the Orleans landscape. Information is provided below for:

- Watersheds
- Freshwater Ponds
- Coastal Embayments
- Protected Areas

### 2.2.1 Watersheds

Watersheds refer to the areas of recharge and groundwater which flow toward a surface water body, be it a freshwater (lake, pond, wetland) or marine feature (tidal wetland, coastal embayment, open ocean). Due to the sandy soil in most of Orleans, the areas of the natural watersheds correspond strongly to the groundwater contours and flow.

In terms of watersheds, the Town is divided into four areas that drain into Cape Cod Bay, Nauset Harbor, Pleasant Bay, and the Atlantic Ocean. The first three represent the major watersheds. Work by the United States Geological Survey (USGS) has led to further sub-division of the three major watersheds into sub-watersheds for the Town's prominent tidal ponds, inlets and embayments. Figure 2-4 depicts the four major watersheds as well as the sub-watersheds leading to Pleasant Bay and Cape Cod Bay. Further sub-division of the Nauset watershed will be possible when the Massachusetts Estuary Project (MEP) report and underlying databases are made available for this area. The direct watershed of the Atlantic Ocean is not included in the MEP studies. The groundwater in Orleans (and Cape-wide) has been designated as a Sole Source Aquifer by the USEPA.

### 2.2.2 Freshwater Ponds

Orleans is well-endowed with freshwater features, including 63 ponds which cover approximately 220 acres. Most of these ponds are relatively small in size, with only 12 being greater than 5 acres. These include: Bakers Pond, Bolands Pond, Cedar Pond, Crystal Lake, Gould Pond, Ice House Pond, Pilgrim Lake, Sarah's Pond, Shoal Pond, Twinings Pond, Uncle Harveys Pond, and Uncle Seths Pond (see Figure 2-5). Four of these are listed as Great Ponds by the Commonwealth of Massachusetts: Bakers Pond, Cedar Pond, Crystal Lake, and Pilgrim Lake. Eight of these ponds will be further analyzed as part of the needs assessment: Bakers Pond, Bolands Pond, Cedar Pond, Crystal Lake, Ice House Pond, Pilgrim Lake, Shoal Pond and Sarah's Pond.

Historical water quality information prior to the 1970s is sparse for most Orleans ponds, and consists mainly of state assessments of depth profiles of temperature and dissolved oxygen levels for acceptable trout habitat. Publicly-available information on water quality for the 12 ponds listed above and 5 additional smaller ponds is summarized in the Cape Cod Commission's *Cape*


## Major Basin

- Atlantic Ocean
- Cape Cod Bay
- Nauset System
- Pleasant Bay

Source: Aerial imagery provided by MassGIS.
Watershed boundaries from MEP.

0 4,000 8,000 Feet

Orleans CWMP

**Major Groundwater Basins**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-4 |

WRIGHT-PIERCE
Engineering a Better Environment

Tuesday, September 23, 2008 7:34:22 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-4.mxd


Principal Fresh Water Ponds

Source: Aerial imagery provided by MassGIS.

0 4,000 8,000 Feet

Orleans CWMP

**Freshwater Ponds**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-5 |

WRIGHT-PIERCE
Engineering a Better Environment

Thursday, September 11, 2008 8:08:26 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-5.mxd

*Cod Lake and Pond Atlas*. The water quality data, based on the 2001 Pond and Lake Stewards (PALS) summer survey, include key trophic indicator parameters: total phosphorus (TP), total nitrogen (TN), chlorophyll *a* (chl *a*), and Secchi disk transparency (SDT) depth readings. Some additional water chemistry for relevant Cape Cod ponds is also available.

The Commission used an USEPA method and the sampling results from the 2001 PALS snapshot to estimate Cape-Cod-specific nutrient reference criteria. Comparison of the 2001 PALS data to these reference threshold data indicated that, of the 17 Orleans ponds sampled, all were classified as "impacted" for at least one of the following parameters: chlorophyll a, total nitrogen, or total phosphorus. It is important to note that USEPA's use of the term "impacted" is not equivalent to impairments as defined under the state water quality standards, although available data does show some correlation. The USEPA method picks the lower 25$^{th}$ percentile from all available data as the threshold. This method has some notable limitations (e.g., accounting for macrophyte influence), but its results on Cape Cod generally match other data developed in the northeast and USEPA analysis of data within the eastern US coastal ecoregion. Individual assessments of each pond is a preferred approach, but this type of analysis can be useful for ponds with limited water quality data. Further evaluation of water quality, trophic status, and the potential susceptibility to current and future land uses is provided in Section 3.4.1 and Appendix A.

More detailed evaluation of the morphological features and conditions of the three larger ponds (Bakers, Crystal and Pilgrim) is provided in the *Cape Cod Lake and Pond Atlas* with bathymetric maps. All three of the water bodies were considered impacted. Varying amounts of information is available for other Orleans ponds regarding bathymetry, average depth and pond volume. The most complete study of an Orleans pond is the *Baseline Water Quality Study for Crystal Lake*, which synthesizes chemical, physical and biological conditions of the lake, as well as describing the nature and character of the watershed.

In addition to the PALS water quality "snapshot" data for Orleans ponds, water quality data and field observations were collected over the summer of 2002 to 2005. These water quality samples

and observations were made by Orleans volunteers with the oversight, laboratory services, and cooperation of the Cape Cod Commission, the Cape Cod National Seashore, and UMass Dartmouth's School of Marine Science and Technology (SMAST). To date, this effort includes over 600 water quality samples collected from over 17 ponds in Orleans along with over 1,800 complementary field data points (dissolved oxygen, temperature) during the past four summers. These data have been analyzed and interpreted by Commission staff with regard to selected ponds' hydrologic and nutrient budgets, trophic status, and recommended changes in current management practices and monitoring activities. A document presenting the data summary and preliminary results (*Review and Interpretation of Orleans Ponds Volunteer Monitoring Data*) was issued in draft form in September 2006.

### 2.2.3 Coastal Embayments

Coastal embayments, tidal creeks and inlets are important features of the Town of Orleans, which has an abundance of coastal shoreline. The more significant coastal embayments, inlets and major water bodies include: Areys Pond, the Atlantic Ocean, Cape Cod Bay, Little Namskaket Creek, Little Pleasant Bay, Lonnies (or Kescayogansset) Pond, Meetinghouse Pond, Mill Pond, Namskaket Creek, Nauset Harbor, Namequoit River, Paw Wah Pond, Pleasant Bay, Pochet Inlet, Quanset Pond, Rock Harbor, The River, and Town Cove (see Figure 2-4).

