



CAPE COD
COMMISSION

Coastal Use Templates for Economic Development

Phase 1 Report
May 2011



Executive Summary

Coastal Use Templates for Economic Development

The goal of the *Coastal Use Templates for Economic Development* project, one of several priority projects identified through the Cape Cod Comprehensive Economic Development Strategy's (CEDS) regional planning process, is to promote a healthy year-round coastal economy and reinforce the Cape economy's historic connection to the sea (*Section 1*). The primary industry sectors on Cape Cod that are partly or wholly dependent on access to the coast and sea, and therefore constitute the Cape's coastal economy, include: 1) Tourism, Leisure and Real Estate; 2) Arts, Culture and Recreation; 3) Marine Sciences, Technology and Education; 4) Natural Resource Industries, and 5) Transportation, Ferry Services and Ports (*Section 4*). Other emerging industries, such as Information Technology and Renewable Energy, were identified by a Harvard University study as having the potential to diversify and expand the region's economy.

Several regional issues influence the Cape's existing economy, as well as its future potential (*Section 5*). The Cape's seasonal economy limits well-paying, year-round employment opportunities, while lower income workers living on the Cape are increasingly challenged to find affordable housing. Local commercial fishing, long a traditional industry on the Cape, faces overfishing and regulatory pressures, forcing some fishermen to find other livelihoods or adapt to new conditions. Reducing nutrient loading from wastewater to the Cape's ponds and estuaries is a critical and urgent need to prevent continuing environmental and potentially severe economic impacts. Of course, the Cape's peninsular setting and geography makes it vulnerable to coastal hazards such as hurricanes and nor'easters, and associated coastal flooding that affects much of the Cape. Future sea level rise will only increase the reach of these storms, threatening people, property and critical infrastructure. Other issues, such as vehicular traffic, are equally important factors influencing the Cape's coastal economy.

Phase 1 of the Coastal Use Templates project, completed in 2010, consisted of an analysis of coastal land uses on Cape Cod, five harbor case studies, a survey of pertinent regulations from the perspective of economic development, and development of conceptual future coastal uses (*Section 2*). Hyannis Inner Harbor, Woods Hole/Great Harbor, Provincetown Harbor, Chatham and Stage Harbors, and Saquatucket and Wychmere Harbors were selected for more in-depth study since they each represent one or more of the primary regional industry sectors (*Section 6*). Information and data about each prototype harbor(s) was collected primarily through interviews with town officials and GIS data and mapping. Detailed information concerning harbor location and geographic context, dominant natural resources, coastal vulnerability, primary harbor uses and infrastructure, economic resources, and public access was compiled in order to provide a comprehensive profile of each site.

Features of a harbor that contribute positively to the local harbor economy (assets) and features that currently limit the full use potential or function of the harbor (constraints) are summarized for each harbor in *Section 7*. Replication opportunities, which are harbor features that enhance the local harbor economy and if replicated at another harbor or coastal area may benefit the local economy, are also identified. Examples of replication opportunities include public transit and/or pedestrian access to the waterfront, scenic viewing opportunities on or near the waterfront (i.e., a viewing platform), and reserved parking and gear storage sites for local commercial fishermen.

The baseline data and information collected and summarized in *Section 6* of the report, harbor assets and use constraints (*Section 7*), and modified Smart Growth principles for coastal and waterfront communities form the basis for identifying the future coastal use concepts identified in *Section 9*. Conceptual future coastal uses are organized into four groups, including: 1) coastal areas where development or redevelopment is desired; 2) coastal areas to be “un-developed;” 3) inland and coastal economic area linkages, and 4) sea-level rise mitigation areas. Examples include converting (through redevelopment) non-water-dependent structures to water-dependent or maritime uses in areas located outside of coastal hazard zones, and removing (where possible) development in high hazard zones (e.g., V zone). Identifying conceptual future coastal uses will help inform the creation of coastal land use and regulatory models (or templates) that can be applied to the Cape’s coastal and waterfront communities, the primary goal of the *Coastal Use Templates for Economic Development* project (Phase 2). Coastal land use templates developed in Phase 2 of the project that serve as guidance for future coastal development must conform to local, state, regional, and federal regulations governing development along the coast. *Section 8* provides an overview of the large and complex array of statutes that currently exist to protect the diverse environmental, cultural and economic resources of the state, including Cape Cod. Regulations and permits are applicable to project siting, construction, operations, and maintenance. Identifying all of the legal restrictions that may be applicable to a specific location or project is the first step in project development.

1. Project Goals and Benefits

The Cape Cod Comprehensive Economic Development Strategy (CEDS) is a regional planning process focusing on economic development. In 2009, the CEDS five-year strategic plan for regional economic development was submitted to the U.S. Department of Commerce's Economic Development Administration (EDA). The EDA certified the plan, making the region and the towns eligible to receive funding assistance for public works, planning, and technical assistance projects related to economic development. As part of the CEDS planning process, five work groups, consisting of economic and workforce development practitioners, policy makers, and business leaders, were convened to identify 16 regional priority projects for inclusion in the CEDS – one of which was *Coastal Use Templates for Economic Development*.

The long-term goal of the Coastal Use Templates project is to develop land use and regulatory templates for representative coastal areas on Cape Cod that will promote a healthy, year-round coastal economy on the Cape. An equally important objective of the project is to reinforce (or re-establish, where necessary), the Cape's historic connections to the sea. The Cape's traditional social and economic ties to the sea may be as critical to the region's future economic success as its coastal and marine recreational resources. Preserving the health of the Cape's natural resources, and enhancing their viability where possible, is a critical component of the project's goal of improving the Cape's coastal economy.

The primary industry sectors on Cape Cod that are partly or wholly dependent on access to the coast and sea, and therefore constitute the Cape's coastal economy, include:

- 1) Tourism, Leisure and Real Estate
- 2) Arts, Culture and Recreation
- 3) Marine Sciences, Technology and Education
- 4) Natural Resource Industries
- 5) Transportation, Ferries Services, Ports

Five harbors on the Cape that represent one or more of these primary regional industry sectors were selected as study sites to characterize the region's coastal land uses. The harbors selected for study include: Hyannis Inner Harbor, Woods Hole/Great Harbor, Provincetown Harbor, Chatham and Stage Harbors, and Saquatucket and Wychmere Harbors. Table 1 lists the primary industry sectors represented within each harbor study area. Dominant industry sectors at each harbor location were based on their estimated economic value relative to the overall size of the harbor.

Table 1: Harbor Study Areas and Regional Industry Sectors

Harbor	Industry Sectors
Hyannis Inner Harbor	Tourism/Leisure Arts, Culture and Recreation Transportation
Woods Hole/Great Harbor	Tourism/Leisure Arts, Culture and Recreation Marine Sciences, Technology and Education Transportation
Provincetown Harbor	Tourism/Leisure Arts, Culture and Recreation Natural Resource Industries Transportation
Chatham and Stage Harbors	Natural Resource Industries Tourism/Leisure
Saquatucket and Wychmere Harbors	Recreation Natural Resource Industries Transportation

The first phase of this project was completed in 2010 and consisted of an analysis of coastal land uses on Cape Cod, case studies of the five harbors, and an overview of pertinent regulations from the perspective of economic development. This document compiles the Phase 1 baseline data collection and analyses completed to date. Subsequent phases of this project will be determined with guidance from the CEDS lead agency, the Association to Preserve Cape Cod's Cape Cod Business Roundtable, and the Cape Cod Commission.

The intended benefits of the project are many, including:

- 1) Supporting essential coastal industry sectors including local fin and shell fishing and related low-impact resource dependent uses, marine science and technology, tourism, and recreation
- 2) Stimulating redevelopment along the coast that is consistent with best practices for coastal, floodplain, and green construction
- 3) Improving the productivity of working waterfronts with safe and modern harbor infrastructure
- 4) Lessening adverse impacts to estuaries, salt marshes, and related natural infrastructure that is essential to the health of coastal waters
- 5) Improving public access to the coast
- 6) Lessening economic losses associated with sea-level rise and natural disasters

2. Project Methodology

Phase 1 of the *Coastal Use Templates for Economic Development* study consists of an analysis of the five harbors that were selected based on their representation of coastal industry sectors present on Cape Cod. Five specific coastal land use/economic industry sector categories were identified and mapped: Recreation, Educational Institutions, Working Harbors, Commercial, and Natural Resources. The industry sectors are discussed in greater detail in Section 4 of this report. Cape-wide coastal resource attributes derived from MassGIS (Geographic Information Systems) were used for initial “in-house” characterization of the harbor study sites. Based on this information, location and resource maps [natural resources (including wetlands and rare species habitat), shellfish habitat, and flood zones] were created for each harbor (Section 12).

The following sequence of tasks was completed by Commission staff to complete the Phase 1 baseline land use data collection and regulatory analysis phase of study.

- Identified and summarized the primary industry sectors influencing coastal uses on Cape Cod (Section 4) and identified five harbor study sites that represent one or more of the primary industry sectors.
- Identified and summarized regional issues specific to Cape Cod that influence economic development in the coastal zone (Section 5).
- Used MassGIS data for initial characterization of natural and cultural resources, risk and vulnerability, land use cover, recreation, demography, etc. in and adjacent to the five harbor study sites.
- For each harbor study site, collected data relative to current land, waterfront, and harbor uses and infrastructure; coastal, marine and natural resources; public access and recreation opportunities; transportation alternatives, and general economic data (i.e., primary economic drivers at each site) (Section 6). Data and information was obtained by interviewing town officials (harbormaster, natural resource officers, town planners, etc.), harbor management plans, NOAA community profiles, and internet sources.
- Summarized baseline use information into categories: Coastal Economy Niches, Harbor Assets and Use Constraints, and identified Replication Opportunities that may form the basis for land use templates (Phase 2) (Section 7).
- Compiled summary information on environmental laws, regulations, and/or environmental resources that potentially influence development in the coastal zone (Section 8).
- Conducted an analysis of conceptual future uses in the coastal zone, including identifying where development/redevelopment is appropriate, areas for “un-development,” opportunities to link coastal and inland economies, and identifying “natural coastal infrastructure” and/or appropriate locations for man-made coastal structures to mitigate for the

- impact of future sea-level rise and other coastal disasters (Section 9).
- Cited information sources and References in Sections 10 and 11.
- Compiled information and data for Phase 1 baseline land use data collection and regulatory analysis into summary report.

3. Geographic and Socio-Economic Setting

Cape Cod is a unique and fragile geologic landform composed of sediments laid down during the last glacial age over 10,000 years ago. Surrounded by the sea, the Cape has long supported maritime industries and traditions that have bounded its people to the shore, bays, and ocean. Yet the same ocean that has sustained Cape Codders for generations, threatens the long term existence of this sandy peninsula. Rising sea level, driven in part by climate change, is steadily eroding and re-making the Cape. Waterfront and coastal properties are increasingly threatened by coastal erosion and flooding, forcing regulators and coastal managers to strike a difficult balance between protecting private property and infrastructure, while preserving the function and integrity of important coastal resources. Coastal and marine resources are part of the natural infrastructure that supports some of the most important elements of the Cape's economy, including tourism, recreation, boating, and commercial fishing. Many rare species and natural plant community types, some of which are globally rare, also exist in the coastal zone.

Fifteen towns comprise the Cape, each with a physical connection to the sea. Tourism represents almost half of the Cape's economy, and is a significant segment (~25%) of the region's employment. Over a third of the jobs on the Cape are in retail and accommodations/food service, two job sectors critical to maintaining the summer tourism industry. Rising housing costs, influenced by the second home market on the Cape, have made it more costly for year-round residents on fixed or low wages and seasonal workers to subsist on the Cape. The increasing numbers of retirees that have relocated onto the Cape have created new employment opportunities in healthcare and social services. Barnstable County has the oldest population in New England, with approximately 37% of the population age 55 and older. Seniors, 65 years and older, compose 24.5% of the Cape's population (only 13.6% in Massachusetts as a whole).

4. Major Industry Sectors

PRIMARY COASTAL INDUSTRY SECTORS

As mentioned in Section 1, the primary industry sectors on Cape Cod that are dependent on access to the coastline and the sea (i.e., the Cape's coastal economy) include: Tourism and Real Estate, Arts, Culture and Recreation, Natural Resource Industries, Marine Sciences, Technology and Education, and Transportation. The following subsections are a general discussion of each primary industry sector on the Cape, including elements supporting each industry sector, potential threats, and how the industry sectors influence the Cape's economy.

Tourism/Leisure and Real Estate: Tourism is a significant segment of the Cape's employment and economy, and affects the region's community character and natural resources. Two of the largest employment sectors on the Cape in 2009 were in two industries closely tied to tourism: retail trade (16.7%) and accommodations & food services (16.1%) (U.S. Bureau of Labor Statistics, 2009). At least 20% of visitors to Massachusetts visit Cape Cod and the Islands, the second most visited destination after Boston. The Cape's myriad coastal ecosystems, especially its beaches and water quality, are the foundation of the region's tourism industry. This industry sector also relies on water access and harbor infrastructure, including public beaches, boat ramps, as well as parking and public transit options. Accommodations and restaurants on the water or with a water view, scenic drives and bikeways, and hiking/walking areas with coastal vistas and water access are also important in attracting tourists. The quaint character of many of the Cape's towns and villages are also important elements. Village scale development with historic harbors and properties, art galleries, and access for artists to work all contribute to the quintessential Cape scene. Second home owners are drawn to the Cape for similar reasons, but overbuilding can conflict with the scenic and natural values sought by tourists.

A number of factors could threaten the region's tourist industry, including environmental degradation, loss of coastal access, insufficient infrastructure to serve tourists, insufficient workforce, etc. Maintaining the health and integrity of the Cape's coastal environments, and restoring systems where necessary, will go a long way toward sustaining the region's widespread appeal. Equally important, is thoughtful planning of development to preserve the natural and aesthetic character of the coast (and coastal communities). The incremental loss of access to the shore is a critical threat to the quality of tourism on the Cape. Closure of traditional right-of-ways to the beach by new development or the decommissioning of a boat ramp diminishes access to the Cape's premier recreational assets. Maintaining adequate parking, boat launches, public piers and restrooms, etc. are critical in facilitating recreational use of the shore and adjacent waters, as is providing accommodations.

Real estate, construction and other trades benefit from the Cape's second home industry. Affordable housing for workers and businesses that cater to builders (lumber and hardware suppliers, etc.) are important needs for this industry. The lack of affordable housing, of course, could diminish the availability of the workforce to fully support the tourism and construction industry. Escalating property values and taxes may limit the variety of housing that can be built. Continued private and public capital investment is essential.

Natural Resource Industries: Massachusetts has always been a leading state in the fisheries sector, with landings in Chatham and Provincetown among the highest in the state (behind New Bedford and Gloucester) in 2007. Clean water, healthy coastal and marine habitats, and sustainable fishing practices are critical in maintaining the productivity of the regional fishery. Functional harbor infrastructure, including piers, docks, parking, storage space, off-loading facilities, etc., and marine supply businesses are equally important for commercial fishermen. Shellfishers require continued access to the shore to reach clam flats and aquaculture sites. Eighty percent of the aquaculture in Massachusetts takes place on Cape Cod. Value-added processing and transportation links for exporting fish to outside markets are other contributors to a vibrant industry. Commercial development of other marine resources (e.g., sand and gravel) will rely on adequate landing and transportation connections.

The productivity and profitability of the region's commercial fishermen is affected by numerous factors including environmental quality, regulations, harvesting levels, corporate fishing interests, permit costs, harbor/shore access and infrastructure, market demand, etc. Potential use conflicts with offshore renewable energy facilities, invasive species, and affordable housing for local fishermen may also influence this industry. Regional non-profits, such as the Cape Cod Commercial Hook Fishermen's Association, have implemented innovative programs (e.g., Sector Management Program, Cape Cod Fisheries Trust Program, and Community Supported Fishery Program) on the Cape to assist independent commercial fishermen in coping with many of these issues.

Arts, Culture and Recreation: Tourists flock to the Cape Cod for its rich cultural offerings, including art galleries, studios, artisans' shops, museums, and its myriad performing arts venues. The historic town villages, working waterfronts, and cultural landscapes are critical in maintaining the unique character that draws so many people to the region. Recreational opportunities that attract large numbers of tourists depend on high quality natural environments (especially along the shore) and public access.

The cultural flavor of the Cape is intricately tied to community character, which gives the Cape its unique appeal. Inappropriate development can infringe on the integrity of important cultural and historic sites, or culturally significant viewsapes. Local artists depend on access to scenic, historic and natural sites to

paint or sketch, venues to sell their arts and crafts, and the availability of affordable housing. Lack of any of these, will force artisans off Cape and diminish the viability of this industry sector. As mentioned above, the Cape's recreational assets depend on the health and integrity of its coastal environments, and land-use planning that preserves the natural and aesthetic character of the coast and communities. The provision of adequate infrastructure to support the recreational industry (parking, shore access, boat ramps, etc.) is critical, as are services that cater to recreationists, such as sport shops, restaurants, lodging, etc.

Marine Sciences, Technology and Education: Marine research and education, marine engineering and services, marine instrument design and construction, etc. comprise this industry sector. Deepwater harbors with piers for large research vessels, a well-educated and highly skilled workforce, laboratory and office space in close proximity to research locations, and natural areas for outdoor education are among the many needs of this industry sector. Woods Hole is the hub of marine science research and education on the Cape, although many smaller research and/or education facilities and centers exist elsewhere, such as Provincetown Center for Coastal Studies and Mass Audubon's Wellfleet Bay Wildlife Sanctuary.

A primary regional threat to this industry sector is escalating land values, especially along the shoreline, which limits access and siting opportunities for new facilities, especially on the waterfront. High property values also hamper the development of affordable housing for workers and support staff. Research and education may be hindered by inadequate harbor infrastructure, especially for small educational organizations needing docking space, etc. The loss of shore access can make it more difficult to reach research sites or areas suited for outdoor education. Most educational non-profits rely on private donations to support operating endowments.

Transportation, Ferry Services, Ports: The transport of passengers and freight is an important contributor to the regional economy. Major transportation hubs on the Cape are located in Hyannis (ferry, airport), Woods Hole (ferry), and Provincetown (ferry, airport). The Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority, the largest transportation company on the Cape and Islands, provides transportation services for passengers, autos, and freight to and from Nantucket and Martha's Vineyard.¹ Several other, smaller ferry companies operate from other Cape ports, shipping passengers and freight (e.g., Freedom Cruise Lines in Harwich). Marine transportation may be impacted by fluctuating fuel costs as well as the shoaling of navigation channels. The Steamship Authority (SSA) is a regulatory body created

¹ The Steamship Authority, a public entity of the Commonwealth of Massachusetts, is one of the enduring features of Cape Cod. For nearly a century, this company has been transporting passengers, vehicles, freight and living essentials between Nantucket, Hyannis, Woods Hole and Martha's Vineyard, a service so valuable it has been dubbed "the Lifeline to the Islands."

by the Massachusetts legislature to provide transportation to and from the islands of Nantucket and Martha's Vineyard. Private ferry operators are licensed by the SSA to provide passenger service between New Bedford and Oak Bluffs (seasonal), New Bedford and Vineyard Haven (year-round), Falmouth and Edgartown (seasonal), Hyannis and Oak Bluffs (seasonal), Hyannis and Nantucket (seasonal and year-round), and Harwichport and Nantucket (seasonal).

High property values or over-development can make it difficult to site needed support facilities, such as overflow parking areas for the ferries. Inadequate maintenance of surrounding roadways and other infrastructure may impact this industry given the large numbers of users. The lack of affordable housing, or the cost of living on the Cape, may drive lower paid workers off Cape to find accommodations. Dredging of navigation channels suitable for the passage of large vessels is critical to maintaining ferry operations. Smaller ferry companies operating out of harbors with non-federally maintained harbor entrance channels are at greater risk of having to navigate shoaled channels. Environmental regulations and limited funding for dredging projects has made channel maintenance difficult in some harbors.

EMERGING INDUSTRY SECTORS

Regional Industry Clusters: Research conducted in 2003/2004 by Dr. Michael Porter, Harvard University Institute for Strategy and Competitiveness, indicates that the Cape has a number of emerging industries with the potential to diversify and expand the region's economy. He identified clusters of activity in the following sectors:

- ★ Marine research & technology
- ★ Arts and culture
- ★ Information & related technology
- ★ Education & knowledge creation

Renewable energy and related technology could well be added to this list.

The Cape Cod economy, like any economy, is made up of traded sectors and local service sectors. Traded sectors export goods and services and are generally the focus of economic development. On Cape Cod, the dominant traded sector is tourism – tourists and second homeowners earn their money off Cape but spend it here, thus increasing the size of the Cape economy. Traditional industries such as fishing, shellfishing, and cranberry cultivation are traded export sectors. The Cape's emerging export-based marine and information technology sectors are important to the future growth of our economy, as is the arts and culture sector, that is increasingly selling products both off-Cape and to tourists. The opportunity to sell products via the Internet has already contributed to growth in off Cape sales and exports. Infrastructure planning, land use policies, and

development regulations should support and encourage an expansion of the Cape's traded sectors.

Local service sectors are generally understood to circulate money within the local economy. Yet, local service sectors can also have a role in economic growth through local business ownership and the provision of goods and services locally that were previously purchased outside the region. Luckily for the Cape, the vast majority of local service businesses are locally owned. Most regions have seen their local service sectors, from banking to retail, saturated by national corporations, chains, and formula businesses. We found that prior to the current economic recession, as our per capita income rose, the Cape had been attracting the attention of national competitors. When the economic recovery gets underway and land prices once again begin to increase, local businesses are going to find it more and more difficult to compete with non-local corporations.

5. Regional Economic Issues

SEASONAL ECONOMIC BASE

Cape Cod's economy is predominantly based on delivering services, and has long been dominated by tourism and hospitality industries that offer primarily low wage, seasonal jobs. Over 25% of Cape Cod's workforce is employed in the retail and accommodations/food services industry sectors. The low wages provided by service industry jobs and the high cost of living on the Cape have many in the workforce struggling to make ends meet. However, the average wage is skewed by the large percentage of the Cape workforce that remains in the hospitality sector, whose wages are significantly lower than those of other industry sectors. The U.S. Bureau of Labor Statistics (2009) indicates that the average individual income in Barnstable County is \$38,697, while the median household income is \$56,991. The healthcare industry is another strong regional economic sector that provides services for the Cape's many retirees. Both the healthcare and tourism industries depend on local spending and the provision of local services by a regional workforce.