These marine features and their biological resources have been the focus of much attention in Orleans and neighboring towns due to their status as nitrogen-sensitive waters and their functional role as important environmental indicators of potential eutrophication due to land use influences. Extensive information and databases on these water bodies, their current water quality and biological conditions, trophic status, current and projected nutrient loads from their watersheds, and potential management implications, are being developed as part of the MEP modeling and TMDL (Total Maximum Daily Load) process.

All of the coastal embayments impacted by Orleans are included in the Massachusetts Estuaries Project. A series of reports containing watershed-specific information, nutrient loads, modeling analyses, and underlying databases is being developed by SMAST; one each for Pleasant Bay, and the Nauset system and three for individual Cape Cod Bay systems. The Pleasant Bay

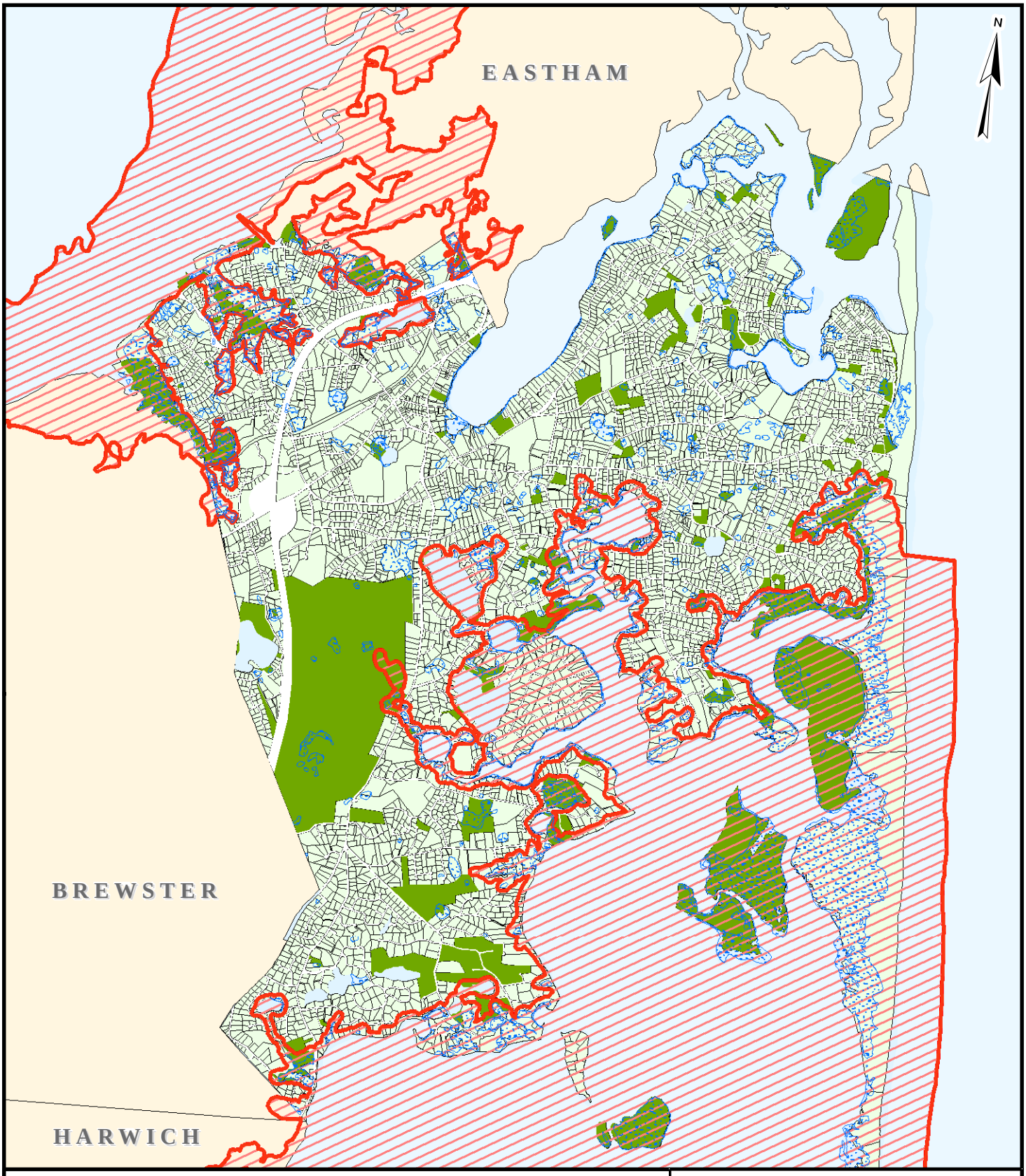
technical report was issued for public comment in 2006 and the Cape Cod Bay reports in 2008. The Nauset report is expected to be issued by late 2008. These reports, which provide an evaluation of water quality and the potential susceptibility to current and future nitrogen loadings, have been or will be reviewed and the relevant findings incorporated into the Orleans CWMP. Following completion of the MEP technical reports, DEP and EPA propose and then adopt nitrogen-based TMDLs that establish the nitrogen loads below which water quality impairment will not occur. These TMDLs form the regulatory basis for potential enforcement actions against towns that do not provide for appropriate control of nitrogen loads.

### 2.2.4 Protected Areas

Environmentally sensitive areas include protected areas such as Areas of Critical Environmental Concern (ACECs), wetlands, cranberry bogs, shellfishing areas, outstanding resource waters (ORWs), and protected lands. These areas were identified through analysis of Town GIS mapping provided by the Planning Department, and through mapping available from the MassGIS. These protected areas are shown on Figures 2-6 and 2-7 and described below.

#### *Areas of Critical Environmental Concern*

ACECs are natural communities that have been nominated and designated for recognition due to the presence of critical resources, wildlife habitat and scenic landscapes, among other features. The Town of Orleans includes portions of two ACECs: Pleasant Bay and Inner Cape Cod Bay (Figure 2-6). The Pleasant Bay ACEC was designated in 1987 and encompasses 9,240 acres in Brewster, Chatham, Harwich, and Orleans. The Pleasant Bay ACEC comprises approximately 6,600 acres in Orleans (72 percent of its total acreage) and includes the Namequoit River, The River, Crystal Lake, and Pilgrim Lake, as well as numerous wetlands, creeks, salt marshes, tidal flats and barrier beaches that discharge into, or border upon Pleasant Bay. The Inner Cape Cod Bay ACEC was designated in 1985 and encompasses 2,600 acres in Brewster, Eastham, and Orleans. Approximately 750 acres of this ACEC are located within Orleans and include Cedar Pond, as well as several tidal creeks, salt marshes and barrier beaches that discharge into, or border upon Cape Cod Bay.