The Cape's workforce today is less reliant on tourism and hospitality industries as a source of employment. Instead, the regional workforce is more evenly distributed among other industry categories, such as healthcare, government, professional, and business industries. The top four industries on the Cape are: health care/social assistance (17.4%), retail trade (16.7%), accommodation/food services (16.1%), and educational services (7.7%) (U.S. Bureau of Labor Statistics, 2009). This trend indicates a move toward a more permanent, year-round economy, rooted largely in the service provided to retirees and second-home owners. However, up to 25% of the Cape's workforce continues to be affected by seasonal changes in the economy. To sustain a year-round population, the Cape economy needs to continue building a foundation of permanent, year-round jobs in the professional, business, and higher paying "emerging industries." Higher-paying, year-round jobs raise the level of economic security. In addition, sustainable economic growth should not endanger the Cape's fragile and non-renewable environmental resource, which is critical in supporting its tourism industry and upon which so much current and future wealth generation depends.

COASTAL HAZARDS

Cape Cod's peninsula setting increases its vulnerability to storms relative to more inland locations. Coastal flooding, shoreline erosion, high winds, and storm surges all contribute to storm damage of natural and human built environments on the Cape during northeast storms (Nor'easters) and less frequent hurricanes. Sea-level rise around Cape Cod has been about 1 ft. (30 cm) over the last century (3 mm/yr), causing erosion along much of the Cape's shoreline.

Of all the natural threats that affect Cape Cod, hurricanes have the potential to cause the most property damage and loss of life. Coastal hazards associated with hurricanes include damaging winds, storm surges, heavy downpours and occasionally tornadoes or waterspouts. Southern New England has been affected by 41 hurricanes between 1900–2002, with twelve of these storms having caused significant landfall damage. Storm surges are the primary threat to human life during hurricanes, unless people are evacuated ahead of time. They can inundate evacuation routes, cripple communications, and cause sewers and stormwater basins to back up. Storm surges can wash out roads or leave streets filled with sand and debris, rendering them impassable long after surge waters have receded. The height of the hurricane season (August and September) coincides with the zenith of Cape Cod's tourist season. The Hurricane of 1938 was the last major hurricane to strike southern New England. The increase in population and resources on the Cape would likely multiply the damages caused by any major hurricane striking the region today.

Winter storms, or Nor'easters, have more damaging effects on the north shore of the Cape. Nor'easters have the potential to inflict more damage than many hurricanes because the high storm surge and high winds can last anywhere from 12 hours to 3 days, while the duration of hurricanes generally ranges from 6 to 12 hours. New England typically experiences at least one or two Nor'easters each year with varying degrees of severity. Storms that coincide with a high tide create an additional layer of vulnerability and associated risk to power and transportation infrastructure and other critical facilities. Inundation of low-lying sections of some evacuation routes during storm surges, such as Rte. 6A, may cut some areas off from evacuation and emergency services.

Shorelines on the Cape exposed to the full fury of Nor'easters experience the greatest shore erosion, with average rates of erosion along the outer shore of Cape Cod of about 3 feet per year. The southern shore of upper Cape Cod and shoreline along Buzzards Bay are most exposed to the damaging effects of hurricanes, especially those that track west of the Cape, as did Hurricane Bob in 1991. Roughly two-thirds of the Cape's shoreline (66%) is eroding, with about a third (32%) accreting, and 2% showing no long-term net change (Regional Hazard Risk Map, Cape Cod, 2004). The causes of shoreline change, especially erosion, are both natural and human induced. Storms, compounded by ongoing sea-level rise, drives continued erosion of the Cape's shores. Hard coastal structures, such as revetments, seawalls, groins and jetties interrupt sediment sources and hinder longshore sediment transport. Shore erosion through natural processes is essential for coastal landforms (beaches, dunes, salt marshes, etc.) to maintain themselves in the face of ongoing sea-level rise. The loss of beach sediment volumes from interrupted shore erosion and longshore drift exposes shorefront property to increased storm damage.

COMMERCIAL FISHING

Cape Cod's commercial fishing industry, which consists primarily of small vessel fishing under individual ownership, contributes to the overall diversification of the Cape's economy. It helps mitigate the effect of seasonal employment and provides livable wages. The Cape's community-based fishing operations have also been responsible for technological and strategic innovations that have improved stewardship and sustainability of the fishery. The fishing industry on Cape Cod is not only an important export sector, it is closely linked with our largest sector, tourism, which is also an export industry. Loss of the Cape's fishing industry would impact the social and aesthetic character of our communities and the size of the regional economy.

Overfishing has taken its toll on the Cape Cod fishing industry. The 2009 National Marine Fisheries Service report to Congress on the status of U.S. fisheries indicates that of the Northeast region's 49 monitored fish stocks, 8 stocks are subject to overfishing, 17 stocks are overfished (cod, haddock, yellowtail flounder, etc.), and no stocks are approaching an overfished condition. As stocks become threatened, government policies have been established to allow regeneration of stocks by limiting catch through quotas. In an effort to adopt a market-based solution to overfishing, the number of commercial fishing permits was limited. An unintended consequence of this practice is that as permit costs have risen, corporate fishing interests have begun to crowd-out independent fishermen unable to afford to buy permits. Other independent fishermen have found it is more lucrative to sell their permits and stop fishing altogether.

Regulatory pressures, dwindling fish stocks, and ongoing changes in the ocean environment (possibly related in part to climate change) are impacting commercial fishermen throughout New England, including Cape Cod fishermen. Local fishermen are increasingly forced to adapt to changing conditions and regulatory pressures by exploiting new species, such as conch, horseshoe crab, squid, and crab (some of which are also harvest limited). Other fishermen are retiring their boats for good. Several initiatives are currently helping Cape fishermen to continue operating, including the Cape Cod Commercial Hook Fishermen Association's (CCCHFA) sector management program, Cape Cod Fisheries Trust program, and the community supported fishery program. The sector management program is a harvesting cooperative that allows fishermen to work collectively to harvest a combined quota of fish. A sector is a group of fishermen that collectively sign a contract with the government to catch only a certain amount of fish. In exchange for pledging to abide by this group quota, sector fishermen are exempted from other regulations designed to limit their catch. This fishing cooperative increases flexibility and profit for fishermen, encourages sustainable fishing methods, and makes it easier for fishermen to stay within annual limits. Currently, there are only two sectors operating in New England, both are based in Chatham and managed by the Cape Cod Commercial Hook Fisherman's Association.

The Cape Cod Fisheries Trust program, a national model for a permit leasing system while preserving an independent community-based fishing industry, purchases commercial fishing permits to help support local fishermen. Some local fishermen are also exploring the feasibility of establishing a community supported fishery (CSF) that would better connect community with local fishermen. CCCHFA's community supported fishery program, a pilot program funded by the U.S. Dept. of Agriculture and the Cape Cod Economic Development Council, ran for five weeks during the Fall 2010. The Cape Cod Weir Harvest (CCWH) community supported fishery is a new CSF in Chatham that works with local weir fishermen and shore-side operations to deliver fresh seafood to members in season.

WASTEWATER DISPOSAL

The Cape's underlying geology, consisting of broad, glacial outwash plains and hilly moraines, supports a productive, sole-source aquifer that provides drinking water to over 450,000 people at the peak of summer. Today, approximately 85% of homes on Cape Cod use individual on-site Title 5 septic systems. Nitrogen, a nutrient that degrades groundwater, lakes, ponds, bays and coastal water quality, is not removed by Title 5 septic systems. Other sources (e.g., stormwater runoff, fertilizers, etc.) also contribute to excessive nitrate levels in coastal waters. Nitrogen-related water quality decline represents one of the most serious threats to the ecological health of the Cape's nearshore coastal waters.

Of the 57 major coastal embayments on Cape Cod, 46 have been studied, or are identified for study through the Massachusetts Estuaries Project to establish their degree of nitrogen sensitivity.² Half of the 46 nitrogen sensitive watersheds are currently subject to U.S. EPA established Total Maximum Daily Loads (TMDL), that describes the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. The remaining watersheds (23) are under review or identified for review to establish TMDLs. Regional wastewater planning on Cape Cod involves the cooperation of all Cape Cod towns and Barnstable County agencies including the Barnstable County Department of Health and the Environment, Barnstable County Commissioners, the Assembly of Delegates, and the Cape Cod Commission. These efforts are coordinated by the newly created Cape Cod Water Protection Collaborative.

² The Massachusetts Estuary Project (MEP) is a collaborative effort by two state agencies, the Executive Office of Environmental Affairs (through the Department of Environmental Protection) and the University of Massachusetts's School of Marine Science and Technology. MEP will provide water quality, nutrient loading, and hydrodynamic information for 89 estuaries in Southeastern Massachusetts, including Cape Cod. A linked watershed/estuary model will be used to predict the water quality changes resulting from land use management decisions, and the nutrient tolerance of an estuary. Total maximum daily loads (TMDL) of nutrients (e.g., Nitrogen) are based on this information.

AFFORDABLE HOUSING

Since 2000, the median value of single-family homes appreciated nearly 85 percent on the Cape, while the average family income increased 58 percent.³ Compared with the state as a whole, housing costs are 10% higher and the average wage is 35% lower on the Cape. The rate of increase in the cost of housing over the past 10 years has priced middle-income people out of the market. To buy a home on Cape Cod today, an approximate annual income of \$80,000 is now needed. In a region dominated by lower-wage service sector and tourism-related jobs, there is a critical need for a sufficient amount of housing that is affordable in order to attract and retain a diverse workforce. Currently, no towns on Cape Cod meet the state's affordable housing threshold target of 10%, with the majority of towns having less than 5% of affordable housing.

The high cost of housing results from the increased demand for second and/or retirement homes, and from local zoning and other regulatory policies. Currently, one-third of the Cape's housing stock is used by seasonal residents. The higher average incomes of second homeowners (nearly double that of the region's) allows them to compete for existing housing stock which drives up the overall cost of housing. The regional efforts to control growth and to protect the Cape's groundwater have resulted in most Cape communities adopting large-lot zoning bylaws. The combination of escalating land prices and this type of zoning has contributed to the difficulty of creating more affordable housing without some relief from limits on development density.

³ P. Ruchinkas, personal communication, February, 28, 2011

6. Harbor Study Areas

Location and resource maps (including coastal wetland types, rare species habitat, shellfish habitat, and flood zones) for each harbor study site are located in Section 12. Five prototype harbors (Fig. 1), including Hyannis Inner Harbor (Barnstable), Woods Hole (Falmouth), Provincetown Harbor (Provincetown), Chatham and Stage Harbors (Chatham), and Saquatucket and Wychmere Harbors (Harwich), were identified on Cape Cod representing the range of primary industry sectors in the region. Information and data concerning the location and geographic context, natural resources, coastal vulnerability, harbor uses and infrastructure, economic resources, and public access was collected for each harbor. The sections below summarize this information.

Hyannis Inner Harbor

LOCATION AND GEOGRAPHICAL CONTEXT

Hyannis Inner Harbor is part of the larger Lewis Bay/Hyannis Harbor complex on the south shore of Cape Cod and serves as the primary gateway to Nantucket (Fig. 2).⁴ The inner harbor is a small embayment that extends seaward to Harbor Bluff where the inner harbor opens to Lewis Bay. While most of the harbor is in the Hyannis section of Barnstable, a portion of the outer section of the harbor is in Yarmouth. This small but busy harbor is used by recreational boaters, commercial fishermen and other commercial operators (e.g., fishing and sailing charters, etc.), and is the main point of origin for ferry service to Nantucket. Hyannis Inner Harbor is largely surrounded by high density urban and residential development. Downtown Hyannis is located just north of the inner harbor. In order to support water-dependent uses, the area around the harbor is zoned as a Harbor District.

Hyannis is the largest of seven villages in Barnstable and is the commercial and transportation hub of Cape Cod. It contains the Barnstable municipal offices, historic downtown Main Street, and the Iyannough and Falmouth Road commercial districts. Hyannis has long been an important tourist destination and is the primary aviation (as well as



Fishing boats at Ocean Street Docks, Hyannis Harbor

⁴ Hyannis Harbor is a separate and larger coastal waterbody that borders Hyannisport and is located between Kalmus Beach and the Hyannisport breakwater.

ferry) link for passengers and freight to Nantucket Island. The cultural significance of Hyannis was strengthened when John F. Kennedy was elected President and continued to spend time at his Hyannisport summer home during his presidency. The summer homes of the Kennedy families (the Kennedy Compound) are located along the waterfront on Hyannis Harbor (not the inner harbor). The JFK Hyannis Museum on Main Street focuses on John F. Kennedy's time spent in the town. There is a memorial to President Kennedy on the Lewis Bay waterfront that was erected by Barnstable citizens in 1966. Veterans Memorial Park is located just north of the Kennedy Memorial. President-elect John F. Kennedy gave his acceptance speech on Nov. 9, 1960 at the former Hyannis Armory, which is on the National Register of Historic Places. Sections of Hyannis Port are also a historic district.

Boats in Hyannis Inner Harbor have easy water access to Lewis Bay, Hyannis Harbor, and Nantucket Sound. Kalmus Beach, a barrier beach that separates Lewis Bay from Hyannis Harbor, and Great Island, a large peninsula that shelters Lewis Bay, are both important natural, recreational, and scenic attractions in the area. The Cape Wind renewable energy project will be visible from the south-facing shores of Barnstable, including the village of Hyannis.

NATURAL RESOURCES

There are few mapped natural resources in the inner harbor (Fig. 3) probably due to the heavy maritime use of the area. The harbor supports habitat for quahogs and soft-shelled clams although the beds are closed to shellfishermen due to impaired water quality (Fig. 4).⁵ Priority and estimate rare species habitat extends across Lewis Bay and into the lower section of Hyannis Inner Harbor (possibly for rare shorebirds). There are no rare plant communities in the study area.

Since most of the land around the harbor (and Lewis Bay) is sewered, water quality and overall ecosystem health in the inner harbor is reported as generally good given its urbanized surroundings. Water quality in the inner harbor is presently classified as moderately impaired. Based on the loss of historic eelgrass in much of Lewis Bay, these areas, too, are significantly impaired due to moderate levels of nutrient enrichment. The primary nutrient causing impairment of coastal embayments, such as Hyannis Inner Harbor and Lewis Bay, is nitrogen. Major sources of nitrogen loading in the harbor watershed are wastewater disposal from septic systems and nonpoint source runoff (stormwater runoff). Boat waste is reportedly not a problem in the inner harbor (a pump-out

⁵ The harbor supported a productive stock of quahogs in the 1970s and 1980s and soft-shelled clams in the area of the Hy-Line terminal, but shellfish beds were later closed due to diminishing water quality. The Fish Hills embayment currently supports quahogs.

station is located at the town pier). The inner harbor and nearby harbors and bays have not been designated as “No Discharge Zones.”⁶

Extensive areas of eelgrass and shellfish habitat exist just outside of the inner harbor. Kalmus Beach provides habitat for Piping Plovers, Least Terns, and Roseate Terns, all of which are listed as rare species. The disposal of dredged materials on the beach since 1985 has enhanced the site as nesting and/or staging habitat for rare shorebirds, at one point supporting 42% of the state’s Least Tern breeding population (1999). Kalmus’ value as rare shorebird habitat changes, however, due to shifting habitats, recreational use, and predation. The Stewart’s Creek restoration project (near Hyannisport) will restore tidal flow to the lower section of the creek.

SHORELINE CHANGE AND COASTAL VULNERABILITY

The area around the inner harbor is subject to coastal flooding (Fig. 5) by the 100-year storm (A zone, el 10 ft.) and by hurricane surges. Coastal flooding with wave action (V zone) extends into the lower harbor to an elevation of 15 ft. NGVD 1929. Four critical facilities (e.g., Bismore Park Marina, Hyannis Marina, etc.) are located in coastal flood or SLOSH (Sea, Lake and Overland Surge by Hurricanes) zones around the harbor. FEMA recently certified the town’s Hazard Mitigation Plan. There is no readily available shoreline change data for the inner harbor.

HARBOR USE AND INFRASTRUCTURE

Harbor Users

Hyannis Inner Harbor supports a variety of recreational, commercial, and marine transportation uses. Recreational boating and marine transportation companies (ferries) are the dominant users, while commercial uses are comparatively less. The waterfront and harbor are built out and there is a constant competition for space between smaller vessels and larger commercial vessels, including the ferries.



Harbor waterfront, Hyannis Inner Harbor

⁶ "No Discharge Area" is a designated body of water that prohibits the discharge of treated and untreated boat sewage. Federal Law prohibits the discharge of untreated sewage from vessels within all navigable waters of the U. S., which include territorial seas within three miles of shore.

Recreational Boating - The Hyannis Marina, located on the east side of the harbor, provides dockage for private recreational boats with over 160 slips. Boat slips are also available at the Bismore Park Marina on the west side of the harbor off Ocean Street, and at Gateway Marina at the end of Pleasant Street. Both town marinas have long wait lists, although the waiting time is less now due to the economy and ageing users. The Hyannis Yacht Club is located on Ocean Street, just south of the harbor. Overall, the number of recreational boats in the harbor is declining.

Marine Transportation - The quasi-public Steamship Authority's Hyannis Terminal, located between Pleasant and School Streets, provides passenger, vehicle and freight service to Nantucket. The *Iyanough*, a high speed passenger ferry, provides 1-hour service to Nantucket. The private Hy-Line Cruises ferry terminal just south of Bismore Park provides service to both Nantucket and Martha's Vineyard. The ferries significantly affect other harbor users due to their size and need to maneuver within the confines of the harbor. They also cause shoaling in the harbor due to prop wash. Both ferries create a significant demand for parking in the harbor and in adjacent areas, especially during the peak summer tourist season.

Commercial Boat Operators - There are numerous commercial boat operators in the harbor including fishing charters (Predatuna Sportfishing Charters, Helen H, Hy-Line Deep Sea Fishing, etc.), sailing charters (Catboat Rides, Inc., Cape Cod Sailing Excursions), tour boats (Bay Spirit Tours, Hy-Line Cruises), and others (Pirate Adventures).

Reportedly, there is a push to encourage more recreational boating and commercial tour boats in the harbor, especially if the commercial fishing fleet in the harbor continues to decline. However, the number of recreational boats in the harbor has declined in recent years due mainly to the downturn in the economy.



Hy-Line ferry, Hyannis Inner Harbor

Commercial Fishing - The harbor's commercial fishing fleet consists roughly of 12 year-round boats and about 24 transient boats during the summer. Lobster boats, scallop draggers, and long-liners (or tub-trawlers) are among the commercial fishing boats in the harbor. Transient fishermen from surrounding New England states generally come from May to July to fish for surf clams, lobster, etc. The inner harbor is not an ideal base for commercial fishermen due to the congestion, mix of harbor uses (i.e., ferries, recreational boats, charter boats, etc.), and the lack of gear storage space along the waterfront. Aside from dockage, there are few facilities available for the commercial fishermen, such as

off-loading cranes, ice machine, etc. Parking for fishermen is available near the Ocean Street docks (town pier). Most commercial fishing boats tie up at the town pier, with other boats docking at the Pleasant Street dock (two lobster boats and an offshore dragger) and at the dock at the end of School Street. Fishermen off-load, re-fuel, and sometimes sell their catch at the town pier (though this is not a permitted activity). Some of the catch is sold to local fish markets, though the bulk of it is trucked off-Cape to Boston, Gloucester, etc. One local fisherman is involved in the Community Supported Fishery program. Increasing pressure from fishing regulations, sector management, and the overall cost of commercial fishing (permit fees, fuel, taxes, etc.) may eventually reduce the size of the fleet further. Despite the decline in number of working boats in the harbor, they are a tourist attraction (especially when off-loading) and continue to play an important role in the overall harbor experience.

Other – Visitors flock to the harbor, mainly during the summer, to view the boats, take a scenic tour of the harbor, eat at local restaurants, relax, play or watch an outdoor concert at Aselton Park. Commercial fishing boats and off-loading draws the interest of many visitors, who gain access to the waterfront along docks, both public and private. Although discouraged by the town, some recreational fishing occurs from the docks, especially at night during squid season (April-May). The Public Access and Recreation section discusses visitor uses in more detail.

Harbor Infrastructure

Hyannis Inner Harbor is physically built out and there is significant competition for space. There are two town piers: Bismore Marina (also known as the “Ocean Street docks”) and Gateway Marina, located off Pleasant Street. The Ocean Street docks serve commercial fishing vessels, tour boats (e.g., Bay Spirit Tours, Pirate Adventures, etc.), and private recreational boats. Ticketing is often dockside of the tour boat or nearby. As mentioned above, there is a long wait list for slips and moorings (~10 years) and they are very expensive. The natural harbor configuration limits space for additional boats, and there is no space around the harbor for storage racks (Hyannis Marina does store some boats on racks).

The harbor’s coastal structures were found to be in fair to good condition based on a survey by Ocean & Coastal Consultants, Inc. The town piers are reportedly in good condition with some minor repairs still needed (e.g., grant money is being sought for repairing the bulkhead at the Ocean St. docks). Gateway Marina primarily serves recreational boats but three commercial charter boats also tie up there. Pump-out stations are located at the Ocean Street docks (pumpout boat and shoreside facility), Gateway Marina (shoreside facility), and Hyannis Marina (shoreside facility). Commercial fishing boats refuel by tanker truck at the Ocean Street docks.

The Gary Brown boat ramp, Pleasant Street docks, and the new Welcome Center and dockmaster building at Bismore Park are the most recent projects. The Gary R. Brown boat ramp located off Lewis Bay Road became operational in 2009, and includes a two-lane boat launch, a new bulkhead with floats, and an increased number of parking spaces. Another public boat ramp is located off Old Harbor Road on the west side of the inner harbor. No new capital projects in the harbor are planned in the near future. Slip and dockage fees and embarkation fees from the Steamship Authority are used to fund harbor maintenance and improvements. The town currently does not have a harbor management plan.

Parking – Public parking is available at a number of locations around the harbor, including Ocean Street next to Bismore Park, next to Spanky’s Clam Shack, at the new Gary R. Brown boat ramp located off Lewis Bay Road, and at locations in downtown Hyannis. However, parking capacity near the harbor may be insufficient to meet peak demand. Long-term parking for ferry customers is located near the terminals and in satellite locations. Customers of the Hy-Line ferry, fishing charters, and tour boats put significant pressure on local parking. Use patterns (temporary, long term) of parking areas adjacent to the harbor are unclear.

Traffic - Traffic congestion around the harbor clearly increases in the summer months when the Cape's population nearly triples. The presence of the ferry terminals and Cape Cod Hospital create a unique traffic problem, with peak congestion generated by shift changes (hospital) or during ferry arrival/departure times. The inadequate capacity of roads within the harbor area to accommodate the high traffic volumes is highlighted by the bottlenecks that occur in the area several times a day: typically along Ocean Street, south of South Street, and at the signalized intersection of South Street, Ocean Street, and Old Colony Road.

The six-legged intersection of South Street, Ocean Street, and Old Colony Road is a primary concern for the town. The intersection operates fairly well except during ferry-generated traffic, and there are relatively few vehicular crashes (as compared to other locations in the town). Safe passage of pedestrians walking from downtown to the harbor on the “Walkway to the Sea” is a significant concern. Currently pedestrians must cross several lanes and wait for potentially two pedestrian crossing phases to reach the other side safely. The town is currently investigating options for improving pedestrian access at this intersection.

Dredging – The entrance channel to the inner harbor is a federally-maintained channel that was last dredged by the Corps of Engineers around 1995. Sediments from federal dredging were deposited at Kalmus Beach in 1985 and in 1997-98, which enhanced nesting habitat for shorebirds. However, erosion of these sediments subsequently contributed to shoaling in the bay, so dredged sediments will likely be placed elsewhere in the future. The Hyannis Marina also conducts regular maintenance dredging (where these dredged materials are disposed of is

unclear).

Shoals are created by the ferries churning up sediment within the inner harbor. A shoaling study of Hyannis Harbor/Lewis Bay completed in 2005 also identified shoaling in the Fish Hills embayment, near Bay Shore Road. Dredged materials from the inner harbor consist of silty sands that are not suitable for beach nourishment, and must either be trucked to a landfill or deposited offshore.

PUBLIC ACCESS AND RECREATION

There are several public access options to the harbor, including two town-operated marinas: Bismore Park Marina and Gateway Marina. Bismore Park on Ocean Street has public parking (fee, 103 spaces), as well as public access and viewing from a promenade along the Ocean Street docks. Public walkways along the edge of the harbor lead to Aselton Memorial Park (corner of South and Ocean Streets), which offers space for relaxation and passive recreation with a view of the harbor. Aselton Park also provides a venue for outdoor performing arts. While these public locations provide visual access to the water, the presence of bulkheads and other shoreline structures generally prevent direct physical access to the shore. Public restrooms are located at Welcome Center at Bismore Park, though additional facilities are needed.

A new boat ramp is located off Lewis Bay Road (Gary Brown boat ramp, 7 parking spaces) and a small boat ramp is located off Bayshore Road on the lower west side of the harbor. Jet skis and kayaks can be launched at the Gary Brown boat ramp, though recreational kayaking opportunities are limited in the busy inner harbor. Other public access points include: Gateway marina on Pleasant Street, the Pleasant Street wharf (also used by commercial fishermen), and a town “way to water” at end of School Street. The town is currently working on a shoreline path around the harbor.

Veterans Park (141 parking spaces) and Kalmus Beach (409 parking spaces) on Ocean Street provide beach access just outside of the inner harbor (Lewis Bay). Across the bay is another public beach, Bay View Beach, in Yarmouth. The town has identified most historic access points to the water and is in the process of re-establishing these “ways to water” despite opposition by some landowners. In an effort to bring more visitors from Main Street to the waterfront, the town completed a “Walkway to the Sea” in 2004, thanks to a \$1 million grant from the Massachusetts Department of Housing and Community Development.

The Cape Cod Regional Transit Authority (CCRTA), which operates the only public-transit bus system on Cape Cod, provides free trolley service seven days a week from late June through Labor Day. The trolley accesses the Steamship Authority and the Hy-Line ferry and Ocean Street docks. The Hyannis Area Trolley connects with other carriers at the Hyannis Transportation Center (Barnstable Villager, SeaLine, the H2O Line, P&B/Bonanza bus service to

Boston/Providence). Sidewalks around harbor area allow easy pedestrian and bicycle access.

ECONOMIC RESOURCES

A variety of businesses are located around the inner harbor including restaurants (Spanky's Clam Shack, Baxter's Fish n' Chips, Dockside Bar, Tugboats Restaurant), overnight lodging (Hyannis Harbor Hotel, Anchor's Inn, Hyannis Holiday Motel), and other marine related businesses, such as Oyster Harbor Marine. Cultural sites of note

include the Cape Cod Maritime Museum, located on the north side of the harbor next to Aselton Park, which celebrates Cape Cod maritime history with various maritime-related activities.

Seven artist shanties in Bismore Park provide affordable studio and gallery space for local artists who create and sell their work from May to September. Both the artist shanties at Bismore and Aselton Park with its outdoor concerts and other

performing arts, are part of the Hyannis Arts District. The village has a fledgling art community that would benefit from greater town support. Although not on the harbor, the Kennedy Museum, JFK Memorial Park, and the Hyannis Armory where JFK gave his victory speech are located nearby.



Artist shanties at Bismore Park, Hyannis Inner Harbor

Visitors come to harbor for many reasons. Popular activities include enjoying a meal at one the harborside restaurants, watching fishermen unload their catch, experiencing the harbor and bay on tour boats, purchasing crafts at the artist shanties, or simply walking around the harbor. The ferries bring a lot of people to the harbor though typically just for a brief time as most are en route to or from the islands. Most harbor businesses are seasonal, with the exception of the ferries and marine supply businesses. The town is seeking more year-round business for the area, such as a hotel and conference center (there is a need for more year-round lodging). As with most towns on the Cape, affordable housing is insufficient to meet demand.

Woods Hole and Great Harbor

LOCATION AND HISTORY

The Woods Hole study area is located in Great Harbor at the extreme southwest tip of mainland Cape Cod. Great Harbor is mostly sheltered by Penzance Point to the west, Nonamesset Island to the south, and Juniper Point to the east. The shoreline and harbor bathymetry is somewhat irregular due to its location along a major glacial moraine (Buzzards Bay Moraine) and the presence of islands (Ram Island, Devils Foot Island) and numerous subtidal reefs. The mean tidal range at Woods Hole is 1.8 ft., with spring tides up to 2.3 ft. The currents in Woods Hole Passage, between Great Harbor and Nonomesset Island, can exceed seven knots, some of the swiftest in the world.

The study area includes the harbor area adjacent to the village of Woods Hole, the Steamship Authority ferry terminal, various research institutions, and Eel Pond, a small coastal pond (15-20 acres) linked to the harbor (Fig. 6). A drawbridge at the mouth of Eel Pond allows boats to enter and exit the harbor according to a fixed schedule. The village of Woods Hole itself is a vibrant commercial area that serves the marine research community, summer



Great Harbor and Woods Hole Village
weneedavacation.com

tourists, and people accessing the nearby islands of Martha's Vineyard and Nantucket. Woods Hole Oceanographic Institution (WHOI), Woods Hole Marine Biological Laboratory (MBL), and the National Marine Fisheries Service (NMFS) are among the research and education institutions at Woods Hole. WHOI is the largest private non-profit oceanographic institution in the world, and was incorporated in 1930. WHOI is also home of the deepsea diving research submarine, ALVIN, and its researchers are renowned for finding the *Titanic*. MBL is an international center for research, education, and training in biology, biomedicine, and ecology. The Northeast Fisheries Science Center is the research arm of NOAA's National Marine Fisheries Service in the region.

Historically, Woods Hole was one of the few good harbors (along with Hyannis) on the south side of Cape Cod and became a center for whaling, shipping, and fishing. During the years from 1863 to 1889, the economic life of Woods Hole centered around the *Pacific Guano Works* plant which was located at what is now known as Penzance Point. The company went bankrupt in 1889 bringing financial hardship to many Woods Hole residents. The period from 1871 to 1887

witnessed Woods Hole reinventing itself into a scientific research center, a concept conceived and implemented largely through the efforts of Spencer Baird. Baird was the Assistant Secretary of the Smithsonian Institution and became the first U.S. Commissioner of Fish and Fisheries (now NOAA's National Marine Fisheries Service), which was the nation's first Federal conservation agency. Fisheries research began in Woods Hole in 1871, but a permanent research station did not exist until 1885.

NATURAL RESOURCES

Great Harbor and most of the adjacent waters of Vineyard Sound and Buzzards Bay are identified as Priority Rare Species Habitat by the Massachusetts Natural Heritage Program (Fig. 7). Eelgrass covers a large part of the western half of Great Harbor and smaller patches are mapped along the coastline (including Eel Pond) within the study area itself. The west side of Great Harbor and Eel Pond are identified as suitable habitat for quahogs (Fig. 8). Although the harbor is heavily used by ferries, marine research vessels, and other recreational and commercial interests, its overall water quality is reported as generally good (probably due to good tidal circulation). Since the village area is sewered, nitrate pollution is not a significant concern for the harbor. However, stormwater infrastructure (which is reported to be about a century old) discharges to the harbor. Pump-out facilities help mitigate pollution caused by boat discharges.

There currently are no aquaculture leases or other marine resource industries currently operating in the harbor adjacent to the study area.⁷ The town has an interest in increasing aquaculture, but needs to develop a policy to guide where and when leases would be granted.

SHORELINE CHANGE AND COASTAL VULNERABILITY

Based on available shoreline change data, Woods Hole's shore is accreting up to about a foot per year (probably due to its sheltered location). Much of the village adjacent to the harbor and Eel Pond is located in a coastal flood zone (A and V zones) (Fig. 9). Three critical facilities (Drawbridge Hut, Penikese Island School, Woods Hole Library) in the village are located in the SLOSH zone. Massachusetts Coastal Zone Management's StormSmarts Coasts program selected Falmouth as one five pilot projects to help coastal communities address challenges associated with storms, floods, rising sea-level, and climate change. Through multi-hazard mitigation planning and use of FEMA's HAZUS model,

⁷ Although not directly tied to Woods Hole, a local Falmouth firm (Associates of Cape Cod, Inc.), is a global supplier of a clotting component known as Limulus Amoebocyte Lysate (LAL), which is derived from horseshoe crabs. LAL is necessary for the detection of human pathogens in drugs, patients, and intravenous devices. Since no synthetic substitute has the same accuracy as LAL, horseshoe crab blood must be used. The company received the first license by the FDA for this purpose. The market for LAL is approximately \$50 million per year at this time.

Falmouth is taking action to adapt to future changes along the coast.⁸ Beach nourishment, moving vulnerable infrastructure, utilities and services, and land acquisition are potential mitigation actions under consideration by the town.

HARBOR USE AND INFRASTRUCTURE

Harbor Users

The Steamship Authority and the marine research and education institutions (WHOI, MBL, and NMFS) are the dominant users of the study area. The ferry provides passenger and vehicle transport from Woods Hole to Vineyard Haven on Martha's Vineyard. (The route of the New England Fast Ferry, which runs between Martha's Vineyard and New Bedford, passes through Woods Hole Passage.) Mooring fields for private recreational boats (mostly sailboats) are located in Eel Pond and the west side of Great Harbor. A significant percentage of the harbor's recreational boating is by transient boaters passing through the area. In general, there's little available dockage and virtually no more space for moorings. Recreational anglers in their own boats or charter fishing boats travel offshore to catch tuna (bluefin, yellowfin, albacore or big-eye), sharks, and marlin. Sport fishing enthusiasts come to Woods Hole every year to participate in the annual July Monster Shark Fishing Tournament on Martha's Vineyard. The U.S. Coast Guard's Southeastern New England sector station (RI to Boston) is located in Little Harbor, just east of Great Harbor.

The marine research institutions at Woods Hole (especially WHOI) own and occupy large areas of the waterfront. WHOI's Bigelow Laboratory, Smith Laboratory, and Iselin Marine Facility are located just north of the ferry terminal. NOAA research ships Albatross IV and Delaware II are home-ported in Woods Hole. Although research vessels are highly visible when in the harbor, they are often out at sea.



Research vessels at Woods Hole Oceanographic Institution (hydro-international.com)

⁸ HAZUS-MH is a powerful risk assessment methodology for analyzing potential losses from [floods](#), [hurricane winds](#) and [earthquakes](#). In HAZUS-MH, current scientific and engineering knowledge is coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs.

About 10 commercial fishing boats tie up at the town pier, with a handful of other transient fishermen (seasonal squid fishermen) who tuck into the harbor when needed. Most fishing boats are outfitted for trawling (groundfish) and pot fishing (lobster). The number of home-ported vessels in Woods Hole has varied from 6 to 11 between 1997 and 2006. During this same period, the number of vessels with owners living in Woods Hole has declined, possibly reflecting the high cost of housing in Woods Hole. Total landings (fish) in Woods Hole peaked in 2001 and have declined ever since (to 2006). Fueling and off-loading of fish is allowed at the pier, but fishing gear is generally stored elsewhere. Recreational boats are allowed to tie up at the town pier only temporarily. There are no fish processing plants in Woods Hole and fishermen sell their catch to regional distributors. Although the town supports the local commercial fishing industry, Woods Hole is less than ideal for fishermen for several reasons including: local traffic congestion, restricted parking, more expensive dockage rates, cost of living, and lack of affordable housing. Ongoing changes in the ocean environment (probably related in part to climate change) may also impact the local fishing community. For example, the lobster fishery in Buzzards Bay and elsewhere along the Cape's south shore is threatened by warming seawater temperatures that affects spawning of this coldwater species. Overall, the fishing fleet, while present at Woods Hole, is dwarfed by the harbor's other uses.

Visitors to Woods Hole Village also visit the harbor, although waterfront access is somewhat limited (e.g., Waterfront Park). Visitor activities along the waterfront and in the village are discussed in greater detail in the Public Access and Economic Resources sections.

Harbor Infrastructure

Municipal infrastructure includes the town pier and boat ramp (located next to the Northeast Fisheries Science Center on Albatross St.), a small pier on Eel Pond, and a small dock near the Eel Pond drawbridge. The town pier was re-built about seven years ago and is currently in good structural condition.⁹ There is no fuel dock at Woods Hole and boaters must go elsewhere to re-fuel such as Martha's Vineyard or Falmouth Inner Harbor. In addition, there is no town parking near these facilities for visitors or boat trailers. Woods Hole Marine operates a three-season pump-out boat that services the harbor area. Public restrooms are only available at the ferry terminal.

The Steamship Authority is a strong presence in the harbor, not only due to the number of passengers and the size of the ferries, but also with the associated infrastructure including parking and staging areas. Most parking for ferry customers is located offsite except for a 44-car lot near the terminal where the Shining Sea bike path comes into town. Parking elsewhere in town (street side) is metered. Off-site ferry parking areas include: Palmer Ave. lot, Cataumet lot,

⁹ The rehabilitation work was funded by the Seaport Advisory Council and Office of Fishing and Boating access, which requires that the structure be publicly accessible.

Gifford Street lot, and the Sun lot. Ferry operations do not interfere with overall harbor operations, but traffic associated with the ferry clogs local streets, especially when tourists attempt to park in the village instead of using satellite parking.

Pinky's Marina and Woods Hole Marine (both in Eel Pond) offer slips and moorings for boats up to 50 feet in length. Woods Hole Marine, the largest mooring holder, is the only recreational fishing supply store and service center in the village. Woods Hole Yacht Club is also located on the harbor, off Bar Neck Road. Like most other Cape harbors, there is always a demand for moorings and slip space.

Bourne Consulting Engineering conducted a statewide inventory of coastal structures. Many of the structures in town need to be repaired but none of this work is pending. Shoaling is not a significant problem in the harbor. However, the Corps of Engineers dredged a section of the harbor near the NMFS building to allow the NOAA research vessel *Henry B. Bigelow* to dock. The dredged materials were re-used at Menauhant Beach, near Bourne Pond, in Falmouth. The town currently does not have a harbor management plan for the study area. Boat landing, slip and mooring fees are used by the town's Waterway committee to fund harbor maintenance and improvements.

PUBLIC ACCESS

Direct shore access is limited to the public boat ramp on Albatross Street (next to the town pier) and a small, town-owned property (~1 acre) just north of the Steamship Authority that provides water access (specifics on this parcel are not known). Although the remaining shore in Woods Hole is privately owned, visitors can access the waterfront at places such as Waterfront Park. The Bell Tower Garden on Millfield Street (next to Eel Pond) is also publicly accessible. Kayaks are also a popular way of exploring the harbor, and jet skis are allowed in the harbor and Eel Pond at headway speed. Launching any type of trailerable or hand-carry boat is probably hampered by the limited parking in town.



Woods Hole Village (weneedavacation.com)

Access to the village is possible by car, bus, boat, or bike. Motorists may be frustrated by congested roadways during summer and limited parking. Parking

is limited to metered street parking (metered Steamship Authority parking, 44 spaces, is for ferry passengers only), and there is virtually no publicly-owned space to create additional parking. A better way to access the village and harbor is by the Cape Cod Regional Transit Authority's WHOOSH trolley that runs seven days a week (roughly on a half hour schedule) from Falmouth Mall and the town hall lot to Woods Hole. Bicyclists can reach the village via the Shining Sea Bikeway, which runs from North Falmouth along the Buzzards Bay shore to Vineyard Sound and Woods Hole (about 10 miles).

The town owns a couple of conservation parcels on the Penzance peninsula and parts of both islands in Great Harbor (Rams and Devils Foot) are protected as conservation land (Penzance Point is a gated community and is not publicly accessible). Stoney Beach, a town beach on Buzzards Bay, is for residents only and has limited parking. A town committee is currently researching the few right-of-ways to shore that exist.

ECONOMIC RESOURCES

Woods Hole village is the primary marine science, technology and education center on the Cape, and also serves as a major transportation hub for the Steamship ferry terminal. Local village-based tourism, arts and leisure, and commercial fishing are also components of the local harbor economy. The village is zoned as Public Use (research/education institutions), General Business, and Single Residential.

Roughly half of Woods Hole village is owned by private research institutions with much of the remaining area occupied by the Steamship Authority and private business. WHOI, the Steamship Authority, and MBL are the largest employers in Woods Hole. The mix of commercial businesses includes retail (gifts, arts/crafts, art gallery, many by local and regional artists), numerous restaurants, lodging, and services (bank, taxi, marine supply, library, etc.). In general, private residential development is increasing (beyond the village) while the number of hotels and motels are decreasing, with some having been converted to time shares and Section 8 housing. Many tourists that come to Woods Hole are passing through (ferry passengers, boaters) or are day-trippers, so there currently is not a strong need for additional overnight lodging facilities. Affordable housing is also lacking, forcing lower income residents (fishermen, artisans, etc.) to live elsewhere (the town is working to increase this segment of housing stock). Penzance Point is a gated residential community on the west side of the harbor that consists of high end homes with no public access.

The main tourist attractions are Woods Hole village, the scientific research institutions (WHOI, MBL), the Aquarium at the Northeast Fisheries Science Center (the oldest in the country), and the Nobska Point Lighthouse, which is located roughly a mile east of the village. MBL's visitor center and WHOI's Ocean Science Exhibit Center also attract visitors. Fishing draws many people to

Woods Hole. As previously mentioned, sport fishing enthusiasts enjoy the annual Monster Shark Fishing Tournament on Martha's Vineyard in July and the Calcutta Fishing Derby which continues through the month of September (the derby is sponsored by the Woods Hole Business Association). Woods Hole Theatre Company on Water Street is a small venue for plays at affordable prices. The annual Woods Hole Film Festival brings a week of independent films, events, and workshops to the village. Otherwise, Woods Hole does not host a significant artist community. Areas along Water Street (downtown Woods Hole), Church Street, and Juniper Point and Hinckley Roads are historic districts, with many architecturally significant buildings. All of these local places and events draw tourist and tourist dollars that are pumped into the local economy.

Provincetown Harbor

LOCATION AND GEOGRAPHICAL CONTEXT

Provincetown Harbor is a natural harbor that includes the waters between the town of Provincetown and Long Point, a large barrier spit that extends northeast from Wood End lighthouse. The barrier beach to Wood End and the Long Point barrier spit, which together extend nearly three miles in length, shelters the harbor from southwesterly winds and waves. A mile-long dike (referred to as the West End breakwater) was built a century ago to protect the harbor in the event of a breach of the barrier beaches. A true breakwater just seaward of the municipal pier provides additional shelter for the municipal pier, Fishermen's Wharf, and the adjacent waterfront. Provincetown's downtown is wedged between the harbor and Rte. 6, with most commercial development concentrated along Commercial Street which parallels the waterfront. Cape Cod National Seashore and the extensive Provinceland dunes are located just north of downtown Provincetown and Route 6. The study area focuses on the section of Provincetown Harbor near the municipal pier (MacMillan Pier) and Fishermen's Wharf, and along Commercial Street (Fig. 10).

Provincetown Harbor is almost entirely surrounded by unique natural land- and seascapes including the beaches, salt marshes, dunes, coastal forests, and woodlands of Cape Cod National Seashore. The National Seashore's Provinceland Dunes are significant in terms of their scale and form as well as geology, ecology, and aesthetics. Culturally significant features such as the Provincetown Historic District, the Pilgrim Monument, and the lighthouses on Long Point provide a quintessential Cape Cod backdrop to the harbor. The harbor affords views of three working lighthouses: Long Point, Wood End, and Highland (or Cape Cod) Light. All three lighthouses are on land within the Cape Cod National Seashore. The Provincetown Historic District includes most of downtown Provincetown, and is listed in the National Register of Historic Places. Other noteworthy natural resources near the harbor include Stellwagen Bank National Marine Sanctuary.