DEP Designated Wetland

Area of Critical Environmental Concern

Open Space

Source: Parcels and Wetland data were obtained from Orleans Planning Dept.
Aerial imagery, open space, and ACEC provided by MassGIS.

0 4,000 8,000 Feet

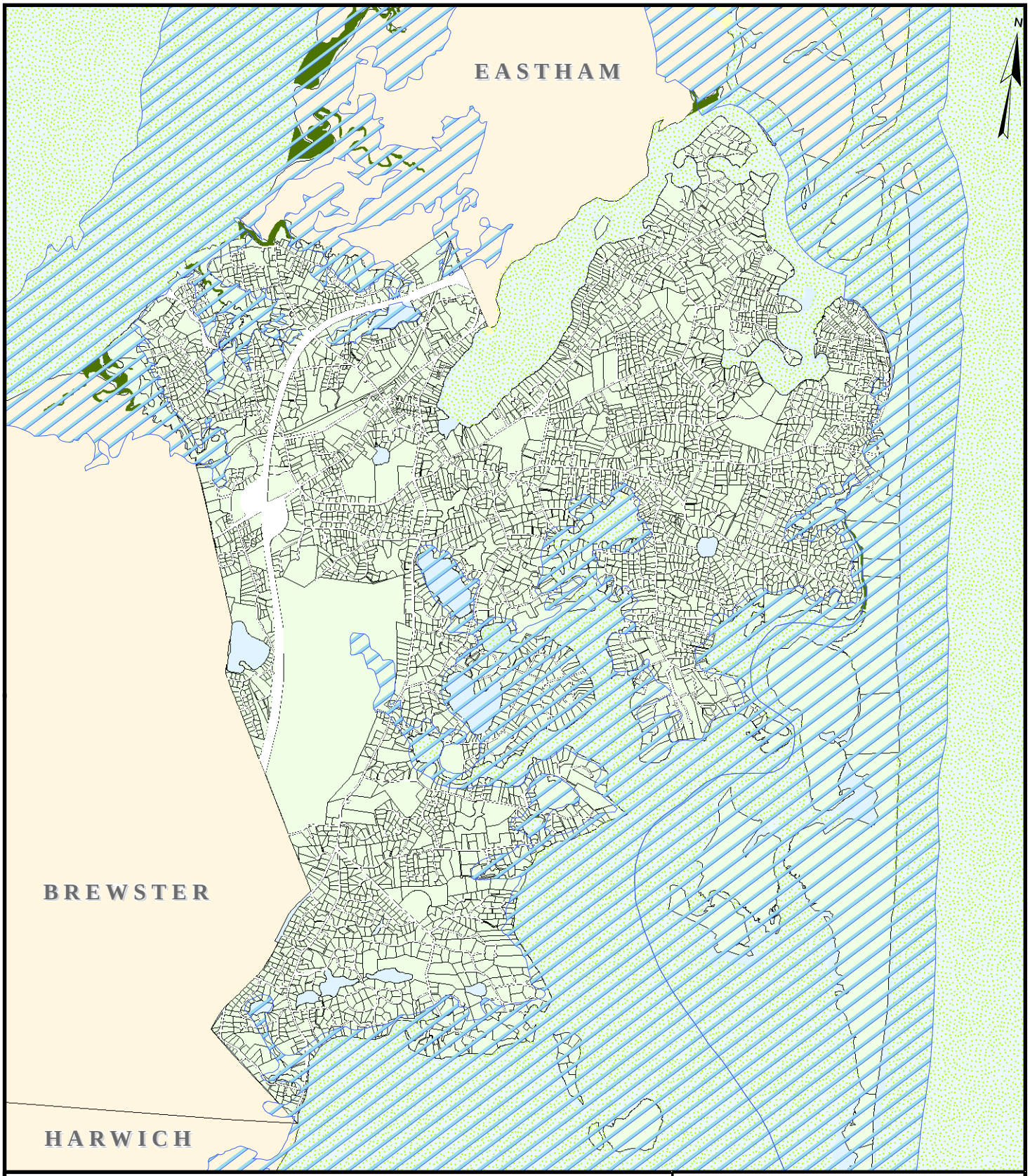
Orleans CWMP

**ACECs, Wetlands, and Open Space**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-6 |

WRIGHT-PIERCE
Engineering a Better Environment

Tuesday, September 23, 2008 7:36:55 AM W:\GIS_Development\Projects\10645B-OrleansRecommendationPlan\Fig2-6.mxd




Approved Shellfish Growing Area

Prohibited Shellfish Growing Area

Outstanding Resource Waters

Source: Parcel data obtained from Orleans Planning Dept. Aerial imagery and growing areas provided by MassGIS.

0 4,000 8,000 Feet

Orleans CWMP

**Outstanding Resource Waters and Shellfish Growing Areas**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-7 |

WRIGHT-PIERCE
Engineering a Better Environment

Thursday, September 11, 2008 8:09:49 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-7.mxd

***Wetlands***

According to the Massachusetts DEP wetlands mapping, approximately 340 acres of freshwater wetlands are located in the Town of Orleans (Figure 2-6). Freshwater wetlands include marshes, shrub or wooded swamps, wet meadows and bogs. Wetland resource areas in Orleans also include approximately 220 acres of freshwater ponds including two Great Ponds of more than 10 acres (Crystal Lake and Pilgrim Lake), 940 acres of salt marsh, and 20 acres of cranberry bogs.

***Parks, Open Space and Conservation Lands***

Currently, almost 30 percent (2,600 acres) of land in Orleans is designated open space or protected lands (Figure 2-6). Of these 2,600 acres, approximately 1,000 acres are privately-owned open space land, including private land trusts and the Orleans Conservation Trust which manages land owned in fee and held in conservation restrictions. Approximately 1,600 acres of open space is publicly owned, including approximately 75 acres of federal and state-owned lands (land owned or protected by conservation constructions) and the remainder of town-owned lands (land owned in fee or protected by conservation restrictions). Federal and state-owned lands of significance include the Cape Cod National Seashore, Sampson Island and Hog Island, which are managed by the National Park Service; and Nickerson State Park and Campground in Brewster, which is managed by the Massachusetts Department of Conservation and Recreation and which covers a portion of the watersheds of Orleans' water supply wells.

***Shellfishing***

Electronic mapping of shellfish areas is not yet available from the Town of Orleans. MassGIS has an available data layer of designated shellfish growing areas. This data layer depicts areas of potential shellfish habitat and their respective harvest classification. According to this information, the tidal waters in Orleans are classified as “Approved,” which is indicative of general compliance with applicable water quality standards (Figure 2-7). However, the Town does have a posted list of shellfish closures (effective November 2005) which includes 6 shellfish areas that were closed to harvesting. As of early 2007, 80 acres of shellfish areas were closed.