Provincetown Harbor

NATURAL RESOURCES

Exceptional natural resources occur within and around Provincetown Harbor (Fig. 11). Water quality in the harbor is generally good to excellent due to unrestricted tidal exchange (tidal range ~12 feet).¹⁰ While most of Commercial Street is sewered, not all waterfront properties are connected and bacterial contamination from poorly functioning septic systems (and/or other sources) may be the cause of some beach closures. The town has also been working to reduce point source and non-point source pollution to the harbor with funding from MassDEP 319 grants.¹¹ These efforts have resulted in fewer beach closures. Provincetown Harbor (along with Cape Cod Bay) is a *No Discharge Area*, which is an EPA designated body of water where the discharge of treated and untreated boat sewage is prohibited.

Other important coastal resources in the harbor include eelgrass beds, finfish resources, and the extensive tidal flats inside Long Point and near Mayflower Heights (east end of downtown) and the shellfish they support. Extensive beds of eelgrass occur in the inner harbor but have been damaged by recreational and commercial boating, the placement of docks and moorings, and other development activities in the coastal waters. The Mass Bays Program initiated a two-year restoration and monitoring program to restore eelgrass in the harbor in 2010.¹² The town also has grant funding from the NFWF Fishing for Energy partnership to remove fishing gear and debris from the harbor bottom.

Mapped habitat for quahogs and soft-shelled clams occurs in the inner harbor, with surf clam habitat more seaward and near Long Point (Fig. 12). There are three designated shellfishing areas (east and west of the Wood End breakwater, and the west and east ends of the harbor) and six private aquaculture grant areas just east of the Wood End breakwater. The inner section of the harbor in and around the waterfront and town pier is closed to recreational shellfish harvesting. The flats inside Long Point are seasonally open (with the exception of private aquaculture grants).

No rare species or NHESP priority natural community types are identified in the harbor itself, although these important biodiversity features are documented at the National Seashore. At least one invasive marine species has been documented, *Didemnum vexillum*, a colonial tunicate or sea squirt that fouls marine habitats, ship hulls, and other marine structures.

The West End Breakwater encloses extensive salt marshes formed in the lee of the barrier beaches. The town recently approved the initiation of a feasibility

¹⁰ UMass Dartmouth has conducted 3 years of testing and the Provincetown Center for Coastal Studies has done water quality sampling in Cape Cod Bay.

¹¹ There are 25 outfall along the waterfront and the town is working to eliminate them (3 were removed as of 2009) (draft Provincetown Harbor Plan, 2009).

¹² Developing an eelgrass nursery may happen depending on the outcome of the restoration.

study by the Corps of Engineers that will take a closer look at the potentially harmful effects the breakwater is having on the salt marshes in the West End by restricting flow.

Scenic views in and around the harbor are important elements of the tourist experience. These include: the view of the lighthouses and dunes on Long Point and Wood End; views from the water of the piers and boats in the harbor with the downtown (Universalist Church, town hall, and the library, etc.) and the Pilgrim Tower as a backdrop.

SHORELINE CHANGE AND COASTAL VULNERABILITY

The shoreline of Provincetown Harbor has been relatively stable over the last 150 years. MassGIS shoreline change maps indicate the inner harbor shoreline as generally accreting at a rate of 0-2+ ft/yr (hence the need for periodic dredging). Coastal flood zones (A, V zones) affect the entire length of the harbor shoreline though only in a few locations do they extend to Commercial Street (Fig. 13).¹³ Five critical facilities or infrastructure sites are located in the coastal flood zone (A and V zones) including: MacMillan Pier and Provincetown Yacht Club/Harbor Master/Fish Plant, Fishermen's Wharf and Provincetown Marina/Fish Plant, Fire Station #5 (514 Commercial St.), U.S. Coast Guard Station (125 Commercial St.), and Flyer's Boatyard (131A Commercial St.). Hurricane-induced surges from Category 2, 3 and/or 4 hurricanes (SLOSH zones) extend over and across Commercial Street in several locations in the study area.¹⁴ Several critical facilities near the waterfront but outside of the coastal flood zone would be impacted by a hurricane surge. The town is currently awaiting FEMA approval of its Multi-Hazard Mitigation Plan.

HARBOR USE AND INFRASTRUCTURE

Provincetown Harbor supports a wide variety of infrastructure and users including a commercial fishing fleet, recreational fishermen, U.S. Coast Guard, harbor cruise boats, passenger ferries, and the local whale watch fleet. The U.S. Coast Guard small boat station and pier near the west end of the harbor is a sub-unit of Sector Southeast New England. The Provincetown Center for Coastal Studies, a non-profit marine research, stewardship and educational organization, also works out of the harbor.

Harbor Users

Recreational boaters are proportionally the largest users of the harbor, with motorboats outnumbering sailboats. Commercial charter and party boats also

¹³ Zone B (potential areas of 100-yr. flooding of <1 ft.) flooding extends across the section of Commercial Street landward of the town pier.

¹⁴ SLOSH or Sea, Lake, and Overland Surges by Hurricanes.

serve recreational fishermen and tourists. Currently, about 70 commercial fishing boats, both home-ported and transient, use the harbor. The Provincetown Yacht Club, established in 1867, is the second oldest yacht club in the country.

Commercial Boat Operators – A number of commercial boat companies operate out of the harbor (mostly docking at the municipal pier), such as charter fishing boats, excursion schooners and harbor tour boats, and Provincetown's renowned whale watch fleet (Dolphin, now merged with Portuguese Princess). The whale watch boats run from April to late October, weather permitting. Ferries also dock at the municipal pier. The Provincetown to Boston ferry (Bay State Cruise Company) docks at MacMillan Pier, making runs to and from Boston three times daily from May to October. The Boston Harbor Cruise Lines (Provincetown fast ferry) and the Plymouth to Provincetown Express Ferry also dock at the town pier. Revenue from the ferries provides significant income for the town pier.

Commercial Fishing - The commercial fishing industry is no longer the mainstay of the community's economy, but its cultural significance persists. MacMillan Pier is the primary base of operation for commercial fishermen, who store boats and gear, and even park on the pier. About 70 commercial boats currently work out of the harbor, including fishermen who berth their boats in the harbor year-round and transient fishermen who come in season. The



Commercial fishing boats, Provincetown Harbor
infonavigate.com

number of home-ported vessels generally declined, from 45 in 1997 to 27 in 2006. In 2007, the number of commercial fishing boats in the harbor was: 14 draggers over 50 feet (of which 12 operate regularly), eight dragger/flex-boats under 50 feet, and at least 35 lobster boats. The number of draggers in the harbor has declined the most, with a trend toward smaller vessels rigged to take advantage of changing conditions and proximity of the fishing grounds. Smaller vessels require less crew and fuel to operate and can get out and back more quickly. In addition, rigging and operations on smaller boats are more easily changed to adjust to seasonal fluctuations of product. The town has invested in harbor infrastructure to support local fishermen by constructing an off-loading dock for small boat fishermen, installing three jib cranes for off-loading fish, and installing an ice plant and delivery system (undercutting New Bedford delivered ice prices). The draft Harbor Management Plan also identifies other facilities at the town pier that would benefit fishermen such as freshwater, restrooms, a small lift for off-loading fish, etc.

There are no fish processing businesses in town, so catches are shipped to New Bedford by the fishermen themselves or in buyers' trucks. Fishermen harvest groundfish (cod, haddock, yellowtail flounder, monkfish, dogfish, etc.), lobsters, scallops, and shellfish. Groundfish landings have declined since 2006, while lobster and scallop harvests have increased. Commercial groundfishermen (from Provincetown and elsewhere) are under great pressure from low stocks and emerging regulations. In addition, permits are being consolidated, forcing some small fishermen out of business. The industry will continue to be in flux, with lobstering probably remaining steady for the foreseeable future, while new regulations affect other types of fishing (e.g., scalloping). Hydraulic clamming, which some local fishermen employ, is controversial due to its impacts to eelgrass and other benthic environments. Shellfish aquaculture was an expanding industry before the QPX (a quahog parasite) increased mortality in cultivated shellfish. The draft Harbor Management Plan states that aquaculture (of species that don't harm the marine ecosystem) should be a priority use of the harbor given its potential role in sustaining and revitalizing the commercial fishing industry. Future use of artificial reefs in the harbor to directly or indirectly enhance commercial fishing/shellfishing may become more common.

Harbor Infrastructure

Harbor infrastructure in the harbor includes piers and wharves, berthing space, mooring fields, and navigation channels and fairways. MacMillan Pier (municipal pier) was completely reconstructed and enlarged in 2004 at a cost of \$18M.

Provincetown's marine facilities (including MacMillan Pier) are managed and maintained by the Provincetown Public

Pier Corporation.¹⁵ In addition to commercial fishing boats, charter boats, whale watch boats, ferries, and other excursion boats tie up here. The town pier is well protected except when easterly winds kick up waves which strike the floating dock and commercial fishing boats tied up on the east side of the pier (where most working boats are berthed). The town hopes to install a wave attenuation



MacMillan Pier and Harbormaster's office, Provincetown Harbor (iamprovincetown.com)

¹⁵ PPPC's mission is to effectively manage, maintain and improve Provincetown's marine facilities; to stimulate economic development; to encourage and support commercial fishing; and to ensure a safe and welcoming harbor (www.provincetownpublicpiercorporation.com)

structure to dampen waves to protect both town infrastructure and the fishing boats. The town also maintains a free transient dinghy dock and a courtesy float.

Fishermen's Wharf is privately-owned and was reconstructed in 1970s (but is now near end of its useful life). In addition to its rustic façade, the building at the end of the pier is embellished by an outdoor art installation of five large portraits of local Portuguese-American women photographed by Norma Holt (titled *They Also Faced the Sea*). The installation, visible from afar, was conceived as a tribute to the Portuguese community and its fishing heritage. The pier also has a fuel dock, cell phone service and entertainment venues, and mainly serves recreational boats. The town is interested in buying Fishermen's Wharf and would expand it with additional slips and other amenities for recreational boaters. Renovations would be funded (in part) using revenue from these additional uses.

A large private mooring field is located east of the town pier and a rental mooring field is located west of Fishermen's Wharf. Flyer's Boat Rental also maintains a mooring area just east of the Coast Guard pier. The current unmet demand for slip space is about 100-200 slips, which is roughly what might be added to Fishermen's Wharf if and when it's re-built. A shoreside pump-out facility is located between the town pier and Fishermen's Wharf and is connected to the sewer. A 300-gallon pump-out boat that services the harbor is also available. The town plans to construct a separate, sewer-connected pump-out station to service ferries and other boats that can't reach the bulkhead. Boaters can re-fuel at the CITGO fuel dock located on the far side of Fishermen's Wharf, and fuel trucks deliver diesel for larger boats. The Provincetown Marina located at Fishermen's Wharf has both slips and moorings for seasonal and transient vessels. Berths and moorings are also available at the Whydah Pirate Museum and Flyer's boat rental.

The U.S. Coast Guard also maintains a large, concrete pier in the harbor, located near the intersection of Commercial and Franklin Streets. USCG administrative buildings and barracks are located at the proximal end of the pier. The current USCG station opened in 1979 and is responsible for safety and law enforcement across 1,200 square miles of Cape Cod Bay and the Atlantic Ocean.

As mentioned above, a mile-long dike (referred to as the West End breakwater) was built a century ago to protect the harbor in the event of a breach of the Long Point and Wood End barrier beaches. The dike is also a popular access for sightseers and fishermen. A true breakwater, built between 1970 and 1972 and located about 850 feet seaward of MacMillan Pier, provides additional protection for the municipal pier, Fishermen's Wharf, and the adjacent waterfront. Most of the harbor shoreline is unprotected by coastal structures (seawalls, revetments, etc.).

Dredging – Provincetown Harbor is accessed via a federal entrance channel off Long Point that extends to the inner harbor and diverges to fairways leading to the municipal pier, Fishermen’s Wharf, and the Coast Guard pier. Maintenance of the federal channel is managed by the Coast Guard, but it generally needs little dredging. The areas between the town pier and Fishermen’s Wharf and east of the town pier will require dredging within the next five years. Most of the sediments dredged from the harbor by the County have been re-used to nourishment local beaches (some harbors sediments are contaminated). The draft Harbor Plan calls for a regular maintenance program for areas outside the federal channel.

PUBLIC ACCESS

There are a variety of ways for the public to access Commercial Street and the harbor without driving directly into town: shuttle bus, ferry, boat, etc. With traffic congestion and limited parking around the harbor a major issue during the summer, optional means of accessing the harbor are important. The town is trying to encourage less automobile use since parking is at capacity during the summer. In addition, the town is seeking possible TIGER grant funding for a parking structure.¹⁶ Visitors currently can park for a fee in the municipal parking lot near the town pier or the private lot a block further at the end of Standish Street.

The Provincetown Shuttle bus runs on a 30 minute schedule from North Truro to Provincetown (MacMillan Pier), and to other points of interest such as Herring Cove Beach, Race Point, and other parts of town. The Flex bus runs between Harwich and Provincetown every hour. The Provincetown to Boston high speed ferry (Bay State Cruise Company) docks at MacMillan Pier, and runs to and from Boston three times daily from May to October. The Plymouth to Provincetown ferry also docks at the town pier and makes runs twice a day. The Plymouth and Brockton bus company makes runs twice a day between Boston and Provincetown. Provincetown Marina is located at MacMillan Wharf and has both slips and moorings for seasonal and transient vessels. The town is also working on bike trails in-town, which would support the four, local bike rental companies. Public restrooms for visitors are located in several places (near the town pier, town hall, Fishermen’s Wharf, Court St.), and the town is looking to install more.

Many street ends on the harbor are historic rights-of-way. The draft harbor plan identifies 13 town landings, but other landings, ROWs, and cart roads exist. Abutting landowners have encroached on many ROWs with plantings and fences, etc., and the town is currently attempting to recover as many ROWs as possible and improve viable ones with signage, enhanced viewing, and amenities such as

¹⁶ The TIGER grant program (Transportation Investment Generating Economic Recovery) is a new grant program authorized by the American Recovery and Reinvestment Act of 2009, and administered by the Department of Transportation (DOT).

benches, bike racks, dinghy tie-ups, and dog waste bags. Visitors can use the beaches on either side of the town pier.

Visitors can launch a boat from the West End public boat ramp, located off Commercial Street, near West Vine Street. The boat ramp site has a metered parking area, but limited space for trailers and no float. Jet skis must launch from the boat ramp at Good Templar Place and follow the fairway out of the inner harbor. Boat rentals can be arranged at Flyer's Boat Rental and outfitters in town rent kayaks for day use. For those without boats, there are several charter boats, whale watch boats, excursion schooners, and harbor tour boats available.

ECONOMIC RESOURCES

Provincetown's waterfront is a vibrant mix of water-dependent and non-water-dependent businesses and residential uses, and hosts a well-established arts community (Provincetown is America's oldest art colony). Most businesses depend on tourists visiting the waterfront, Provincetown tower, art galleries, etc. The quirky charm of the downtown area itself is a unique tourist attraction. One



Commercial Street, Provincetown (iamprovincetown.com)

third of the town (from the Provincetown Inn to Allerton) is designated as a historic district. Provincetown is listed on the National Trust for Historic Preservation's Dozen Distinctive Destinations that offer an authentic visitor experience by combining a dynamic downtown area, cultural diversity, attractive architecture, cultural landscapes, and a strong commitment to historic preservation, sustainability and revitalization. The town has grown into a welcoming place largely built around and by the gay and lesbian community. The Provincetown Business Guild was created to promote the gay and lesbian community in town, and now represents the interests of over 280 gay-owned businesses.

Other tourist attractions in the area include whale watching, and the beaches and dunes of the Cape Cod National Seashore. The area's ecotourism potential is significant and the town hopes to reach out to Mass Audubon and the Provincetown Center for Coastal Studies to further this opportunity. The town recognizes the area's value as a national (and maybe international) destination, and has a strong interest in enhancing the viability of the local tourist industry and maintaining and increasing water-dependent uses. The Public Pier

Corporation, which manages MacMillan Pier, promotes water-dependent uses of the pier. The town's Visitor Service Board administers a "tourist fund" which derives from room tax revenues (35%); the money is used to market the town and promote the local tourist industry. While the number of hotel rooms in town has declined, the availability of short-term rentals has increased. The roughly 67% of private residences that are second homes are available as weekly rentals, which are not required to pay room tax. As a result, the town guest tax revenues (11% tax on lodging) have fallen. In addition, the increase in short-term rental housing drives housing prices higher, with second home owners benefiting, not year-rounders.

Provincetown's seasonal tourist economy is relatively strong, with marine-dependent businesses, such as whale watch tours, fishing charters, and boat tours, relatively steady. The town also hosts the annual Blessing of the Fleet (started in 1948) and the Provincetown Portuguese Festival during the last weekend of June. The Great Provincetown Schooner Regatta, an eight day sailing and educational event that honors the area's maritime heritage and that promotes awareness of the historic importance of schooners and other historic vessels, begins on Labor Day weekend. With the tourist season only five months of the year, however, the Economic Development Council is striving to develop a more diversified, year-round economy. Finding ways to extend business and attract visitors during the shoulder seasons is a focus. Provincetown's distant location and the relatively low number of year-round businesses and population are among the challenges in creating a year-round economy.

The town's goal is to redevelop the waterfront and more effectively open the commercial district to the waterfront (most businesses along Commercial Street currently face away from the harbor). In addition, the town would like to capitalize on the value of Fishermen's Wharf as a town facility, turn the municipal parking lot into a park, and increase access to the waterfront. Selectman recently backed off on a P&S agreement with the Cabral family (owners of Fishermen's Wharf) due to uncertainty about the structural condition of the pier (deferred maintenance) and the current economic situation.

Provincetown has many art and entertainment venues. There are about 70 private art galleries in town. The Provincetown Art Museum, in addition to displaying art, offers courses for artists, painters, sculptors, writers, etc. The Fine Arts Work Center, a non-profit enterprise, is devoted to encouraging the growth and development of emerging visual artists and writers through residency programs. The Norman Mailer Center and writing colony offers workshops and fellowships for writers. The town hall auditorium, which seats 700, provides meeting space and hosts concerts and film showings. The Provincetown Theater and Art House, Unitarian Universalist ("UU") Church, and MacMillan Pier also serve as venues for performances. Unfortunately, the Hawthorne School of Art, where Norman Rockwell and other iconic painters honed their talents, is up for sale. Sitting on some of the last open land in Provincetown, Mass., it is likely to

be cut up for housing.

Affordable housing stock is insufficient to handle the demand and makes it difficult to recruit new employees. Although there is a large resident artist population in town, some are forced to leave due to the high cost of housing. Provincetown has the highest unemployment rate in state due to its highly seasonal economy. Only 3-4 restaurants are open during the winter. Overall, year-round economic activity has diminished due to the economic decline and high housing costs.

The town is currently working on several capital projects including the library restoration, extensive renovation of town hall (recently completed), and the repaving of Commercial Street.

Chatham Harbor and Stage Harbor

Note: Chatham Harbor is the focus of this part of the study, especially its role in the local commercial fishing industry. Stage Harbor was included in the study area due to its close proximity to Chatham Harbor and its importance to local fishermen working the waters of Nantucket Sound and points south.

LOCATION AND GEOGRAPHICAL CONTEXT

For most of the last century, Chatham Harbor was sheltered from open ocean conditions by Nauset Beach, a barrier spit extending south from Orleans and sheltering Pleasant Bay (the beach is part Cape Cod National Seashore). The breaching of the barrier beach in 1987, and again in 2007, resulted in the formation of tidal inlets that have caused significant changes to tidal dynamics and sediment transport patterns in Pleasant Bay and Chatham Harbor. The section of Nauset Beach south of the 1987 inlet has since attached (at its north end) to the Chatham mainland, and is now known as South Beach. The barrier island located between the two inlets is known as North Beach Island. Chatham residents refer to the Nauset barrier spit as North Beach.

Chatham Harbor (Fig. 14) is a shallow coastal waterbody located between North Beach Island and the mainland shore, and extends from Ministers Point to the 1987 inlet. The economic focal point of the harbor is Aunt Lydia's Cove and the Chatham Fish Pier where fishermen off-load their catch for packing and shipment to market. Tourists can watch the incoming fishing boats and view the harbor and barrier beaches from an observation deck on top of the Fish Pier building. The location of



Chatham Harbor (tripadvisor.com)

Chatham Harbor at the “elbow” of the outer Cape provides local commercial fishermen with relatively easy access to offshore fishing grounds.

Coastal and subtidal environments in and around Chatham Harbor are still in flux and adjusting to changes in tidal hydrology caused by the formation of inlets in 1987 and 2007. Tern Island, owned and managed by Mass Audubon, is located in Aunt Lydia's Cove about 600 ft. from the Fish Pier. Sand associated with local dredging projects has been placed on the island as recently as 1995. Most, if not all, of the harbor's western shore is built out with private residences and at least

one resort (Chatham Bars Inn).

Stage Harbor (Fig. 15) located on Nantucket Sound, is about two miles by land from the Fish Pier but considerably further by water now that Monomoy Island is attached to the mainland. The harbor is a naturally deep and serves recreational craft and working boats fishing Nantucket Sound and waters to the south. Except for Hardings Beach near the mouth of the harbor, most of the area is surrounded by private residences. Mill Pond and Little Mill Pond are tidal ponds that drain into Stage Harbor via the Mitchell River. Oyster Pond, another tidal pond, is linked by the Oyster Pond River to Stage Harbor. Tidal waters from the harbor and its tributaries flow to Nantucket Sound through a man-made inlet at Hardings Beach that was created by the Corps of Engineers in 1962.



Stage Harbor, Chatham (forum.woodenboat.com)

NATURAL RESOURCES

Chatham Harbor supports diverse, high quality marine and coastal resources, notably Pleasant Bay, Nauset Beach, North Beach Island and South Beach (Fig. 16). Due in large part to improved tidal exchange through the two breaks in the barrier beach, the harbor has excellent water quality and supports a healthy shellfish resource including quahogs, soft-shelled clams, blue mussels, and bay scallops (Fig. 17). Eelgrass is limited by the presence of migrating shoals but occur in small patches in the shallow nearshore area between Tern Island and Ministers Point and near the bayside shore of North Beach Island.

Nauset Beach, North Beach Island, and Tern Island provide nesting habitat for shorebirds, including state-listed species such as piping plover, common tern, and least tern (Chatham Harbor, Tern Island, and the barrier beaches are all identified as Priority Rare Species Habitat by NHESP). Red knots (a declining shorebird species) feed on the tidal flats in the harbor during fall migration, and various waterfowl (black duck, brant, common eiders, etc.) rest and feed in the bay and harbor during the winter. The American oystercatcher has recently reclaimed its historic nesting grounds in the area.

The tip of North Beach Island and the bar opposite the Fish Pier are important haul-out sites for harbor and gray seals during the winter, and for gray seals in the summer. The increasing presence of seals in the Chatham Harbor-Monomoy area year-round has attracted great white sharks in recent years, a phenomenon that has caught the attention of swimmers, town officials, and noted shark experts. Pleasant Bay sustains a large, actively breeding population of horseshoe

crabs (the northern section of the harbor is closed to the harvesting of crabs for bait).

Stage Harbor and its associated coastal ponds and tidal rivers, as well as Hardings Beach, are also identified as Priority Habitat for shorebirds. Piping plovers and least terns nest at Hardings Beach, and red knots forage on tidal flats in and around the harbor. Water quality in Stage Harbor is generally good although its more restricted inlet limits tidal flushing, exacerbating pollution impacts. Eelgrass coverage within Stage Harbor itself has fallen by up to 25% between 1994 and 2000. Given the harbor's valuable shellfish resources, the town is working to mitigate nitrate loading by sewerage sections of town within the harbor's watershed and by installing pump-out facilities.

SHORELINE CHANGE AND COASTAL VULNERABILITY

The stability of Chatham Harbor's shoreline has largely been dependent on ongoing changes in the location of the Nauset beach inlet(s) over time. Erosion along the harbor shore accelerates due to the increase in tidal currents and wave energy resulting from the formation of a new inlet. The results of a recent study of shoreline change using marshline and high water level shoreline indicators varied depending on the indicator used. On average, the harbor's shoreline appears to be eroding due to recent inlet formation and associated changes in tidal hydrology in the bay. Erosion rates exceed 2 ft/yr along the outer shore of Nauset Beach. Coastal flood zones (A, V zones) extend to the harbor shore (Fig. 18) but generally do not extend far inland or to Main Street due to the presence of seaward-facing banks along much of the harbor shore. The municipal Fish Pier, emergency boat ramp, and Coast Guard (54 Barcliff Rd. Ext.) are the only critical facilities located in the coastal flood and SLOSH zone. The U.S. Coast Guard station (37 Main St.), another critical facility, is located near the shore but not in either the coastal flood or SLOSH zone (a MediFlight landing zone is also located here). Two "repetitive loss properties" are mapped on the Chatham Harbor shore.

Two critical facilities, the Harbormaster's office and boat ramp (613 Stage Harbor Rd.) and Stage Harbor Marine (Bridge St.) are located in Stage Harbor. Both sites are located in the coastal flood and SLOSH zones.

HARBOR USE AND INFRASTRUCTURE

Harbor Users

Chatham Harbor has long been an important port for commercial fishermen due to its sheltered location and close proximity to productive near and offshore fishing grounds, especially Georges Bank. Fishing boats (day boats) return daily to the Fish Pier to off-load their catch of groundfish (cod, pollock, haddock, tuna,

etc.), lobster, and shellfish. Although ever stricter fishing regulations are putting severe pressure on many commercial fishermen, Chatham fishermen have adapted by outfitting their boats to harvest different fish and shellfish resources and by adopting a “sector” fishing technique promoted by Cape Cod Commercial Hook Fishermen’s Association. However, declining fish stocks, regulations, permit and fuel costs, etc., and the relatively high expense of living on the Cape are challenging many fishermen to stay in business.

The harbor is generally not suited for mooring sailboats or other recreational boats due to shallow water conditions and exposure. However, seal tour boats (e.g., Beachcomber) and charter fishing boats are located in the harbor. The Chatham Fish Pier is suited for limited numbers of tourists. An elevated deck at the Fish Pier provides visitors with the opportunity to watch commercial fishermen off-load their catch as well as enjoy a sweeping view of the harbor and barrier beaches. Visitors can also gain access to the shore on either side of the Fish Pier, and public restrooms are also available. Other public access points include Lighthouse Beach (temporary parking) and a few street ends with little or no parking (Claflin Landing, Andrew Harding Lane, etc.) due to previous erosion (refer to Public Access section). The U.S. Coast Guard Search and Rescue station is also located on the harbor, near the Chatham Lighthouse. The station maintains two surf-capable search and rescue boats at the Chatham Fish Pier.

Stage Harbor serves a more diverse harbor constituency including sailboats, motorboats, charter fishing and seal tour boats, and some commercial fishing boats. The U.S. Coast Guard maintains one surf-capable search and rescue boat at a private marina in the harbor. Being a naturally deep harbor, it also serves deep-draft vessels that can’t access Chatham Harbor. The Harbor Master’s office is also located at Stage Harbor, near the town boat ramp.

The harbor’s commercial fishing fleet includes home port and transient boats. Groundfish boats (long line, gill net, jig), lobster boats, and charter boats are home ported in the harbor. Offshore scallop boats, primarily from other ports, have recently begun to arrive in late April and remain until the end of summer. Tuna, striped bass, and summer flounder fishermen and their boats also use the harbor; three weir companies focus on squid, mackerel and scup.

HARBOR INFRASTRUCTURE

Chatham Harbor - The town re-built the bulkhead at the Fish Pier in 1999, and invested \$1M to re-build the packing houses at the Fish Pier in 2006. The packing houses are leased to private buyers. Fishing boats unload at the Fish Pier and temporarily tie up along piers and bulkheads on either side of the Fish Pier. The catch is boxed and iced at the two packing houses at the Fish Pier and shipped to dealers in Boston, New York and other auction houses. Some dealers buy fresh fish directly at the Pier and some is sold at the Chatham Fish Market next door. Although the town has kept its shoreline infrastructure in good shape,

it is considering new revenue sources to address to address a growing backlog of needed repairs (e.g., underground fuel tank replacement, bulkhead repair, etc.). With funds from the Seaport Advisory Council, the town installed new floats at the Fish Pier and a pier extension north of the Fish Pier in 2008 and 2010. There are no pump-out facilities or public dockage at the Fish Pier.

Most fishing boats are moored in Chatham Harbor east of the Fish Pier and in the anchorage between the Fish Pier and Tern Island. Shoaling south of Tern Island has forced some fishermen to move their boats further out into the harbor which is less sheltered. The harbormaster and the U.S. Coast Guard also berth their boats at the Fish Pier. Charter fishing boats and tour boats also operate out of the harbor. The shallow water conditions and exposure of most of Chatham Harbor is generally not suited for mooring sailboats and other recreational boats. The harbor is typically a “pass through” area for recreational boats from elsewhere in Pleasant Bay, with many recreational boats now accessing the ocean through the new inlet.



Working waterfront, Chatham Harbor

Visitors park in the upper lot at the Fish Pier for free (which typically overflows in summer) and fishermen use the lower lot (permit required). Only small parking lots (20 cars or less) are available for visitors wanting to access the harbor itself during the summer season. The town has established a beach sticker program (fee) that allows public parking along Bridge Street for visitors going to Lighthouse Beach (local businesses opposed this). Since there are presently few opportunities to expand public parking, other alternatives are being sought (e.g., the town is working with the Monomoy Refuge on bike/pedestrian options; also shuttling from offsite parking areas).

Stage Harbor - In the early-mid 1980s, the town purchased the Old Mill Boatyard at Stage Harbor for use as a municipal harbor facility.¹⁷ The site provides dockage, moorings, a public boat ramp, pump-out station, public restrooms, and parking (town resident use only from June 1-Sept 1). The harbormaster’s office and the town’s shellfish propagation upweller system, which grows juvenile quahogs, oysters and bay scallops, are also housed at the site. Damage by marine boring worms will eventually require replacement of the bulkhead, and a major replacement of the pier and floats is on the horizon. There

¹⁷ Coastal Facilities Improvement bond funding was used to help purchase the boatyard.

is a 10-yr waiting list for mooring/slip space at Stage Harbor. There are four private marinas in Stage Harbor with a combined 134 slips and 157 moorings (as of 2002).

Stage Harbor functions as a critical alternate finfish off-loading location for Chatham's commercial fishing fleet. Two privately-owned piers currently serve as the primary off-loading and packing facilities for local and transient commercial fishermen and weir fishermen. Some fishermen tie up at a half-dozen or so private docks on a permission-only basis; others can request use of one of public moorings reserved by the Harbormaster for temporary use. Continued dock access for off-loading and packing is essential to the viability of commercial fishing companies, and several factors raise concerns about the long-term adequacy of these facilities (e.g., needed repairs, future sale of facility to non-fishing interest, etc.).

The town is considering the potential of using Stage Harbor as a back-up off-loading site for commercial fishermen if access to the Chatham Fish Pier is lost due to shoaling of the harbor. The town attempted to buy the private pier next to the Old Mill Boatyard site but the price was too high (the existing pier infrastructure needs to be completely replaced). In addition, the shallow waters around the Old Mill landing may require dredging in order to create a functional pier and off-loading site (the area is also a productive shellfish site). Truck traffic associated with shipping would likely not be welcomed by nearby residents.

HARBOR MANAGEMENT

Harbor management is guided by a South Coast Harbor Management Plan for Chatham's southern coast including Stage Harbor. The Pleasant Bay Resource Management Plan includes Chatham Harbor but is focused primarily on natural resource management and use/access to the shore. The town's Local Comprehensive Plan (not certified by CCC) also addresses harbor issues. The town has been proactive in dealing with shoaling, erosion, and sea-level rise by developing a Multi-Hazard Mitigation Plan, creating a floodplain conservancy district zoning bylaw, and developing a beach nourishment program that places dredged materials where they are needed most. Numerous Federal and State regulations also apply to management of the harbor (see Regulatory Overview). EPA has approved designation of the coastal waters of Pleasant Bay and Chatham Harbor as a No Discharge Area, which prohibits discharges of treated and untreated boat sewage. Stage Harbor was designated as a NDA in 1997.

The town of Chatham values its maritime heritage and actively funds waterside infrastructure through revenue generated from mooring fees, boat excise fees, etc. The town is considering options to help generate additional revenue to fund waterfront infrastructure maintenance and repair.

The movement of sand bars in Chatham Harbor and Pleasant Bay has increased

with recent changes in tidal hydrology, and shoaling is problematic in certain areas. The channel in Aunt Lydia's Cove is dredged annually by the Corps of Engineers using its hopper dredge (Currituck). Dredged materials are dumped in the nearshore area to keep the material in the littoral system. The inlets are not dredged due to the high expense. Materials from spot dredging by the County (Codfish) are used for beach nourishment where needed. Recognizing the value of Chatham's fishing fleet and recreational boating, dredging is a priority for the town in terms of funding.

The town holds a 10-year permit for maintenance dredging of the Stage Harbor inlet channel at Hardings Beach and disposal of the dredged materials as beach nourishment at nearby beaches (e.g., Hardings Beach, Cockle Cove Beach). The dredging is done using the County dredge or other contractor.

The breaching of Nauset Beach in 1987 and again in 2007 has caused profound changes in the configuration of the barrier over the last quarter-century, altering tidal hydrology and shoreline dynamics in Pleasant Bay and along the coast south to Monomoy. A part of the Nauset barrier is now isolated by breaches and is known as North Beach Island. With increased connectivity to the open ocean, the volume of tidal water inside the bay (including Chatham Harbor) has increased, resulting in an increase in tidal range. Currently, the new inlet (2007) is a significant conduit for tidal exchange resulting in more active shoal migration in this area. The shifting location of coastal landforms (i.e., the formation of South Beach and the linking of Monomoy Island to Chatham) has made travel by boat between Chatham Harbor and Stage Harbor more difficult.



Breaching of Nauset Beach in 2007 (boston.com)

The increase in tidal range within Pleasant Bay (including Chatham Harbor) due to the formation of new inlets has exacerbated shoreline erosion along waterfront properties. In addition, coastal erosion, compounded by ongoing sea-level rise, will continue to affect the outer beaches, eventually redistributing the barrier sediments and potentially threatening the future of the harbor and Fish Pier.

PUBLIC ACCESS AND RECREATION

Chatham Harbor - Public shore access opportunities have generally declined since 1987 when erosion following the Nauset breach significantly altered public landings at Claflin Landing, Holway Street, and Andrew Hardings Lane.

Although these public access ways to public beaches still exist, they have either limited or no parking and are generally low usage. The public beach at Andrew Hardings Lane, for example, is used mainly by locals. There are other former “ways to water” (Bearses Way, Mistover Lane) but they have also been highly altered by shifting beach sands (i.e., the beach has accreted, so the shore is much further away now).

The public can more easily access the shore at Lighthouse Beach and South Beach, although it’s not a formal town bathing beach and parking is limited and signed as temporary. Beach-goers can also park along Bridge Street (fee sticker required) but need to walk some distance to the beach. The swift tidal currents near the beach pose safety concerns for swimmers (a harbormaster boat patrols the shore during the summer).

Visitors at the Chatham Harbor Fish Pier can watch the fishing boats unload or view the harbor and the barrier beaches and islands. There are no boat ramps accessing Chatham Harbor but visitors can launch a kayak at one of the street end shore access points. Jet skis are prohibited in the harbor.

Stage Harbor - There are 16 town-owned locations where the public can directly access Stage Harbor. Some access points allow a small boat to be launched, while others provide mooring access or just pedestrian access. Three boat ramps are located at Stage Harbor: one at the town’s Old Mill Boatyard facility that is open to town residents only from June 1 to Labor Day (unrestricted during the off-season) and one near the Mitchell River bridge (Bridge St. ramp). The third ramp located at Stage Harbor Marine is a private use only ramp. The town also identifies water access to the harbor from Morris Island Road, Battlefield Road, and off Stage Harbor Point. The Barn Hill Road landing (off Oyster Pond River) is an all-tide landing that is free and open to the public.

Jet skis are allowed at headway speed in most of Stage Harbor, and kayaking is a popular activity. Any private business operating from a public landing is required by the Town to obtain, with approval from the Selectmen, a Town Landing Special Permit. The permit holder is required to have insurance and offsite client parking. Hardings Beach, which fronts the harbor, is a public bathing beach with access and parking off Hardings Beach Road.

ECONOMIC RESOURCES

Chatham Harbor - The primary commercial entities around Chatham Harbor are Chatham Bars Inn (a world famous, luxury oceanfront resort that is an important contributor to the local economy), the Chatham Fish Market (formerly Nickerson’s fish market), and the Fish Pier (town owned). There are no aquaculture leases in Chatham Harbor, and aside from individual commercial shellfishermen, there are no other economically significant marine resource industries (e.g., worming, seaweed harvesting) in the harbor area. Most or all of

the remaining harbor shore is built out, much of it by high end private residences. The Chatham Beach & Tennis Club is located adjacent to South Beach, near the Chatham lighthouse. There are no yacht clubs or private marinas at Chatham Harbor.

The main tourist attractions around Chatham Harbor are the Fish Pier, Chatham Lighthouse, Old Chatham Village (National Historic Register), Lighthouse Beach, Cape Cod National Seashore beaches, seal tours, and charter fishing opportunities. The opportunity to watch fishing boats in the harbor and the view of the National Seashore from vantage points along Shore Road are themselves significant tourist draws.

Chatham commercial fishing fleet, which is the largest on Cape Cod, significantly contributes to the area's economy. With roughly 5.5 million pounds of fish landed at the town pier in 2009, Chatham leads all other Cape towns in annual fish landings. Commercial fish landings from Chatham and Provincetown Harbors totaled 16.1 million pounds in 2009 (ranked 42nd in 2009 among major U.S. ports) and were valued at \$20M in 2009 (ranked 40th among major U.S. ports). The estimated wholesale value of shellfish harvests in 2009 was over \$1.7M dollars. Community supported fisheries (CSF) are being promoted on the Cape, including Chatham, to provide a more direct avenue for consumers to get the freshest, seasonal seafood available at a fair price for both subscribers and fishermen. The Cape Cod Weir Harvest is a new CSF that works with local weir fishermen and shore-side operations to deliver fresh seafood to their members. Members join the program by purchasing a share for a season. Chatham Natural Market in Chatham is the pick up site.

Stage Harbor - The area surrounding Stage Harbor is largely zoned residential with the exception of the Old Mill Boatyard landing (municipal), the area at and around Stage Harbor Marine (zoned as Historic Business District), public beaches/Morris Island dike (municipal), and Stage Harbor Point (municipal conservancy). The Stage Harbor Yacht Club, Monomoy Yacht Club, and Stage Harbor Marine are located at Stage Harbor. Cape Fishermen's Supply, Inc. is the local supplier of boating and fishing gear for commercial fishermen (Depot Street).

The main tourist attractions in and around Stage Harbor include the harbor and the town facility (restricted to town residents from June 1 to Labor Day; unrestricted in off-season), Hardings Beach (access off Hardings Beach Road), and Monomoy Island (National Wildlife Refuge).

The overall trend in town has been toward gentrification. The amount of affordable overnight lodging has decreased as motels are converted to condominiums and affordable housing for lower income residents has become harder to find. The local artisan community is centered in the downtown area and there are no significant entertainment venues in the vicinity of the harbors.

Saquatucket and Wychmere Harbors

LOCATION AND GEOGRAPHICAL CONTEXT

Saquatucket Harbor (SH) and Wychmere Harbor (WH) are twin harbors (Fig. 19) located within a half-mile of each another on the south shore of Harwich, Massachusetts (Cape Cod). The harbors are similar in size, with SH (Fig. 20) approximately 8.5 acres in area and WH (Fig. 21) about 14.5 acres. Both harbors provide safe anchorage for commercial and recreational boats, and provide slips or moorings, parking, boat launching, and other harbor amenities for users. Saquatucket Marina, owned by the town of Harwich, encompasses much of the land at the head of SH. The town owns and manages a pier and small parking lot on the east side of WH. Nantucket Sound is easily accessed from either harbor.

Route 28, a busy, secondary roadway that extends the length of Cape Cod's southern shore, is located immediately north of the harbors and provides vehicle access to both locations. The village of Harwich Port is located on Rte. 28 about a half-mile west of the harbors, and Harwich center is about 1.5 miles north of the harbors at the intersection of Routes 124 and 39. The land bordering Rte. 28 in the vicinity of SH is commercially zoned. Land elsewhere around SH is zoned residential and consists mostly of residential homes on moderate to large-sized lots. Commercial development surrounding SH includes Brax Restaurant, BackOffice Associates (a global software and services company), Snow Inn Corporation, and abandoned service station and pizza shop buildings on the 2-acre Downey property that borders Saquatucket Marina. Myacommet at Harwich Port (condominium complex) is located north of SH, across Rte. 28.



Saquatucket Harbor

Private residences surround most of WH. The Harwich Port Boat Yard and Stone House Yacht Club (including a private beach just east of the harbor entrance) are located just south of WH. Larson Park, a 1.1-acre town-owned property, borders the north side of the harbor and provides a scenic view of WH from Rte. 28. Wychmere Harbor Beach Club occupies much of the coastal property immediately west of the harbor entrance, and its buildings are the most visually

dominant feature of the harbor. Thompson's Clam Bar, a former tourist destination, once occupied the site of this now private club.

NATURAL RESOURCES

The harbors contain several important natural resources (Fig. 22) despite past modifications to enhance their maritime uses. Although salt marsh was dredged to create SH, a significant amount of this important habitat remains within the harbor. A lesser amount of salt marsh occurs around WH. Beaches and/or dunes occur at the mouth of both harbors, and eelgrass beds exist just offshore of the harbor entrance. Quahogs, oysters, and soft-shell clams occur in or near the harbors (Fig.



Wychmere Harbor

23) and are harvested both commercially and recreationally (WH is currently closed to shellfishing). Freshwater and coastal wetlands border the small streams located at the head of SH (Cold Brook and Carding Brook), including salt marsh and a shrub swamp located just north of the Saquatucket Marina parking lot. Priority rare species habitat occurs both inside and outside of the harbors.

The water quality in both harbors is affected by stormwater runoff from surrounding land uses and boat traffic. Stormwater from Harwich Port flows into WH via a culvert that discharges to the west side of the harbor. Commercial and recreational boat maintenance and repair also contributes contaminants (e.g., paint scrapings, dust, etc.) that are eventually washed into the harbor. Efforts have been made to mitigate this pollution source including a wash pad at Harwich Port boat yard and the prohibition of boat storage at SH (except commercial boats).

A StormTreat system was installed in 1995 in the WH parking lot to remediate stormwater prior to its discharge into the harbor. However, siting of the system within the tidal zone impaired its function, and it will be removed to allow for additional parking space. The water quality of the harbors is routinely tested for coliform, as well as for nitrates, phosphates, chlorophyll, dissolved oxygen, and pH. Both SH and WH were designated as Federal No Discharge Areas in 1998, which means that boaters can no longer discharge either treated or untreated wastewater inside the harbors or in Nantucket Sound within 400 ft. of the shore.

SHORELINE CHANGE AND COASTAL VULNERABILITY

Although no shoreline change data is available for the harbors, their shorelines would be expected to be relatively stable due to their sheltered locations. Shoreline change outside of the harbors along Nantucket Sound is largely controlled by the presence of the jetty near the mouth of Wychmere Harbor and its influence on littoral drift. West of the jetty, the shore is accreting over 2 ft/yr due to the trapping effect of this coastal structure. Accretion rates are less in the shadow of the jetty. The 100-year coastal floodplain (Fig. 24) extends to approximately elevation 11 ft. in the harbors and to elevation 10 ft. on lands bordering the harbors, including some of Rte. 28 and abutting properties adjacent to Saquatucket Harbor. Three critical facilities in the vicinity of the harbors are located in the SLOSH zone and/or the coastal flood zone, including Saquatucket Harbor/Harbormaster's office, the Wychmere Harbor town dock, and Harwichport Boat Works at Wychmere Harbor.