The Town has issued 24 licenses to private aquaculture operators who harvest shellfish in Orleans waters, predominantly in Pleasant Bay near the mouth of Pochet Creek.

***Outstanding Resource Waters***

ORWs constitute water bodies that are designated for protection under Massachusetts surface water quality standards due to high ecological, recreational, or aesthetic values. ORWs include drainage sub-basins, water supply watersheds, and ACECs. All tidal waters in the town are mapped as ORWs, with the exception of Town Cove, Rachel's Cove, Woods Cove, Little Cove, Mill Pond, Roberts Cove, and portions of Nauset Harbor (Figure 2-7).

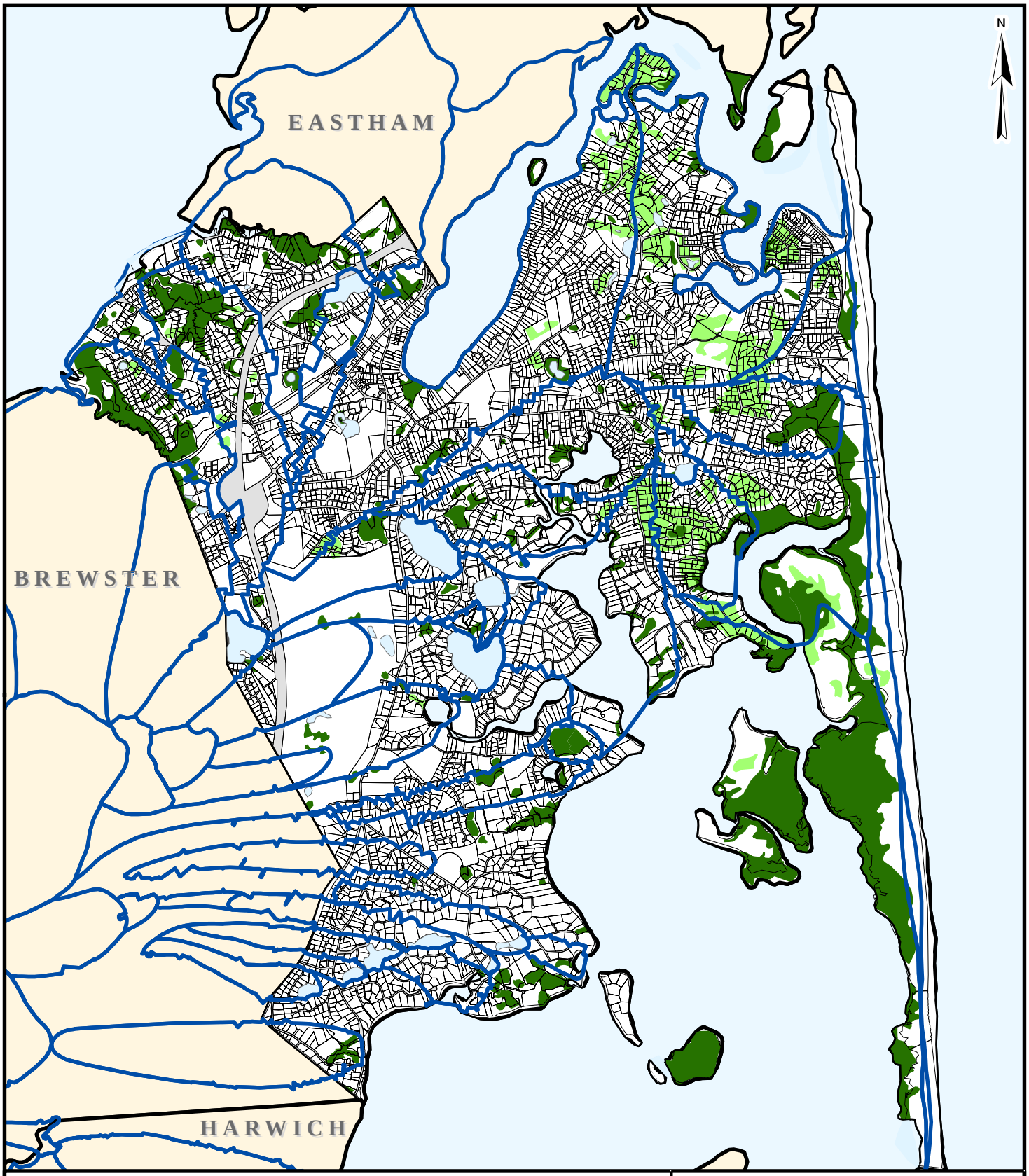
## 2.3 SOILS

Soil conditions are important in selecting sites for effluent disposal and in screening for sanitary needs related to Title 5 compliance. The rate at which effluent can percolate through soil directly impacts the size and design of effluent disposal systems and the viability and longevity of an on-site septic system.

From the standpoint of wastewater collection, treatment and disposal, most of the Cape benefits from sandy soils. Problems associated with bedrock do not exist and boulders tend to be the only similar construction impediment. Problems associated with peat and muck are in limited areas, largely associated with wetlands.

Soils identification begins with the classifications used by the Natural Resources Conservation Service (NRCS). Overall, poorly-drained soils are not suited for large-scale effluent disposal and may be acceptable for siting individual systems only with special design considerations and Title 5 variances. It is common for soils rich in peat or loam to support natural wetlands where groundwater remains at or near the surface for part or all of the year. Most commonly, well-drained soils are a considerable distance above the groundwater table. Well-drained soils are most desirable for siting wastewater facilities. When selecting sites for effluent disposal, sites with well-drained soil should take priority over sites that have moderately drained material.

The majority of soils in Orleans are well drained and consist of sands and silty sands. Moderately well drained soils are typically loamy sands; poorly drained soils are classified as peat- or muck-based which are predominately associated with wetlands. Figure 2-8 highlights the location of soil type by these three major categories. The approximate area covered by these types of soil town-wide is listed below.




Well Drained Soils
Moderately Drained Soils
Poorly Drained Soils
Watershed Boundaries

Source: Parcel data obtained from Orleans Planning Dept. Watershed boundaries from MEP. Soils data obtained from MassGIS.

0 4,000 8,000 Feet

Orleans CWMP

**Soil Conditions**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-8 |

WRIGHT-PIERCE
Engineering a Better Environment

Thursday, September 11, 2008 8:10:28 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-8.mxd

| | |
|---|---|
| Well drained soils | 80 % |
| Moderately well drained soils | 14 % |
| Poorly drained soils | 6 % |

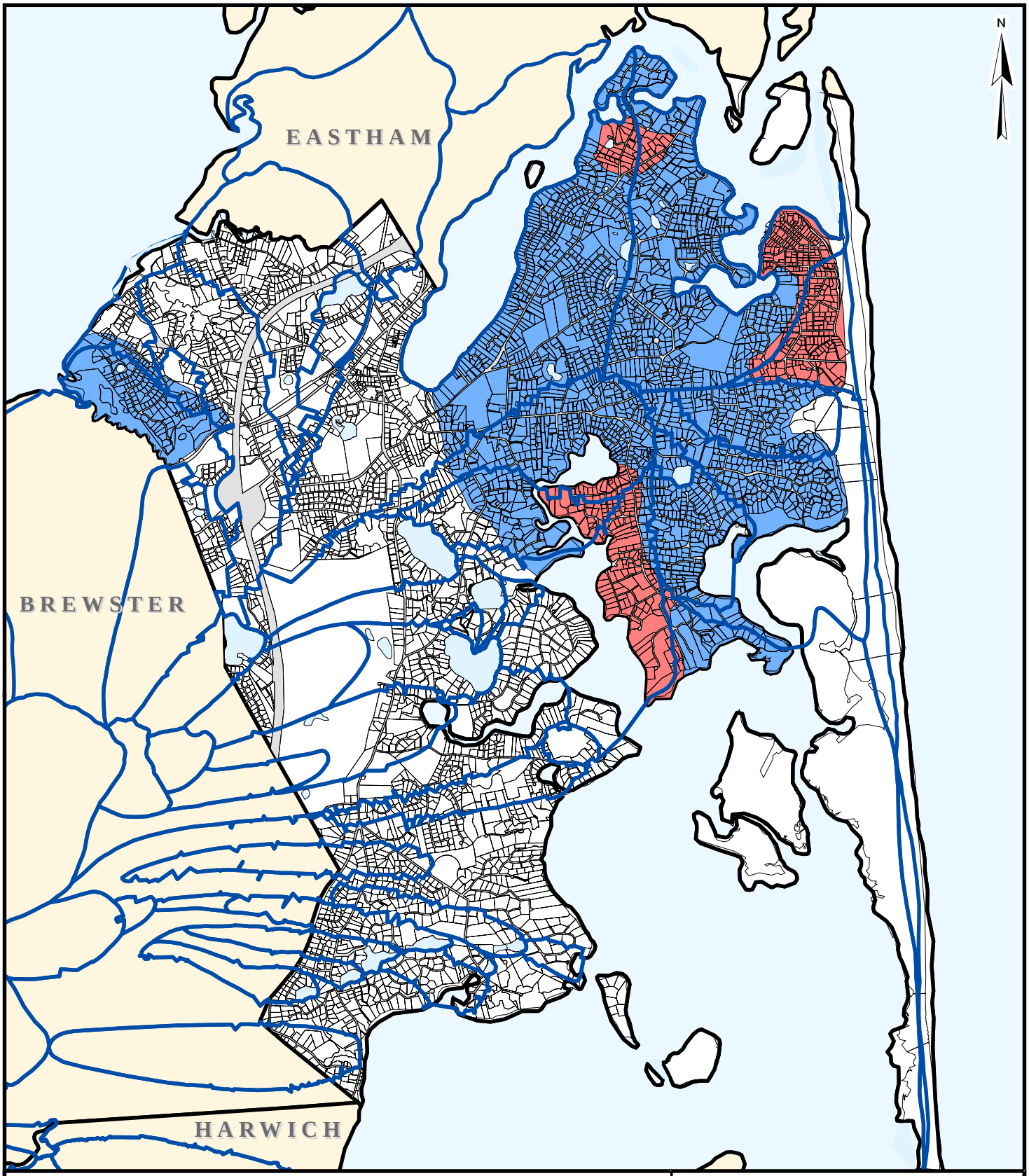
The NRCS data serve as a starting point for determining soil suitability. NRCS usually only classifies the top-most soil strata. Subsurface explorations including test pits and borings are mandatory during later phases of the CWMP process once a number of sites have passed initial screening. Further investigations will also yield valuable information such as: accurate readings of seasonal groundwater, specific classification of deeper soil strata, and permeability rates from small scale testing.

Compared to many towns in New England, Orleans has significant amounts of well-drained soil. Without considering the availability of land, it is clear that good soils exist in each sub-watershed. The Pochet Inlet and Cape Cod Bay sub-watersheds have the greatest area of poorly-drained soils. Figure 2-8 is a valuable overlay for the evaluation of site suitability in all phases of the CWMP.

## 2.4 GROUNDWATER

Groundwater quality is generally good in Orleans. Documented contaminant plumes exist at the town landfill (Town Cove sub-watershed), at the Tri-Town Septage Treatment Facility (Namskaket Creek), Hopkins Cleaners (Rock Harbor) and the Getty gas station (Town Cove). Concerns exist over possible dumping at a gravel pit in Brewster that is located within the Zone II of municipal supply Well 7, but the exact nature of any possible contamination has not been determined.

Figure 2-9 shows those areas of town where silt and clay soils create a perched groundwater condition that impacts septic system siting and design. This figure is derived from non-site-specific anecdotal information and is intended to depict general areas only. Areas of perched water are regularly encountered on the west side of Barley Neck and the Nauset Heights neighborhood. The potential for perched water exists throughout East Orleans and in the Namskaket Creek watershed. The general locations of perched water shown in Figure 2-9 are




Perched Water Often Encountered

Perched Water Potential

Watershed Boundaries

Source: Parcel data obtained from Orleans Planning Dept. Watershed boundaries from MEP. Perched water areas from Orleans Health Dept.

Note: Perched Water data is very approximate and is intended for general planning uses only.

0 4,000 8,000 Feet

Orleans CWMP

**Perched Water Table**

| PROJ NO: | DATE: | FIGURE: |
|---|---|---|
| 10645D | Oct. 2008 | 2-9 |

WRIGHT-PIERCE
Engineering a Better Environment

Thursday, September 11, 2008 8:11:07 AM W:\GIS_Development\Projects\10645B-Orleans\RecommendationPlan\Fig2-9.mxd

supported by data generated by the Cape Cod Commission (*Orleans Water Table Mapping Project*, 1995).

## 2.5 WATER USE AND WASTEWATER FLOWS

The Orleans Planning Department has compiled a database that includes parcel-by-parcel information on lot area, building coverage, zoning designations, build-out data, and water use. The information on water use spans four years, from mid 2002 to mid 2005, and the average daily consumption of 880,00 gallons per day (gpd) over that period has been used as the basis for estimating town-wide wastewater flows.