HARBOR USES AND INFRASTRUCTURE

SH and WH accommodate recreational and commercial vessels, and provide various services for users. However, infrastructure serving the two harbors is quite different. Floating docks and slips at the Saquatucket Marina accommodate recreational and commercial boats, while at WH, recreational boats are moored in the harbor and a small number of commercial boats tie up at the town pier. The town derives a small profit from mooring and slip fees, fuel delivery, and use of the town pier. Commercial and recreational slip space is at a premium at both harbors since there are few good harbors on the south side of the Cape. The waiting list at SH is about 12-15 years.

Coastal Engineering Co., Inc. (CEC) completed a waterfront infrastructure survey for the town in 2009 to assess the integrity of existing harbor structures and to prioritize construction/rehabilitation work at each harbor over the coming decade. CEC identified damage to the bulkhead wall at SH and concluded that the town pier in WH had reached the end of its serviceable life due to deterioration of concrete beams. Other recommendations included replacing the comfort station at WH, replacing the timber and steel bulkhead, and repairing the parking lot and drainage. In 2006, the town replaced over 60 degraded steel and wood pilings at SH and WH with fiberglass pilings. The Town's draft 6-year Capital Plan (2012-2018) includes substantial funding for waterways/harbors infrastructure. However, inclusion of projects in a plan does not guarantee that the projects will be funded during the plan period.

The entrances to both harbors are sheltered by a 1,100 ft. long breakwater and stabilized by jetties and other hard structures, all of which are in good condition. However, shoaling is a chronic problem in the harbors and entrance channels. SH's entrance channel is a designated federal channel maintained by the Army Corps of Engineers. Federal monies have not been available in recent years,

however, leaving the town to rely on the County dredge for spot dredging. The town received a Chapter 91 permit from the Massachusetts DEP for dredging and beach nourishment projects, including dredging of the entrance channels to SH and WH. Harbor and channel dredging is a critical need to allow larger boats to operate in the harbor.

SAQUATUCKET HARBOR

Harbor Users

Saquatucket Marina accommodates motorboats, sailboats, charter fishing boats, a passenger ferry, and a small commercial fishing fleet. The marina is open to recreational vessels from May 1st through November 15th, and is heavily used during the summer, mainly by recreational boaters and fishermen. Fewer sailboats are now berthed at the harbor, presumably reflecting a change in boating interest (at least locally). Sport fishing boats (mostly tuna boats) increase in number in the fall (up to 20-50 boats at a time) when recreational boats begin to vacate the harbor. There are also numerous slips available for transient boaters during the busy summer season.

SH currently supports a commercial fishing fleet of seven boats including: two sea scallopers, three quahog draggers, a jigger, and a gill-netter. Commercial fishermen rely on use of the east bulkhead for off-loading fish and supplies. There are currently four commercial boat licenses issued for SH, including a passenger ferry, a tour boat, and two party fishing boats. The passenger ferry (Freedom Cruise Line, Inc.) boards from the dock and makes runs to Nantucket three times daily during the summer (once daily in spring and fall). The *Perseverance*, a 43 ft. catamaran that operates as Monomoy Island Excursions, offers seal and seabird cruises around Monomoy Island. Two party fishing boats, the *Yankee* and *Cap'n Kids Fishing Adventures* also operate out of SH. One sailboat charter and at least six other charter fishing companies also operate out of the harbor (but are not home-ported here). These commercial enterprises each draw many visitors to the harbor during the summer season, contributing to the local economy. Other users include boaters, kayakers, sightseers, and Brax Restaurant customers who visit the harbor.

Harbor Infrastructure

Harbor infrastructure at the Saquatucket Marina includes floating docks and slips, a vehicle-accessible (but unpaved) loading area on the east side of the harbor (i.e., east bulkhead), a two-lane boat ramp, self-service pump-out facilities, and vehicle and trailer parking. The Harbormaster's headquarters is centrally located adjacent to the waterfront. The marina also has handicapped-accessible bathrooms, showers, and laundry facilities.

The marina currently has 190 slips for boats of various sizes, with most of the

slips serving boats 20 ft. to 30 ft. in length. While most slips are for recreational boats, about 20 slips are reserved for commercial operators (e.g., home-ported and transient fishing boats, party boats, ferry, etc.). Water and 20-30 amp electrical power are available at each slip. The number of commercial and recreational boats in the harbors is fixed and assigned from a waiting list. Because of the shortage of slip space on the mid to upper Cape, demand currently outstrips availability by 700%.

Commercial boats use the east bulkhead for off-loading their catch, supplies, and for repair, etc. Local fishermen typically off-load shellfish (lobster, quahogs) at the east bulkhead and use the town pier at WH for off-loading groundfish since its lower elevation makes off-loading easier. The harbormaster, tuna fishermen, and other boaters also use the east bulkhead to unload supplies. Trucks and other vehicles can easily access the loading area next to the bulkhead, although this use has likely caused damage to the bulkhead. The SH fuel dock formerly located on the east bulkhead was closed in 2006, leaving Harwich Port boat yard as the closest refueling location. Commercial fishing boats refuel at the bulkhead from a tanker truck. A pump-out facility (2,500 gal capacity) is buried in the grassy ridge behind the former fuel shed on the east bulkhead.

The public boat ramp and associated parking area on the east side of the marina was reconstructed in 1983 with funding from the Massachusetts Department of Fish & Game's Public Access Board. A provision of the funding agreement with the Commonwealth requires that the parking facility only be used for public access (unless otherwise permitted by the Commonwealth).

The marina accommodates automobile and boat trailer parking in tow lots. Fees are charged only for parking boat trailers and for use of the boat ramp (seasonal or day passes). The marina parking lots reportedly often fill up during the height of the season or during special events (e.g., Bass Day). Some restaurant, ferry and party boat customers who park in the marina lot compete with other harbor users seeking a parking space.

Downey Property - The 2.2-acre Downey property, located between Rte. 28 and the Saquatucket marina parking lot, is currently on the market and the town has been considering its purchase and potential uses. The site was formerly occupied by a Mobil service station between the 1930s and 1980 and by a pizza shop (Harwich Port House of Pizza) up until 2010. Boats have periodically been stored on the west half of the property. The property's redevelopment potential is complicated by soil and groundwater contamination from leaky underground gasoline storage tanks formerly located at the service station.

WYCHMERE HARBOR

Wychmere Harbor Users - WH accommodates approximately 140 recreational boaters (both motorboats and sailboats) and seven commercial fishermen whose

boats are tied up at the town pier. Many more commercial fishing boats use the pier to off-load fish. No commercial tour boats are home-ported in the harbor. Tourists and others stop to view the harbor from the town pier although the small parking area limits the number of visitors that can use the harbor (since commercial fishermen also use this lot). More often, visitors see the harbor from the overlook along Rte. 28 (Larson Park). However, the 30 minute parking allowance for 5-6 cars along the roadside limits the amount of time visitors can enjoy this area. There are many private docks in WH, a private marina with a boat launch (Harwich Port Boat Yard), and Stonehorse Yacht Club, a private sailing club.

Wychemere Harbor Infrastructure - WH accommodates 140 recreational boats on moorings during the summer. The moorings are maintained by the Harwich Port Boat Yard, but the town holds permits for use of the moorings. The town pier, located on the east side of the harbor, was built in 1978 to replace the original town dock. The pier is coupled to a timber bulkhead constructed in the 1930's and a steel bulkhead that supports the town parking lot. WH is known for tub-trawlers which haul large quantities of fish that are off-loaded at the town pier, since the height of the Saquatucket bulkhead makes off-loading difficult. Periodic flooding of the pier by seawater has weakened the concrete, making its use by large trucks unsafe. The town prohibited its use by trucks over $\frac{3}{4}$ ton in size in late 2009, which prevents fishing boats from re-fueling or off-loading fish from the pier.

WH has considerably less available parking than SH, only 29 spaces including two handicapped spaces. Removal of the "Stormtreat" units would provide a small amount of additional parking space. A small building next to the parking lot houses restrooms, and a pump-out boat and pump-out carts are used to handle wastewater from boats. The shellfish propagation facility at WH (next the town pier) is the largest municipal upwelling system in the state and rears millions of little neck and oyster spat that are broadcast to bays and harbors in Harwich. Several small shanties formerly used as bait shacks for the hook and line fishery are now located adjacent to the parking lot (on or near town land). Local hook fishermen continue to use the shanties for storage.

COMMERCIAL FISHING

SH and WH are home to a number of local fishermen who ply the waters of Nantucket Sound and Georges Bank (east of Cape Cod) using shellfish dredges, clam rakes, longlines, gillnets, rod-and-reels, and lobster traps. The commercial fishing community also supports important jobs and infrastructure for fish processors, marine suppliers, fuel companies, and numerous other industries. Tourism, a crucial component of the local and regional economy, also benefits from the presence of the harbors' commercial fishing fleet.

The town has traditionally supported the local commercial fishing fleet by

investing in infrastructure at SH and WH, such as the town pier, east bulkhead, parking, etc. to accommodate fishermen. Local commercial fishermen use both SH and WH for dockage and off-loading. Closure of the town pier in 2009 to large vehicles has imposed an added hardship on commercial fishermen who can no longer off-load directly to refrigerated trucks nor obtain fuel in an efficient manner. Refueling and off-loading must now be scheduled with the tides.

Fishermen cite increased fees and taxes as an impediment to maintaining the existing commercial fishing fleet in WH and SH, and a barrier to a viable fishing future. Additionally, fishermen note that the lack of off-loading infrastructure (specifically, a bucket-and-hoist system) requires local fishermen to off-load their catch by hand or to travel to Chatham (Stage Harbor) to off-load their catch.



Commercial fishing boat, Saquatucket Harbor

As elsewhere on the Cape, regulatory pressures, declines in fish stocks, and ongoing changes in the ocean environment are impacting the local fishermen in Harwich. Many local fishermen are members of the Cape Cod Commercial Hook Fishermen's Association, a local non-profit that works with fishermen and regulators to align protection of the oceans with the present and future interests of our historic fishing community. Harwich fishermen have been strong advocates of the sector concept since the early 1990s. CCCHFA is working with Harwich fishermen to develop a local brand of seafood which, coupled with the CSF, could be an important showcase for local seafood products and could foster substantial economic development for the fishermen and the community.

ACCESSING THE HARBORS

A variety of public access options are available to reach the harbors by land or water, including auto, public transportation, bicycle, pedestrian, or boat. As mentioned above, public parking is available at both SH and WH, but can be limited during the summer. The Cape Cod Regional Transit Authority's Hyannis to Orleans (H2O) bus service passes the harbors hourly Monday through Friday (a signed RTA bus stop is located at the SH entrance). Bicyclists on the Cape



Recreational fishing at Wychmere Harbor

Cod Rail Trail (just over a mile north of SH) can reach the harbors via Long Road, Oliver Snow Road, and Gorham Road. The lack of sidewalks between Harwich Port and the harbors poses a safety concern for any pedestrians and bicyclists traveling along busy Route 28.

In 2010, the Cape Cod Commission conducted a study of transportation alternatives and routes to encourage pedestrian and bicycle use between Harwich Port and Harwich Center and the town's beaches and harbors (including SH and WH). The study recommends installing sidewalks and wayfinding signage along Rte. 28 to allow safe pedestrian and bicycle access between Harwich Port and the harbors, increasing visibility of the harbors, and extending the Cape Cod Rail Trail in the direction of SH. Economic development opportunities at both SH and WH depend in part on promoting pedestrian, bicycle and auto travel to the waterfront. Parking areas currently create a barrier to pedestrian circulation through each harbor, where users must compete with the flow of traffic to reach the waterfront.¹⁸ Visitors can also reach the harbors by private boat. Several slips are available for transient boaters that can be reserved up to two weeks during the busy summer season.

ECONOMIC RESOURCES

The economic value of the harbors is linked to the Saquatucket marina and its capacity to support recreational boaters and commercial operators, the local fishing fleet, and surrounding businesses dependent on their proximity to the shore. The view of the harbor is important to the success of Brax restaurant as well as the new Wychmere Harbor Beach Club, which hosts weddings and other special events. Tourist attractions at or near the harbors include pleasure boating, charter fishing, boat tours, sightseeing, and eating at local restaurants. Nearby Harwich Port has many shops and restaurants, and some art galleries. The town would like to encourage a mix of tourist and marine businesses and general commercial development in keeping with the maritime and tourist character of the area. Currently there is not a strong need for more overnight lodging, although opportunities exist if the area's tourist potential is increased (though current wastewater treatment may hinder this kind of development). A concern with increasing public use opportunities in the harbor area is whether there is, or will be sufficient parking, access, etc. to support the additional use. The town's proposed acquisition of the 2.2-acre Downey property could help alleviate this potential need.

Little change in the amount of land developed as private residences is expected under current zoning, but that could change if sewer becomes available in the

¹⁸ The Cape Cod Commission completed a study (Saquatucket and Wychmere Harbor Baseline Study and Conceptual Plan, 2011) addressing pedestrian and automobile circulation at Saquatucket Harbor, among other harbor management issues.

future. Harwich has taken steps to increase the amount of affordable housing town-wide to help support lower income residents, fishermen, local artists, etc.

There is a debate whether commercial fishing is declining and if more emphasis should be placed in developing recreational boating at the harbors. Local fishermen and the CCCHFA have made a case for maintaining (and improving and expanding, where necessary) existing infrastructure and traditional use levels to ensure the continued viability of commercial fishing. Many in town support commercial fishing in the harbors to the extent that it is economically successful.

7. Harbor Assets and Use Constraints

Tables 2-6 summarize the assets and use constraints of the harbors researched as part of the study. Harbor assets are those features of a harbor that contribute positively to the local harbor economy. Examples include passenger ferries, whale watch tours, mixed commercial and residential use, public access and viewing areas, or a marine science research and education center. Use constraints are those features that currently limit the full use potential or function of the harbor. Examples include a shoaling navigation channel, inadequate parking space for visitors, or lack of shore access for the visiting public. Potential replication opportunities are also identified. These include existing features identified at the harbors that may contribute favorably to, or enhance the local harbor economy, and if replicated at another harbor or coastal area may benefit the local economy. Examples include a viewing platform on or near the waterfront, waterfront access for tourists, public transit to the waterfront, and reserved parking and gear storage sites for commercial fishermen. The harbor assets and use constraints summary is used in the analysis of future coastal uses (Section 9), which, in turn, will inform the development of the land use and regulatory templates in *Phase 2* of the study.

Table 2 – Summary of Findings for Hyannis Inner Harbor

Harbor	Assets	Constraints	Replication Opportunities
<p>Hyannis Harbor</p> <p>Coastal Economy Niches - Hyannis Harbor caters to three primary industries: Recreational Boating, Transportation (ferries), and Tourism. The other main industry sectors - Commercial Fishing and Arts and Leisure - are less prominent components of the local harbor economy.</p>	<p>Major transportation and tourism hub</p> <ul style="list-style-type: none"> • Steamship Authority and Hy-Line Cruises ferry terminals and infrastructure <p>Tourism amenities</p> <ul style="list-style-type: none"> • Variety of retail and restaurant establishments • Artists shanties, cultural sites, outdoor concerts, and other performing arts events • Recreational fishing • Commercial fishing fleet • Public access points; pedestrian access via waterfront paths and promenade; “Walkway to the Sea” <p>Harbor infrastructure</p> <ul style="list-style-type: none"> • Harbor infrastructure in fair to good condition <p>Commercial fishing</p> <ul style="list-style-type: none"> • Active, though declining commercial fishing fleet <p>Water quality</p> <ul style="list-style-type: none"> • Waterfront sewerage <p>Minimal use conflicts</p> <ul style="list-style-type: none"> • Metered street parking 	<p>Limited opportunities for expansion and growth</p> <ul style="list-style-type: none"> • Vehicular traffic congestion • Insufficient parking capacity near the harbor to meet demand • Long wait list and high cost for slips and moorings • Lack of affordable housing • Need for more year-round business for the area (e.g., hotel and conference center) and year-round lodging <p>Commercial fishing limitations</p> <ul style="list-style-type: none"> • Fishing regulations, costs, and sector management may further reduce the harbor’s commercial fishing industry <p>Shoaling and sedimentation</p> <ul style="list-style-type: none"> • Sediment from ferries creates shoals and sediment enters the harbor with stormwater drainage • Dredging of the inner harbor is a chronic issue <p>Coastal flood vulnerability</p> <ul style="list-style-type: none"> • Four critical facilities (e.g., Bismore Park Marina, Hyannis Marine, etc.) are located in coastal flood or SLOSH zones around the harbor. 	<ul style="list-style-type: none"> • Harbor promenade to bring visitors closer to waterfront • Mix of harbor uses: restaurant, tour boats, recreation, commercial fishing fleet • Venue for local artisans to sell crafts • Pedestrian linkage from downtown to the waterfront (Walkway to the sea) and around waterfront • Public open space adjacent to the waterfront (e.g., Aselton Park)

Table 3 – Summary of Findings for Woods Hole and Great Harbor

Harbor	Assets	Constraints	Replication Opportunities
<p>Woods Hole</p> <p>Coastal Economy Niches - Woods Hole Harbor caters to two primary industries: Marine Scientific Research and Marine Transportation. The other main industry sectors of the coastal economy - Tourism and Arts and Leisure industries - are less prominent components of the local harbor economy. Commercial fishing has a relatively minor presence in the harbor.</p>	<p>Renowned scientific research institutions</p> <ul style="list-style-type: none"> • World class marine science and biological research facilities and deepwater anchorage for research vessels <p>Major transportation and tourism hub</p> <ul style="list-style-type: none"> • Steamship Authority ferry terminal and associated infrastructure • Alternative transportation to village and ferry <p>Tourism amenities</p> <ul style="list-style-type: none"> • Woods Hole Village • Scientific research institutions (WHOI, MBL, and NMFS), including MBL's visitor center and WHOI's Ocean Science Exhibit Center • Aquarium at the Northeast Fisheries Science Center • Recreational fishing • Shining Sea bike path • Nobska Point Lighthouse (near harbor) 	<p>Limited opportunities for expansion and growth</p> <ul style="list-style-type: none"> • Approximately half of Woods Hole village is owned by private research institutions with much of the remaining area occupied by the Steamship Authority • Over-development limits academic institution expansion • High property values and taxes deter establishment of small businesses that support academic institutions and research facilities <p>Limited shore and recreational access</p> <ul style="list-style-type: none"> • Lack of public waterfront, public restrooms • Private and residential development along the shore limits public access • High property values and taxes limit public acquisition of shorefront land • No publicly-owned space to create additional parking • Little available dockage and no space for additional moorings in the harbor 	<ul style="list-style-type: none"> • Educational and interpretive center • Offsite parking for ferry (offsite parking could also be utilized for events) • Sport fishing and film festival events • Bike path and alternative transportation connections • Metered parking

Harbor	Assets	Constraints	Replication Opportunities
<i>Woods Hole (cont'd)</i>	<p>Water quality</p> <ul style="list-style-type: none"> • Good tidal circulation • Sewered village area <p>Minimal use conflicts</p> <ul style="list-style-type: none"> • Offsite ferry parking • Metered street parking 	<p>Commercial fishing limitations</p> <ul style="list-style-type: none"> • Town pier on Water Street is the only commercial pier in Woods Hole • Lack of additional infrastructure to support commercial fishing industry • Inadequate parking areas adjacent to the town pier and boat ramp • Restricted parking, local traffic congestion, more expensive dockage rates, cost of living, and lack of affordable housing <p>Infrastructure</p> <ul style="list-style-type: none"> • Antiquated stormwater system discharges to the harbor • Seawalls in disrepair 	

Table 4 – Summary of Findings for Provincetown Harbor

Harbor	Assets	Constraints	Replication Opportunities
<p><i>Provincetown Harbor</i></p> <p>Coastal Economy Niches – Provincetown Harbor supports several of the Cape’s primary industries: Commercial fishing, Recreation/Tourism, Transportation, Arts/Culture, Recreation, and Marine Science.</p>	<p>Natural resources</p> <ul style="list-style-type: none"> • Diverse coastal, marine and terrestrial natural resources in and around the harbor that support the fishing and tourism industry • Good water quality in harbor <p>Harbor infrastructure and uses</p> <ul style="list-style-type: none"> • Deep, well-protected harbor, except vulnerable to easterly winds • Serves a relatively large and diverse number of marine users: commercial fishermen, tour operators, ferry, recreational boaters, research vessels (PCCS), and U.S. Coast Guard • Town pier (MacMillan) recently upgraded • Large number of private moorings • Ferry service to Boston and Plymouth • Public parking and water access for tourists and boaters <p>Alternative transportation</p> <ul style="list-style-type: none"> • Bus and ferry options to reach harbor 	<p>Harbor infrastructure</p> <ul style="list-style-type: none"> • Boats berthed on east side of town pier vulnerable to easterly winds • Need for additional slips for recreational boats • Limited parking space for trailers and no float at public boat ramp <p>Parking and harbor access</p> <ul style="list-style-type: none"> • Limited parking during summer • Traffic congestion in/around the harbor and Commercial Street <p>Seasonal economy</p> <ul style="list-style-type: none"> • Seasonal economy especially pronounced given Provincetown’s location and low number of year-round businesses <p>Commercial fishing</p> <ul style="list-style-type: none"> • Currently in decline due to fishing regulations • Some infrastructure lacking for commercial fishermen (e.g., freshwater source, off-loading crane) • No fish processing facility in town 	<ul style="list-style-type: none"> • Diverse marine uses to attract more tourists (i.e., whale watch and other tours, recreational boating, etc.) • Commercial and water-dependent businesses that complement harbor • Ecotourism businesses to feature and promote coastal and marine resources • Public transit options to the harbor • Pedestrian friendly harbor