Billed water use during the period of 2002 to 2005 varied considerably. Most of the variability is believed to be associated with weather conditions that impact the quantities of water used in irrigation. An analysis of the data indicates that the water used for lawn watering, car washing, and other uses that do not contribute to the wastewater flow (collectively called "consumptive use") makes up approximately 13% of the total water use in the residential sector. Therefore residential wastewater flow has been computed as 87% of the average water use for the period. Based on literature sources, it has been assumed that 95% of commercial water use becomes wastewater. This analysis leads to estimates of current town-wide wastewater flows, expressed as annual averages in gallons per day, as follows:

| | |
|---|---|
| Residential | 608,000 gpd |
| Commercial, etc. | 171,000 gpd |
| Total | 779,000 gpd |

In this report, the term "commercial" is used as "short-hand" for commercial, light industrial and institutional land uses; in essence all land uses except residential.

The town-wide total of 779,000 gpd represents the best estimate of all the wastewater currently generated in Orleans. The vast majority of that flow is treated and disposed of in individual on-site systems (generally septic tanks and leaching facilities). Some of the wastewater is treated to a higher level in individual treatment systems (often called "I/A" or innovative/alternative

systems) or in modular satellite treatment plants, such as the one that serves the Community of Jesus near Rock Harbor. Town-wide, 97% of the wastewater is disposed of through conventional Title 5 systems; just over 2% in I/A or satellite systems and less than 1% through tight tanks.

It is important to recognize how the residential wastewater generation rates in Orleans vary by size of home and seasonal use. Table 2-2 shows how wastewater flow from residential properties increases based on the size of home, measured by the number of bedrooms. Seasonal homes on average produce about 75% of the wastewater generated at year-round homes, reflecting contrasting factors of reduced periods of occupancy and more intensive use when

**TABLE 2-2**
**CURRENT WASTEWATER FLOWS PER LOT**

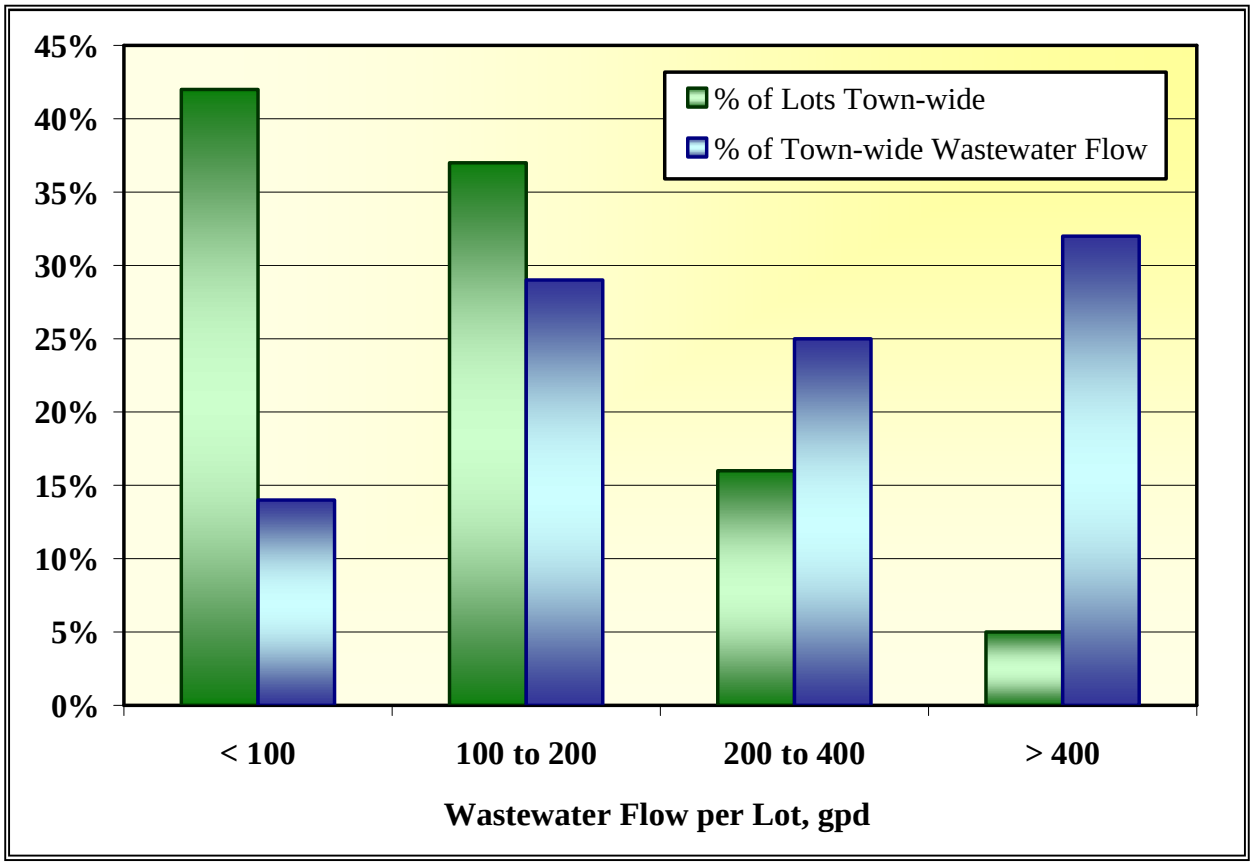
| | Flow By Type of Occupancy, gpd | | |
|---|---|---|---|
| **Type of Use** | **Year-Round** | **Seasonal** | **Town-wide** |
| | | | |
| **Residential** | | | |
| Single-Family Homes | | | |
| 1 and 2 Bedrooms | 110 | 78 | 95 |
| 3 Bedrooms | 142 | 101 | 125 |
| 4 Bedrooms | 163 | 132 | 150 |
| 5 Bedrooms | 197 | 179 | 190 |
| 6 or more Bedrooms | 329 | 143 | 201 |
| Overall | 143 | 107 | 128 |
| Multi-Family Homes | 313 | 259 | 287 |
| | | | |
| **Commercial** | | | 563 |

Note: Based on 3,950 residential parcels and 35 commercial parcels with public water service.
Source: Orleans Water Department, 2002 to 2005 data.

occupied. In creating the lot-by-lot database of wastewater flows, the figures in Table 2-2 were used to estimate the wastewater flows at homes served by private wells, where public water use data are not available. Figure 2-10 illustrates the distribution of Orleans properties by wastewater flow. 79% of the developed lots produce less than 200 gallons per day per lot. Interestingly, 32% of the town-wide wastewater flow is generated on 5% of the properties, those that produce greater than 400 gallons per day per lot.