Harbor	Assets	Constraints	Replication Opportunities
<i>Provincetown Harbor (cont'd)</i>	<p>Commercial fishing</p> <ul style="list-style-type: none"> • Active commercial fishing port, although declining. Town investments in infrastructure for fishermen. • Commercial fishing activity draws tourists to harbors • Commercial and recreational clamming in and around harbors <p>Tourist amenities</p> <ul style="list-style-type: none"> • Mix of water-dependent and non-water-dependent uses on harbor and along Commercial St., including art galleries, historic sites, etc. • Ecotourism opportunities (whale watching, National Seashore, other) • Abutting businesses complement harbor experience (e.g., restaurants along Commercial St.) • Scenic views of harbor, downtown, lighthouses, dunes <p>Marine science and education</p> <ul style="list-style-type: none"> • PCCS and National Seashore 		

Table 5 – Summary of Findings for Chatham and Stage Harbors

Harbor	Assets	Constraints	Replication Opportunities
<p><i>Chatham Harbor (and Stage Harbor)</i></p> <p>Coastal Economy Niches – Chatham and Stage Harbors cater to two primary industries: Fishing and Tourism. The other three main industry sectors of the coastal economy – Arts & Culture, Marine Sciences, and Transportation & Utilities –are not directly accommodated by the harbors.</p>	<p>Quality infrastructure for commercial fishermen</p> <ul style="list-style-type: none"> • Unloading and packing facilities: Chatham Harbor has off-loading, ice and packing facilities at the Fish Pier where fish are prepared for shipment • Protected moorage: Tern Island provides some protection to fishing boats <p>Tourism amenities</p> <ul style="list-style-type: none"> • Fish Pier viewing platform allows visitors to view fishing boats off-loading catch and a scenic view of Nauset Beach and the harbor. • Seal watch and charter fishing boats <p>Proximity to fishing grounds</p> <ul style="list-style-type: none"> • Convenient access to fishing grounds at Georges Bank and Nantucket Sound <p>Water quality</p> <ul style="list-style-type: none"> • Inlet formation has improved flushing and water quality in the harbor and Pleasant Bay • Plans for sewers in Stage Harbor watershed to improve water quality 	<p>Dynamic shoreline and shoaling</p> <ul style="list-style-type: none"> • Shoaling in Chatham Harbor and active coastal erosion and sediment movement along the shore threatening the harbor’s future viability • Dredging is a chronic need in at both harbors • Treacherous outlets from Chatham Harbor to the ocean <p>Limited opportunity to expand</p> <ul style="list-style-type: none"> • Cost to purchase additional facilities for public use • Limited commercial fishermen parking at Fish Pier (lease from Chatham Bars Inn) <p>Limited public access options</p> <ul style="list-style-type: none"> • Public shore access points in Chatham Harbor have been compromised by erosion (or other shoreline changes) and parking is limited • Limited public parking hinders use of other public shore access at Chatham Harbor (e.g., Lighthouse Beach) 	<ul style="list-style-type: none"> • Reserved parking for fishermen • Off-loading facilities and other necessary infrastructure for commercial fishermen • Safe observation platform for viewing loading/off-loading of fishing boats and scenic harbor views

Harbor	Assets	Constraints	Replication Opportunities
<i>Chatham and Stage Harbors (cont'd)</i>	Minimal use conflicts with fishermen <ul style="list-style-type: none"> • Limits on tourism parking • Reserved parking for fishermen 		

Table 6 – Summary of Findings for Saquatucket and Wychmere Harbors

Harbor	Assets	Constraints	Replication Opportunities
<p><i>Saquatucket Harbor (SH) and Wychmere Harbor (WH)</i></p> <p>Coastal Economy Niches - Saquatucket and Wychmere Harbors cater to two primary industries: Recreation/Tourism through boat tours and charter fishing opportunities and Commercial Fishing. Transportation is a minor, but important component of the local harbor economy with the Nantucket ferry (Freedom Cruise Line, Inc.). The other two main industry sectors of the coastal economy - Arts & Culture, Marine Sciences are not directly accommodated by the harbors.</p>	<p>Harbor users and infrastructure</p> <ul style="list-style-type: none"> • Serves a relatively diverse array of marine users including commercial fishermen and tour operators, ferry, and recreational boaters • Public transit, parking, and water access for tourists and boaters <p>Commercial fishing</p> <ul style="list-style-type: none"> • Active commercial fishing port (SH and WH), one of few on Cape's south shore • Commercial fishing activity draws tourists to harbors • Commercial and recreational clamming in and around harbors <p>Recreational boating and fishing</p> <ul style="list-style-type: none"> • Boat launch at SH provides convenient harbor access • Easy boat access to Nantucket Sound • Charter and party fishing boats, tour boats • Harbors located near the southern Cape's bluefin tuna grounds • Yacht clubs and boatyard at WH 	<p>Failing or inadequate harbor infrastructure</p> <ul style="list-style-type: none"> • Failing town pier at WH and bulkheads at both harbors • Inadequate facilities for commercial fishermen (off-loading, limited use town pier at WH, etc.) • Unsafe docks at SH for tourists <p>Parking and harbor access</p> <ul style="list-style-type: none"> • Seasonally limited parking constrains maximum use of the harbor • Limited staging area for charter boat customers • Limited harbor access options for visitors (e.g., sidewalks prevent safe pedestrian/bicycle access) • Risk to pedestrians crossing Rt. 28 <p>Limited tourist amenities</p> <ul style="list-style-type: none"> • Few amenities available for tourists (i.e., picnicking sites, view areas, etc.) <p>Ticketing</p> <ul style="list-style-type: none"> • Physical separation between ticketing, parking, and dock access for some businesses 	<ul style="list-style-type: none"> • Diversify marine uses to draw more users and tourists (i.e., commercial and recreational boaters) • Establish scenic views of harbor that can attract tourist interest • Establish complementary businesses to waterfront that will benefit both business and harbor • Provide public transit options to the harbor

Harbor	Assets	Constraints	Replication Opportunities
<i>Saquatucket and Wychmere Harbors (cont'd)</i>	Scenic views <ul style="list-style-type: none"> • Panoramic view of WH from Route 28 (Larson Park) Complementary businesses <ul style="list-style-type: none"> • Brax restaurant and Wychmere Harbor Beach Club benefit from proximity and view of harbors 	Dredging <ul style="list-style-type: none"> • Shoaling of entrance channel to SH creates hazardous conditions for larger vessels • Shoaling of inner SH harbor slips currently limits berthing options 	

8. Regulatory Overview

A large and complex array of ancient and modern statutes has been developed to protect the diverse environmental, cultural and economic resources of the state, including Cape Cod. Regulations and permits span federal, state, county and local levels of government, and are applicable to project siting, construction, operations, and maintenance. Identifying all of the restrictions that may be applicable to a specific location or project is the first step in project development. This section summarizes the myriad regulations and permits affecting work in the coastal zone. Table 7 summarizes the regulatory programs and/or resources that may be triggered (or affected) by projects along the coast.

The many regulations potentially encountered in completing projects are categorized under “project siting” and “project construction.” Regulatory programs and resource areas that may effect the location and design of the project are listed under “project siting.” Once a site is selected and any environmental design restrictions are considered, the permitting process begins. The “project construction” section identifies the regulatory permits potentially needed for projects in the coastal zone.

PROJECT SITING

Several ***Areas of Critical Environmental Concern*** (ACECs) exist on the Cape, including coastal areas such as the Pleasant Bay ACEC, Wellfleet Harbor ACEC, and Inner Cape Cod Bay ACEC. The purpose of ACEC program is to preserve, restore, and enhance environmental resources of statewide significance. There are certain prohibitions in ACECs, and resource protection is enhanced by the reduction of certain regulatory thresholds (e.g., MEPA, Chapter 91, Massachusetts Wetland Protection Act) to ensure close scrutiny by state agencies.

The ***Coastal Wetlands Restriction Act*** was enacted to protect the various interests served by coastal wetlands and to regulate dredging, filling, or other alterations in coastal wetlands. Executive Order No. 181 (***Barrier Beaches***) prohibits use of state and federal funding for development in hazard-prone areas, including velocity zones and primary dunes on barrier beaches in the Commonwealth of Massachusetts.

Table 7: Regulatory Summary for Projects in the Coastal Zone

Project Phase	Regulatory Program or Resource	Description
Project Siting	Area of Critical Environmental Concern (ACEC)	Complexes of natural resources of state-wide significance. New docks and piers, and improvement dredging are difficult to permit in ACECs
	Coastal Wetland Restriction	Activities in restricted wetlands are prohibited
	Floodplain	New construction or substantial improvements to existing buildings must comply with FEMA regulations, Massachusetts State Building Code, and town zoning bylaw
	Barrier Beaches	State-funded projects must avoid construction in hazard prone areas and in velocity zones
	Massachusetts Endangered Species Act, Federal Endangered Species Act	Prohibits any alteration of significant habitat of state or federally listed rare species that may reduce the viability of the habitat. Permit required from the Massachusetts Natural Heritage Program. Federal Endangered Species Act is similar.
	National Historic Preservation Act	Project must avoid, minimize, and mitigate adverse impacts
	Massachusetts Board of Underwater Archaeological Resources	Permit required for excavation of an underwater archaeological site
	State and Federal Fisheries Regulations	Projects may trigger mitigation and time-of-year restrictions
	Ocean Sanctuaries Act	Structures and activities that significantly alter the ecology of the Ocean Sanctuaries are prohibited (with exceptions). Jurisdiction from mean low water seaward to limit of state waters.
	District of Critical Planning Concern	Districts of Critical Planning Concern (DCPCs) are designated resource sensitive areas subject to special planning and regulation.
	Harbor Management Plans	May have siting and design criteria that affect project siting

Project Phase	Regulatory Program or Resource	Description
Project Siting	Zoning Bylaws	Regulates uses of land, buildings, and other structures to protect the health, safety, and general welfare of citizens.
Project Construction	Massachusetts Environmental Policy Act, National Environmental Policy Act	Project requiring a state permit and state funding must undergo preliminary review if it exceeds impact thresholds. National Environmental Policy Act review is similar.
	Massachusetts Wetlands Protection Act, Rivers Protection Act	Work in wetland resource areas requires a Notice of Intent and must meet specific performance standards. Rivers Act regulates work in riparian zone of perennial rivers, including tidal sections of coastal rivers.
	Cape Cod Commission Act	Regionally significant developments (DRIs) regulated by minimum performance standards in Regional Policy Plan.
	Public Waterfront Act (Chapter 91)	Regulates activities on filled or flowed tidelands to protect the public trust rights
	401 Water Quality Certification	Required if certain thresholds exceeded to ensure that dredging will not adversely affect water quality
	U.S. Army Corps of Engineers	Governs placement of fill in wetlands, placement of structures in navigable waters, etc., and disposal of dredged materials. All permits have been combined into Programmatic General Permit.
	Federal Consistency Review	Ensures that projects requiring a federal permit are consistent with state coastal policies
	Massachusetts State Building Code, State Environmental Code	Conformance to building code is required to protect public safety associated with buildings and structures. Environmental code ensures protection of public health and environmental resources by regulating the discharge of sewage.
	Construction Stormwater General Permit	Required for projects altering over five acres of land to regulate water quality, sediment, and discharge of pollutants

Many of the parcels surrounding harbors and along the coastal zone are within regulated **floodplain** areas (i.e., Land Subject to Coastal Storm Flowage). Flood insurance rate maps created by the Federal Emergency Management Agency (FEMA) delineate flood hazard areas that are based on a Flood Insurance Study that was conducted for each town. Flood insurance rate maps are currently in the process of being updated for the region. Any new construction or substantial improvements to existing buildings must comply with National Flood Insurance Program and FEMA regulations. Specific requirements for flood resistant construction are referenced in the Massachusetts State Building Code and in town zoning bylaws. Construction in the floodplain may require flood insurance in order to obtain construction financing. Generally, development is more expensive in floodplains because building techniques are more costly (e.g., elevating buildings above the base flood elevation, etc.) and because landowners in a flood zone are required to have National Flood Insurance to protect their buildings.

The **Massachusetts Endangered Species Act** prohibits any alteration of significant habitat of state or federally listed threatened or endangered species that may reduce the viability of the habitat. A permit is required from the Massachusetts Natural Heritage and Endangered Species Program for any alteration of significant rare species habitat. Similarly, the **Federal Endangered Species Act** protects federally listed rare species and their habitats.

The Massachusetts Historic Commission administers **The National Historic Preservation Act**. Section 106 of the Act requires federal agencies to review the effects of federal projects on properties on or eligible for listing on the National Register of Historic Places, and guards against the inadvertent destruction of historic resources. A similar process protects properties on the State Register of Historic Places, but which requires project proponents to avoid, minimize and mitigate any adverse impacts to historic resources. Many communities have established local historic districts and local preservation bylaws. The **Massachusetts Board of Underwater Archaeological Resources** manages underwater historic and archaeological resources, and requires a permit for the excavation of an underwater archaeological site.

Commercial and sport fin fisheries and shellfisheries are protected by **State Marine Fisheries** regulations, which require projects in waterways to minimize impacts to these fisheries and their habitat. The Massachusetts Division of Marine Fisheries administers marine fisheries laws in coordination with the National Marine Fisheries Service. Time-of-year restrictions are imposed to protect spawning fish and mitigation is required for damage to shellfish beds or eelgrass. **Federal Fisheries** regulations (Magnuson-Stevens Fishery

Conservation and Management Act and Essential Fish Habitat) protect the habitat of marine, estuarine, and anadromous fish, mollusks, and crustaceans. Projects requiring a federal permit that affect Essential Fish Habitat may be subject to an Essential Fish Habitat assessment. The ***Ocean Sanctuaries Act*** regulates structures and activities in the five ocean sanctuaries, including the Cape Cod Bay Ocean Sanctuary, Cape Cod Ocean Sanctuary, and the Cape and Islands Ocean Sanctuary. Structures and activities that significantly alter the ecology of the ocean, seabed, or subsoil of the Ocean Sanctuaries are prohibited (with exceptions for projects of “public necessity and convenience”). Jurisdiction extends from mean low water seaward to limit of state waters.

Districts of Critical Planning Concern (DCPCs), established under the Cape Cod Commission Act, designate resource sensitive areas for special planning and regulation. Once nominated and approved by the Barnstable County Assembly of Delegates, development within a DCPC is regulated by special “implementing regulations” that may augment existing local bylaws and regulations.

Municipal Harbor Plans establish a community’s objectives, standards, and policies for guiding public and private use of land and water within Chapter 91 jurisdiction (filled and flowed tidelands). Projects in state-approved municipal harbor planning districts must comply with the provisions of the harbor plans, and are reviewed by MassDEP, Chapter 91, and CZM federal consistency reviews.

Cities and towns have established ***Zoning Bylaws*** to regulate uses of land, buildings, and other structures to protect the health and safety of its citizens. Zoning districts have been designated that prohibit or encourage specific types of uses and/or structures. To protect environmental resources, several municipalities have adopted wetlands and floodplain overlay districts and watershed and aquifer overlay districts.

PROJECT CONSTRUCTION

Projects that require a state permit or will be state funded must be reviewed under the ***Massachusetts Environmental Policy Act*** (MEPA). An Environmental Notification Form (ENF) is filed for projects that exceed certain thresholds, including alteration of Coastal Dune, Barrier Beaches, Coastal Bank, and other coastal resources. If ENF review finds significant environmental issues, or if project impacts are significant enough to warrant full review, an Environmental Impact Review (EIR) is required. MEPA review allows state agencies and the public to review the project while it is still in the planning stages. Projects with significant environmental impacts may also be reviewed under the federal ***National Environmental Policy Act***.

Many of the landforms in proximity to the coastal zone are regulated by the ***Massachusetts Wetlands Protection Act***. Land Under the Water, Coastal

Bank, Coastal Dune, Coastal Beach, Salt Marsh, Land Subject to Coastal Storm Flowage (i.e., coastal floodplain), and other coastal features are considered wetland resource areas under the Act, and any construction in a wetland resource area must meet specific performance standards. More recently, the Wetlands Protection Act was revised to include the **Rivers Protection Act** to limit impacts to riparian areas (200 ft. on each side of a river). Rivers Act protection may include the land adjacent to the tidal sections of coastal rivers.

The mission of the **Cape Cod Commission Act**, implemented by the Cape Cod Commission, a regional planning and regulatory agency, is to protect the Cape's myriad natural resources, including coastal resources and ocean water quality, while providing for balanced economic growth and adequate capital facilities (e.g., transportation, water supply, waste disposal facilities, etc.). Regionally significant developments (DRIs) are required to comply with minimum performance standards contained in a Regional Policy Plan.

The **Public Waterfront Act** (Chapter 91) regulates activities in, under, or over filled or flowed tidelands, including dredging, fill, placement of structures, or change of use or alteration of existing structures. This public trust statute protects the public's right to fish, fowl, and navigate below the current or historic high water line, as well as in great ponds and navigable rivers and streams (i.e., public trust lands). A waterways license is required for fill or structures (e.g., docks, piers, seawalls, etc.), with various license types for water-dependent and non-water dependent projects. The term for a Simplified Chapter 91 license for small residential docks, piers, etc. is 10 years; other licenses have 30 year terms. Dredging projects require a Chapter 91 Waterways permit, which has a term of 5-10 years.

A **401 Water Quality Certification** is required for any activity that results in a discharge of dredged material, dredging, or dredged material disposal greater than 100 cubic yards, and that is also subject to federal regulation. 401 review ensures that dredging projects, which can result in the discharge of pollutants, comply with Massachusetts Surface Water Quality standards and the Massachusetts Wetlands Protection Act. MassDEP administers the certification program.

U.S. Army Corps of Engineers jurisdiction includes the construction or placement of structures, dredging, and dredged material disposal in the "waters of the U.S." Several permits are administered by the Corps. Section 10 of the Rivers and Harbors Act regulates work and structures seaward of the annual high water line in navigable waters. A Section 404 (Clean Water Act) permit is required for activities that discharge dredged or fill material into "waters of the U.S." (i.e., navigable waters, coastal waters, wetlands, etc.). A Section 103 permit is required to transport dredged material for disposal in the ocean. In Massachusetts, all these permits have been combined into Programmatic General Permit. Any project in or affecting the "waters of the U.S. must comply with the

conditions of the Massachusetts Programmatic General Permit (PGP) or, for larger projects, the conditions of an Individual Permit.

Any project that is above certain thresholds (generally MEPA thresholds) and that requires a federal license or permit must be consistent with Massachusetts Coastal Zone Management (CZM) coastal policies. CZM's **Federal Consistency Review** ensures that federal activities affecting Massachusetts coastal resources are consistent with state coastal policies (e.g., water quality, coastal hazards, public access, growth management, etc.).

New construction, renovation, or demolition of existing structures, and changes in use or occupancy of an existing building must conform to provisions of the **Massachusetts State Building Code**. The purpose of the building code is to protect public safety by ensuring structures are structurally sound, have proper egress for fire safety, etc. Local building inspectors issue permits. The **State Environmental Code** (Title 5) regulates sewage disposal, which must be disposed of to a municipal sewer system or be in compliance with Title 5 of the code. The purpose of the environmental code is to protect public health and environmental resources by regulating the discharge of sewage. The local Board of Health reviews septic systems generating less than 10,000 gallons per day; larger systems are reviewed by MassDEP.

Construction projects that alter five or more acres of land must obtain a National Pollutant Discharge Elimination System (NPDES) **Stormwater Construction General Permit**. The purpose of the regulation is to control the impacts of construction site runoff (sediments, pollutants) on the water quality of navigable waters. Stormwater from small construction sites will be regulated in the year 2003 under Phase II of NPDES.

9. Future Use Analysis

Cape Cod's scenic coastline and harbors, recreational beaches, and historic villages will continue to attract both year-round and seasonal residents and tourists as it has for generations. It's coastal and waterfront communities have a distinctive sense of place created by their history, characteristic sights and sounds, and the salty taste of the ocean air itself. Protecting the natural, cultural, and scenic resources along the coast that support the Cape's primary industry sectors will be critical in sustaining an economic future for the region, and will be essential to preserving the ambiance that is Cape Cod.

Yet many coastal communities have found that conventional development patterns threaten the assets they treasure most. Applying smart growth principles to development and redevelopment along the coast can help communities accommodate development while protecting their traditional sense of place (see text box).¹⁹

Future development along Cape's shore will also need to recognize the realities of ongoing (and possibly accelerated) sea-level rise and other coastal hazards while maintaining or expanding a coastal economy that serves a growing population on Cape Cod. Some smart growth approaches can also help

Smart Growth Principles modified for Coastal and Waterfront Communities

1. Mix land uses, including water-dependent uses
2. Take advantage of compact community design that enhances, preserves, and provides access to waterfront resources
3. Provide a range of housing opportunities and choices to meet the needs of both seasonal and permanent residents
4. Create walkable communities with physical and visual access to and along the waterfront for public use
5. Foster distinctive, attractive communities with a strong sense of place that capitalizes on the waterfront's heritage
6. Preserve open space, farmland, natural beauty, and the critical environmental areas that characterize and support coastal and waterfront communities
7. Strengthen and direct development toward existing communities and encourage waterfront revitalization
8. Provide a variety of land- and water-based transportation options
9. Make development decisions predictable, fair, and cost effective through consistent policies and coordinated permitting processes
10. Encourage community and stakeholder collaboration in development decisions, ensuring that public interests in and rights of access to the waterfront and coastal waters are upheld

¹⁹ NOAA, et al., 2009. Smart Growth for Coastal and Waterfront Communities, September 2009 (<http://coastalsmartgrowth.noaa.gov>)

communities be more resilient to coastal hazards such as storms, sea level rise, and coastal flooding by protecting and restoring critical environmental areas and by making efficient investments in buildings and other infrastructure that consider natural hazards.

Identifying conceptual future coastal uses will help inform the creation of coastal land use and regulatory models (or templates) that can be applied to the Cape's coastal and waterfront communities, the primary goal of the *Coastal Use Templates for Economic Development* project. The baseline data and information collected and summarized in Section 6 of the report, harbor assets and use constraints (Section 7), and modified Smart Growth principles form the basis for identifying future coastal use concepts identified in this section.