Based on estimates of current population, the Town's water use data indicates an average per-capita water use of 65.3 gpd. Using the estimates of consumptive use noted above, this figure translates to an average per-capita wastewater flow of 56.8 gpd. These per-capita figures, and the per-property data summarized in Table 2-2, are consistent with reported water use and wastewater generation rates from other Cape Cod towns.

**FIGURE 2-10**
**CURRENT WASTEWATER FLOW PER LOT**




Notes: Based on metered water use and estimates of private water use.
Includes separate estimates of consumptive use for residential and commercial lots.
Source: Orleans Water Department, 2002 to 2005 data.

The database can be queried to determine the distribution of wastewater flows by major watershed, with the following results:

| | |
|---|---|
| Pleasant Bay | 39% of wastewater (307,000 gpd)<br>62% of land area<br>1.06-acre average residential lot size |
| Nauset System and Atlantic Ocean | 34% of wastewater (266,000 gpd)<br>23% of land area<br>0.84-acre average residential lot size |
| Cape Cod Bay Systems | 27% of wastewater (206,000 gpd)<br>15% of land area<br>0.94-acre average residential lot size |

The wastewater flow distribution is shown graphically in Figure 2-11. These figures reflect the relative lot sizes and intensity of development across town. The Pleasant Bay watershed covers more than 60% of Orleans' land area, but currently produces only 39% of the wastewater flow. The more heavily developed areas in town, including the commercial districts, are located in the Nauset and Cape Cod Bay watersheds. Nearly 90% of the town's commercial wastewater is generated in these two watersheds.

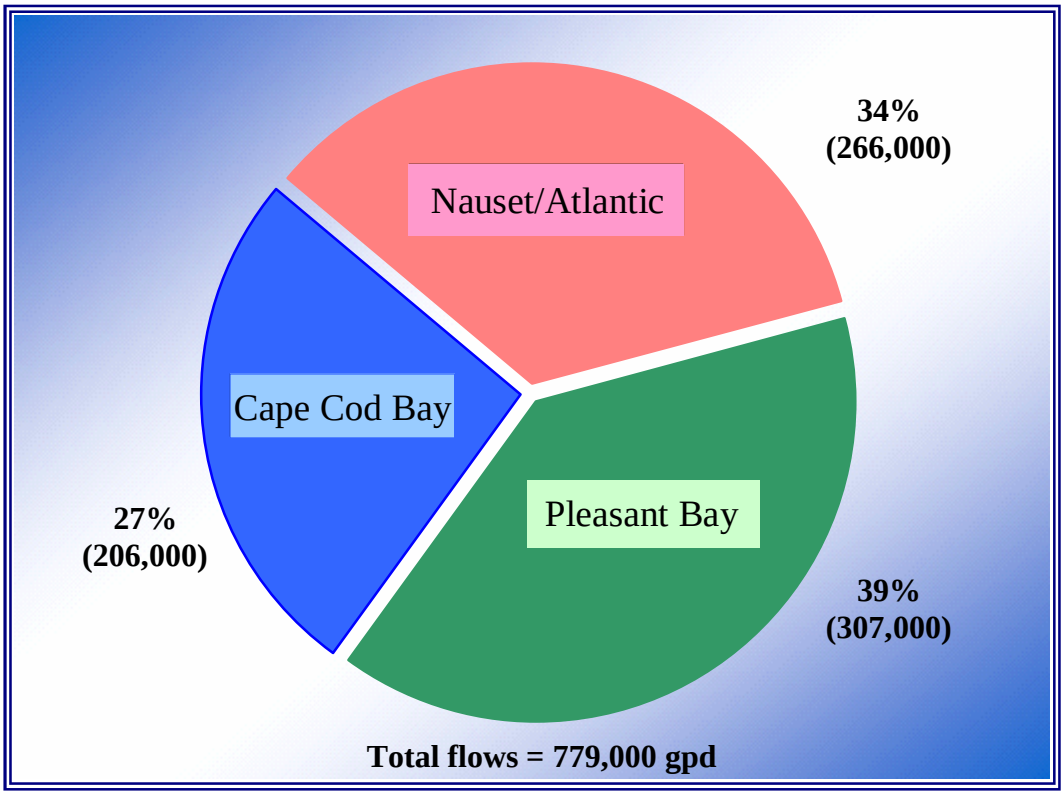
Table 2-3 lists the estimated wastewater flows for all of the sub-embayments that are impacted by land in Orleans.

Wastewater treatment and disposal systems must be sized adequately to handle short-term peak flows. During the summer, water use peaks are attributed to both higher population and higher consumptive use. From the water pumping records available for 1996 to 2005, the following peaking factors have been estimated for wastewater flows:

| | |
|---|---|
| Maximum month: | 2.0 times annual average |
| Maximum week: | 2.2 times annual average |
| Maximum 2-day: | 2.4 times annual average |

Figure 2-12 illustrates typical monthly variations in both water use and estimated wastewater flow.

**FIGURE 2-11**
**CURRENT WASTEWATER FLOWS BY MAJOR WATERSHED**




Source: See text.

Throughout this report, wastewater flow estimates are presented that are based on water use records from the period of 2002 to 2005. These flows are characterized as "current", even though they represent a time period 3 to 6 years earlier than the publication of the draft CWMP. Due to normal year-to-year variations in water use and consumptive use, it is difficult to discern any trends that would indicate that the 2002-to-2005 data are either higher or lower than comparable data for 2008. Nonetheless, it will be important to reevaluate these figures in the design stage of the project, recognizing that the first year of operation of municipal wastewater facilities may be ten years later than the period of this analysis.

It is also important to note that these wastewater flow estimates represent actual wastewater flow leaving homes and businesses. Only the wastewater flows are conveyed to the wastewater

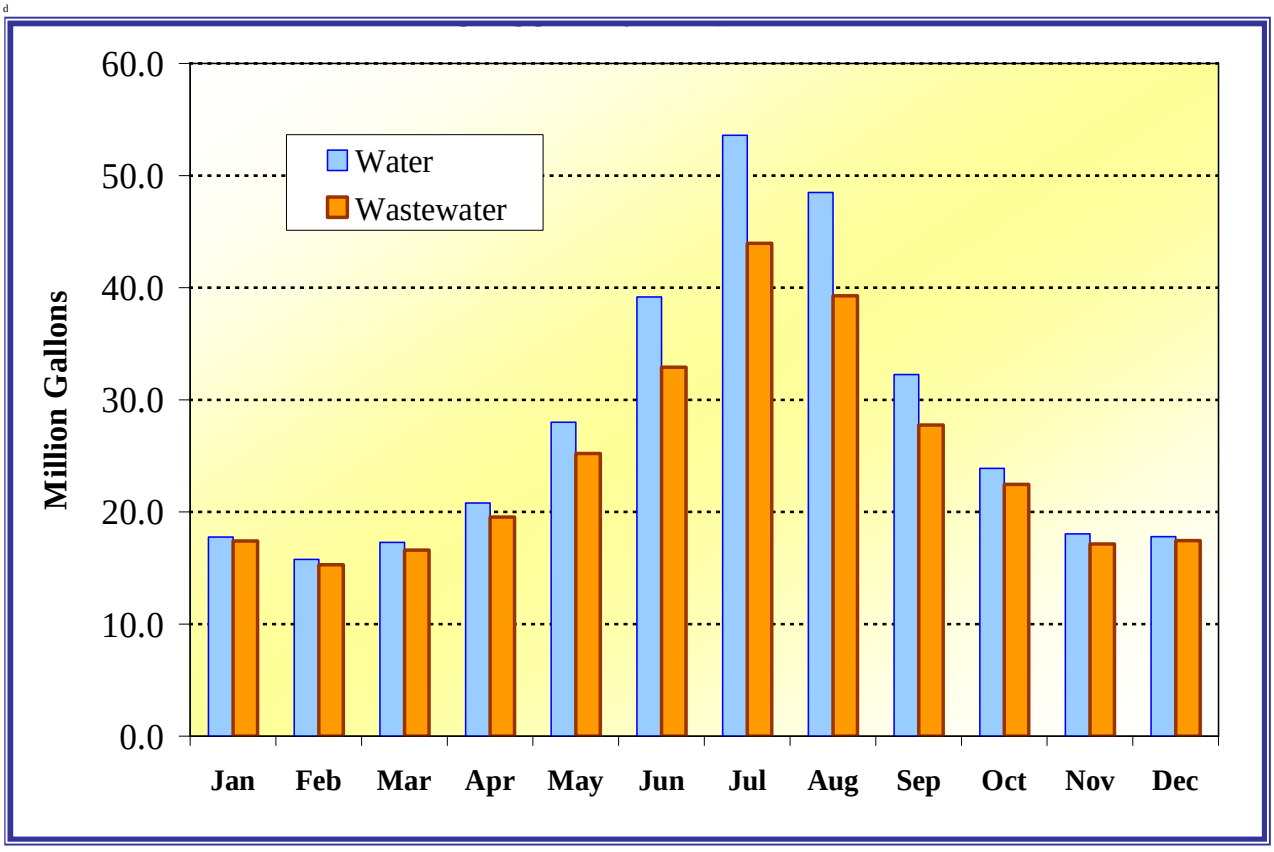
**TABLE 2-3**

**ANNUAL AVERAGE WASTEWATER QUANTITIES BY WATERSHED**
**CURRENT CONDITIONS**

| | | Wastewater Flow, gpd | | |
|---|---|---|---|---|
| **Watershed** | **# Parcels** | **Residential** | **Commercial** | **Total** |
| Areys Pond | 65 | 7,000 | 400 | 7,400 |
| Atlantic Ocean | 155 | 18,000 | 5,000 | 23,000 |
| Baker's Pond | 11 | 1,000 | - | 1,000 |
| Barley Neck | 170 | 18,000 | - | 18,000 |
| Boat Meadow | 13 | 100 | 12,000 | 12,100 |
| Crystal Lake | 67 | 5,000 | 1,000 | 6,000 |
| Deep Pond | 21 | 2,000 | - | 2,000 |
| Gould Pond Well_ORL | 46 | 5,000 | - | 5,000 |
| Kescayogansett Pond | 77 | 7,000 | 1,000 | 8,000 |
| Kescayogansett River | 13 | 1,000 | - | 1,000 |
| Kescayogansett Stream | 18 | 500 | 100 | 600 |
| Little Namskaket | 346 | 51,000 | 11,000 | 62,000 |
| Lower River | 220 | 53,000 | - | 23,000 |
| Meetinghouse Pond | 333 | 42,000 | 8,000 | 50,000 |
| Multiple watersheds | 13 | - | - | - |
| Namequoit River | 147 | 17,000 | - | 17,000 |
| Namskaket Creek | 289 | 30,000 | 23,000 | 53,000 |
| Nauset Harbor | 638 | 70,000 | 400 | 70,400 |
| Paw Wah Pond | 112 | 11,000 | 1,000 | 12,000 |
| Paw Wah Pond Bog | 12 | 1,000 | - | 1,000 |
| Pilgrim Lake | 61 | 6,000 | 2,000 | 8,000 |
| Pleasant Bay | 429 | 47,000 | 1,000 | 48,000 |
| Pochet Neck | 209 | 23,000 | - | 23,000 |
| Pochet Neck Stream | 153 | 18,000 | - | 18,000 |
| Quanset Pond | 44 | 8,000 | - | 8,000 |
| Quanset Pond Bog | 6 | 400 | - | 400 |
| Rock Harbor | 328 | 47,000 | 32,000 | 79,000 |
| Sarah's Pond | 63 | 7,000 | - | 7,000 |
| Shoal Pond | 34 | 4,000 | - | 4,000 |
| Tar Kiln Stream | 35 | 3,000 | 500 | 5,000 |
| The Horseshoe | 11 | 1,000 | - | 1,000 |
| Town Cove | 975 | 98,000 | 73,000 | 171,000 |
| Twinings Pond | 50 | 5,000 | - | 3,500 |
| Uncle Harvey's Pond | 16 | 2,000 | - | 2,000 |
| Uncle Seth's Pond | 23 | 4,000 | - | 4,000 |
| Upper River | 150 | 17,000 | 100 | 17,100 |
| Well 7 Well_ORL | 57 | 8,000 | - | 8,000 |
| **Total** | **5,410** | **608,000** | **171,500** | **779,500** |

treatment facility via the collection and transport system, including gravity sewers, pump stations, force mains. Gravity collection systems are typically installed five to twenty feet below the ground surface and, due to this depth, typically also receive some amount of groundwater infiltration. Manhole covers also allow for some amount of inflow into the collection system during rain events, as do illicit cellar drain connections. In combination, these extraneous flows are referred to as "infiltration/inflow". The sizing of the collection, transport, treatment and disposal systems is based on the combined wastewater and infiltration/inflow.

**FIGURE 2-12**
**SEASONAL VARIABILITY IN WATER USE AND WASTEWATER FLOW**




Source: Water use data from Orleans Water Department (1996 to 2005)