Coastal land use templates developed in Phase 2 of the project will need to conform to local, state, regional, and federal regulations governing development along the coast (Section 8). Communities must also consider the public's right of access to the water when making development decisions. Under the public trust doctrine, all navigable and historically navigable waters, including the lands beneath and resources within, are held in trust by the state for the public's benefit and use. The Public Waterfront Act (Ch. 91) holds Commonwealth tidelands (all land seaward of mean low water) in trust by the state for the public. Tidelands between mean high tide and mean low tide (private tidelands) are subject to the Public Trust Doctrine, whereby the public retains the rights to fish, fowl and navigate.

Conceptual future coastal uses are organized based on the following:

1. Coastal areas where development or redevelopment is desired
2. Areas for "un-development"
3. Opportunities for linking inland and coastal economic areas
4. Areas where natural or man-made structures are best suited for mitigating the effects of future sea-level rise

Coastal Areas for Development or Redevelopment

Future development or redevelopment along the coast should consider existing land uses and infrastructure, environmental and cultural considerations, etc. Development or redevelopment may be suitable in the following coastal locations:

- Areas within existing development (e.g., economic centers) or with existing supporting infrastructure (e.g., sewer lines), and that avoid adverse impacts to sensitive coastal resources and historic sites.
- Areas located outside high hazard areas (e.g., coastal flood zones, barrier

beaches) and where development impacts will not adversely impact sensitive coastal resources (e.g., coastal ponds) or the function and migration of coastal landforms.

- Where opportunities exist to convert non-water-dependent structures to water-dependent or maritime uses.

Several Smart Growth principles for coastal and waterfront communities may be applicable when developing or redeveloping along the shore. Redevelopment and new development should strive for a compact, mixed use design to create more vibrant, sustainable coastal communities. Compact, mixed use communities provide a wider range of housing options, are more pedestrian-friendly, and may promote transportation alternatives (both land- and water-based). Compact designs use land more efficiently, preserving open space and creating greater opportunities for shoreline access for the public. Mixing water-dependent and non-water-dependent uses wherever possible and appropriate (e.g., pier or wharves to serve local fishermen or other maritime uses) provides a more sustainable economic base if waterfront activities slow because of economic conditions, weather or seasonal fluctuations. Adopting zoning policies, building codes and implementing fiscal policies and incentives may be necessary to support mixed land uses.

Areas for “Un-development”

Certain types of development are not appropriate for the coastal zone, or are not the best available use for the limited coastal areas available for development. The following are examples of areas where development should be avoided, or the type of development should be replaced or removed (if possible) to better suit the coastal setting.

- Development in high hazard zones, such as barrier beaches and coastal floodplains (Land Subject to Coastal Storm Flowage), should be avoided, or in the case of existing development, removed wherever possible or limited to existing development footprints. Barrier beaches and coastal floodplains help absorb the brunt of coastal storms and flooding, protecting private property and public infrastructure.

Federal, state, regional, and local regulations control development in hazard prone areas, including the Massachusetts Wetlands Protection Act and its Regulations (310 CMR 10.00), local wetland bylaws, and the Cape Cod Commission’s Regional Policy Plan. The Cape Cod Commission’s *Model Bylaw to Effectively Manage Coastal Floodplain Development* contains specific bylaw language for enhancing the protection of high hazard floodplain zones as well as

siting and design recommendations for existing and new development in the coastal floodplain.²⁰

- Non-water-dependent development, especially development that does not complement other land uses in the coastal or waterfront community, should be discouraged by town permitting authorities, and should be converted to water-dependent uses, where appropriate. Exceptions may include affordable housing for lower income members of the community, or in areas to diversify a local coastal economy composed largely of water-dependent uses.
- Inappropriate development in sensitive coastal environments or habitats (e.g., nitrogen-sensitive coastal ponds, rare species habitat) should be discouraged. In the absence of more comprehensive wastewater management (e.g., sewerage), inadequate wastewater treatment systems in nitrogen-sensitive areas should be upgraded or replaced to lessen water quality impacts.
- Inappropriate development that detracts from the public enjoyment of seascape views should be avoided. Existing structures that block public enjoyment of seascape views should be screened by vegetation (at a minimum) or removed, if appropriate.

Land-Sea Connection Opportunities

There are numerous examples on many scales of economic linkages on Cape Cod between coastal and inland economies. On a larger scale, Cape Cod has long been a tourism destination, which, in turn, has enhanced local and regional economies through tourist spending on services, lodging, restaurants, etc. Commercial fishermen selling their catch to wholesalers for distribution to off-Cape or out-of-state destinations, or to local fish markets is another example of the Cape's local resources contributing to the larger economy. More local examples include user fees, whether parking, boat launches, mooring and slip fees, etc., putting money into town coffers. Bikeways and walking paths that connect inland areas to the coast (e.g., Hyannis Harbor's "Walkway to the Sea") are also examples of linkages between inland and coastal settings. Opportunities to further link the Cape's coastal and inland economies include:

- Provide opportunities for artisans specializing in arts and crafts with a coastal flavor to exhibit their art in seasonal waterfront venues.

²⁰ Woods Hole Sea Grant, et al., 2009. Model Bylaw for Effectively Managing Coastal Floodplain Development, revised October 30, 2009. Prepared by Woods Hole Sea Grant Program, Cape Cod Commission, University of Hawaii Sea Grant.

- Encourage Community Supported Fisheries to help forge a stronger connection between local fishermen and the local community. The Community Supported Fishery program, a pilot program that is similar to the Community Supported Agriculture program, could be an important showcase for local seafood products and could foster substantial economic development for the fishermen and the community.
- Promote pedestrian and bicycling paths that link established paths (e.g., Cape Cod rail trail) to harbors and public open space along the coast.

Sea-level Rise Mitigation Areas

It is anticipated that climate change over the coming century will accelerate the rate of sea-level rise and potentially increase the frequency and intensity of storms, which together may exacerbate erosion of the Cape's shoreline. Maintaining an intact and functional "natural infrastructure" along the coast (e.g., healthy barrier beaches, floodplains, salt marshes) to defend against future storms is a prudent approach to avoid or minimize future losses of life and property. The following approaches will help mitigate the affect of coastal hazards to life and property in the coastal zone:

- Managing development in the coastal flood zone to protect its function and critical characteristics will maximize its capacity to absorb floodwaters and minimize flood damages to the built uplands. Coastal development should also allow coastal landforms (e.g., salt marshes, barrier beaches) to freely migrate with ongoing sea-level rise in order to protect their integrity and function.
- Barrier beaches are natural coastal landforms that intercept storm wave attack that otherwise would impact mainland shorelines. Maintaining intact barrier beach systems will help mitigate the impacts of future sea-level rise on developed coastal areas.
- Nourishment of eroding beaches with compatibly-sized sediment can help mitigate future storm erosion while continuing to provide sediment to adjacent coastal resources. Both beaches and dunes can be nourished to enhance storm protection functions. Although beach nourishment can be especially valuable along armored shorelines where structures have locked up sediment supplies, unintended consequences (e.g., shoaling of navigation inlets) can result if coastal sediment dynamics are not well understood.
- Appropriately site and elevate buildings in coastal floodplain based on understanding of anticipated sea-level rise, storm surges, and erosion

rates and the estimated life expectancy of structures.

As mentioned above, the Cape Cod Commission's *Model Bylaw to Effectively Manage Coastal Floodplain Development* contains specific bylaw language for protecting the function and critical characteristics of the floodplain by limiting development (if allowed to occur at all) to appropriate areas within the floodplain.

10. Information Sources

Much of the information compiled for the *Coastal Use Templates for Economic Development* study is based on interviews with town officials. MassGIS data layers for a variety of resources in the coastal zone were also used to collect information pertinent to the study (e.g., wetlands, shellfish habitat, public access, zoning, FEMA flood zones, shoreline erosion rates, etc.). Information sources for each of five prototype harbors researched is summarized below.

Hyannis Inner Harbor, Town of Barnstable: Joanne Buntich (Dir. of Growth Management), Dan Horn (Harbormaster), Rob Gatewood (Conservation Agent), Joe Gibbs (Mooring Officer/Asst. Harbormaster), Eric W. Shufelt (Marina Manager/Asst. Harbormaster), Douglas M. Kalweit (Supervisor)

Woods Hole, Town of Falmouth: Brian Currie (Town Planner), Gregg Fraser (Falmouth Harbormaster)

Provincetown Harbor, Town of Provincetown: Rex Kingsley (Harbormaster/Pier Manager) and David Gardner (Asst. Town Manager)

Chatham and Stage Harbors, Town of Chatham: Ted Keon (Chatham Coastal Resources Director), Terry Whalen (Town Planner), Stuart Moore (Shellfish Warden)

Saquatucket and Wychmere Harbors, Town of Harwich: David Spitz (Town Planner), Tom Leach (Harbormaster), Saquatucket and Wychmere Harbors Task Force

11. References

GENERAL

Cape Cod Chamber of Commerce website

(<http://www.ecapechamber.com/cape-cod-chamber-economic-development.asp>)

Cape Cod Commission, 2004. Regional Hazard Risk Map, Cape Cod, Massachusetts. Prepared for Pre-disaster Mitigation Project, January 2004.

Cape Cod Commission, 2009. Cape Cod Regional Policy Plan, Barnstable County Ordinance #08-14 – Effective: January 16, 2009.

Cape Cod Commission & Economic Development Council, 2009. Cape Cod Region Comprehensive Economic Development Strategy: CEDS Five-year Update.

Cape Cod Commercial Hook Fishermen's Association

(<http://www.ccchfa.org/programs/fisheries-trail.htm>)

Executive Office of Energy and Environmental Affairs, 2009. Massachusetts Ocean Management Plan, Vol. 2

Mass Audubon website (Important Bird Areas)

(http://www.massaudubon.org/Birds_and_Birding/IBAs/site_summary.php)

Massachusetts Office of Coastal Zone Management, (undated). Environmental Permitting in Massachusetts.

Massachusetts Office of Coastal Zone Management, Massachusetts Ocean Resource Information System (GIS)

NOAA Fisheries, Office of Science and Technology, Commercial Fishery Landings (<http://www.st.nmfs.noaa.gov/st1/commercial/index.html>)

NOAA, 2009. National Marine Fisheries Service, 2009 Report to Congress, The Status of U.S. Fisheries

NOAA, et al., 2009. Smart Growth for Coastal and Waterfront Communities, September 2009 (<http://coastalsmartgrowth.noaa.gov>)

Oldale, Robert, 2001 (revised). Cape Cod, Martha's Vineyard & Nantucket:

The Geologic Story. On Cape Publications.

Pielke, R.A. Jr., and C.W. Landsea. 1998. Normalized hurricane damages in the United States: 1925-95. *Journal of the Meteorological Society of America* 13:621-631.

Stats CapeCod: Cape Cod Profiles, Overview for Barnstable County, MA
(http://statscapecod.org/us_profile_frame.html?S25?C001)

SustainCapeCod website
(<http://www.sustaincapecod.org/indicators/Business>)

Van Voorhees, D., 2007. Fisheries of the United States (E.S. Pritchard, ed.). National Marine Fisheries Service. Silver Springs, MD.

CHATHAM AND STAGE HARBORS

Borrelli, M., (2009). 137 years of Shoreline Change in Pleasant Bay: 1868 - 2005. Technical report submitted to the Pleasant Bay Resource Management Alliance. Harwich, Massachusetts. 29 p.

Cape Cod Commission, 2003. Risk and Vulnerability Map, Town of Chatham.

Chatham annual town report, 2009

NOAA, 2008. Community Profiles for the Northeast US Fisheries, Chatham, Massachusetts. Northeast Fisheries Science Center.

Pleasant Bay Resource Management Plan, 2008 update. Pleasant Bay Resource Management Alliance and Ridley & Associates, Inc. (March 2008).

Town of Chatham, January 2005. South Coastal Harbor Management Plan. Prepared for the Stage Harbor Management Plan Implementation Committee by Ridley & Associates, Inc.

SAQUATUCKET AND WYCHMERE HARBORS

Cape Cod Commission, 2010. A Plan for Improved Pedestrian, Bike, and Shuttle Bus Service in Harwich.

Coastal Engineering Co., Inc., 2009. Town of Harwich Harbors & Marine Facilities Analysis Report.

Dept. of Fisheries, Wildlife and Recreational Vehicles, 1983. Land Management Agreement between the Commonwealth of Massachusetts and the Town of Harwich. October 11, 1983.

GES, Inc., 2009. Release Abatement Measure (RAM) Completion Report. Former Mobil Station No. 01-602, 731 Main Street, Harwichport, MA.

GES, Inc. 2009. Revised Phase IV Remedy Implementation Plan. Former Mobil Station No. 01-602, 731 Main Street, Harwichport, MA.

GES, Inc. 2010. Phase IV Status Report Former Mobil Station No. 01-602, 731 Main Street, Harwichport, Massachusetts. March 2010 – July 2010

Harwich Harbormasters website (<http://threeharbors.com/>)

NOAA, 2008. Community Profiles for the Northeast US Fisheries, Harwichport, Massachusetts. Northeast Fisheries Science Center.

Saquatucket Harbor photo and narrative
(<http://www.vsv.cape.com/~harharb/photosaq.html>)

Town of Harwich, 2010. Open Space and Recreation Plan, dated April 28, 2010.

Town Harwich, 2009. Town of Harwich Harbor Management Plan, Amended November 23, 2009.

Wychmere Harbor Town Dock website
(<http://threeharbors.com/wychpier.html>)

HYANNIS INNER HARBOR

Howes, B., et al., 2007. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Lewis Bay Embayment System, Barnstable, Massachusetts

Mass Audubon website (Important Bird Areas)
(http://www.massaudubon.org/Birds_and_Birding/IBAs/site_summary.php)

NOAA, 2008. Community Profiles for the Northeast US Fisheries, Barnstable, Massachusetts. Northeast Fisheries Science Center.

PROVINCETOWN HARBOR

NOAA, 2008. Community Profiles for the Northeast US Fisheries, Provincetown, Massachusetts. Northeast Fisheries Science Center.

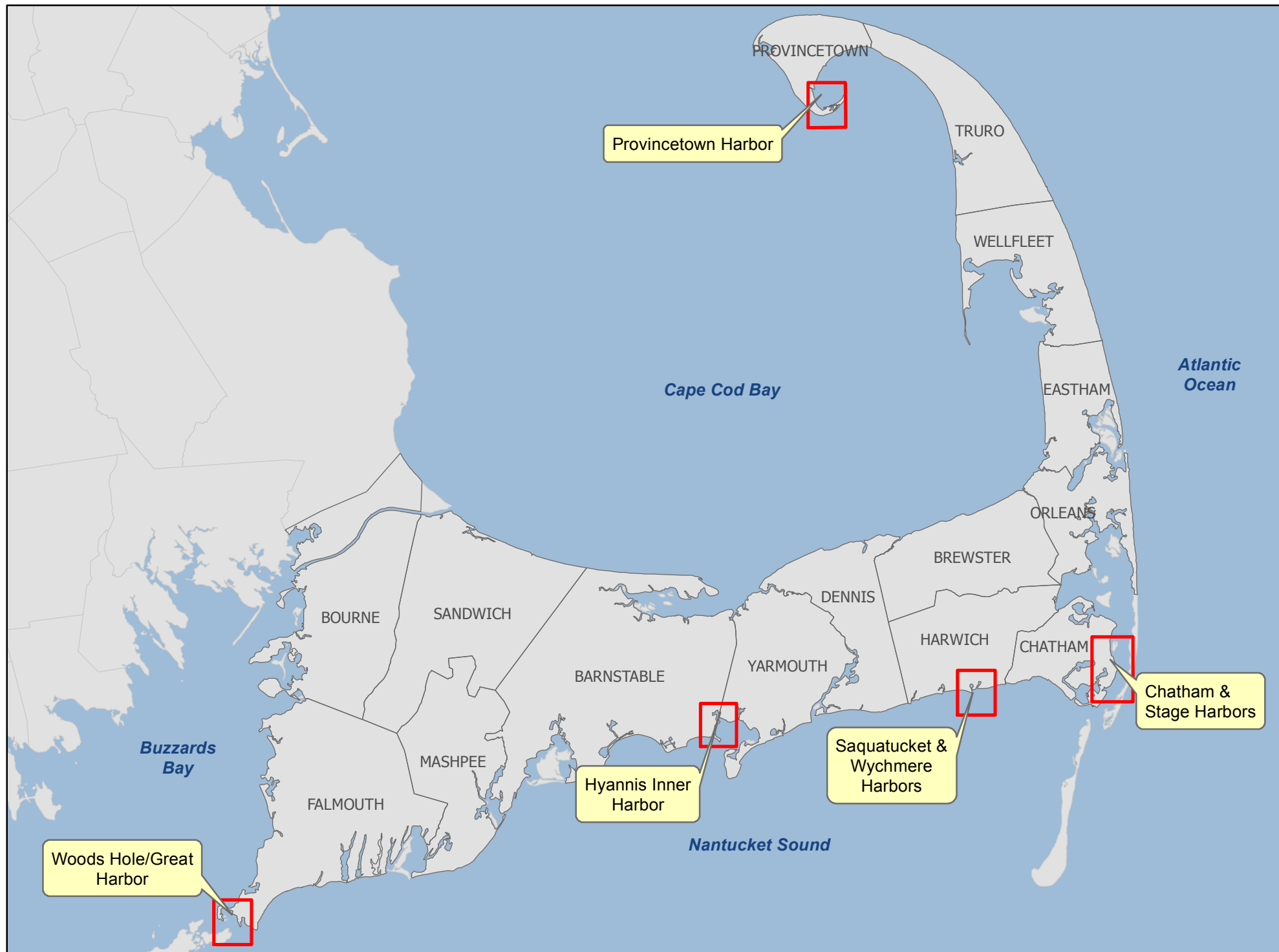
Provincetown Amended Harbor Plan (DRAFT), Provincetown Harbor Committee, revised May 2010.

Town Harbor Guide

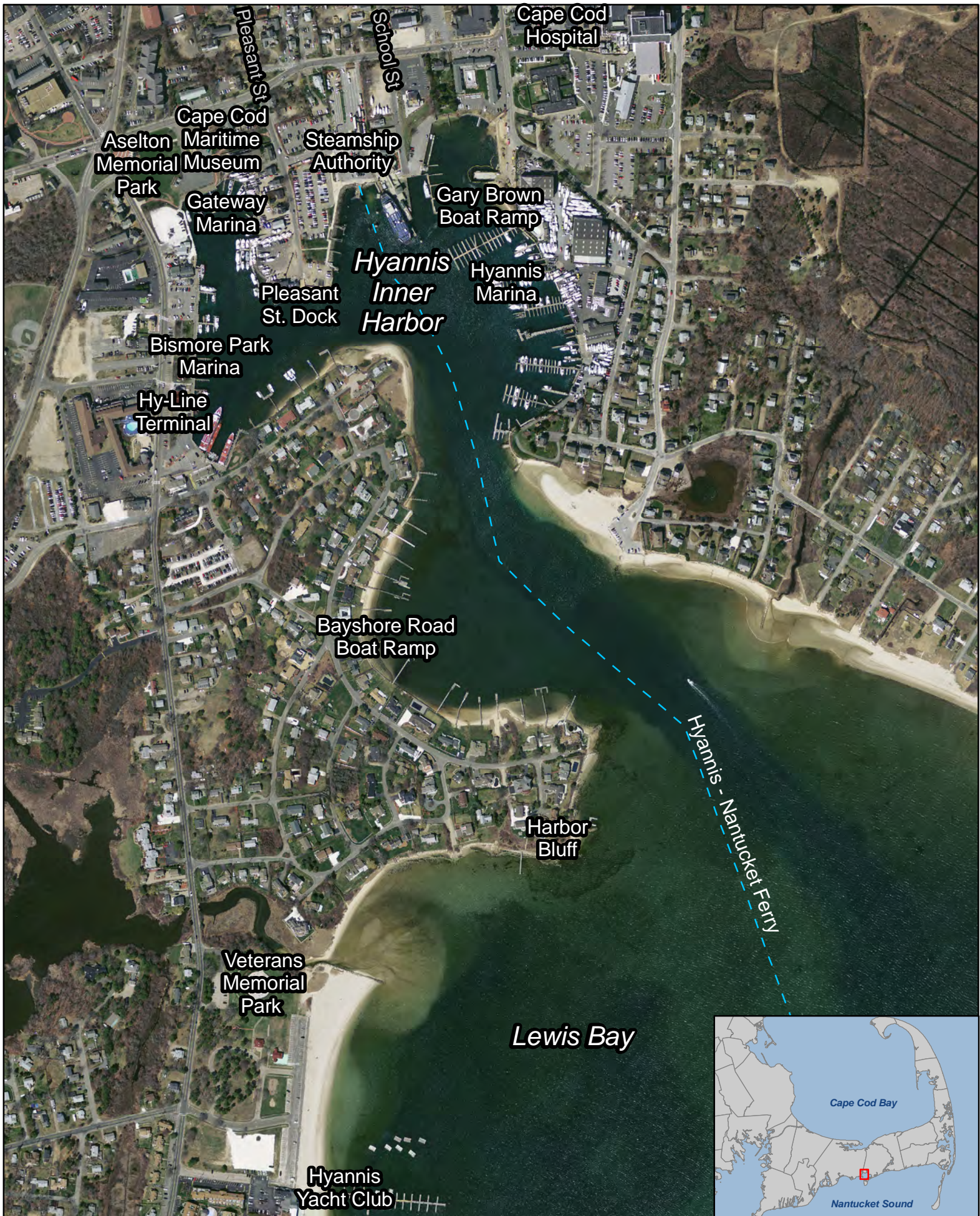
WOODS HOLE

NOAA, 2008. Community Profiles for the Northeast US Fisheries, Woods Hole, Massachusetts. Northeast Fisheries Science Center.

12. Harbor Maps



Hyannis Inner Harbor Maps

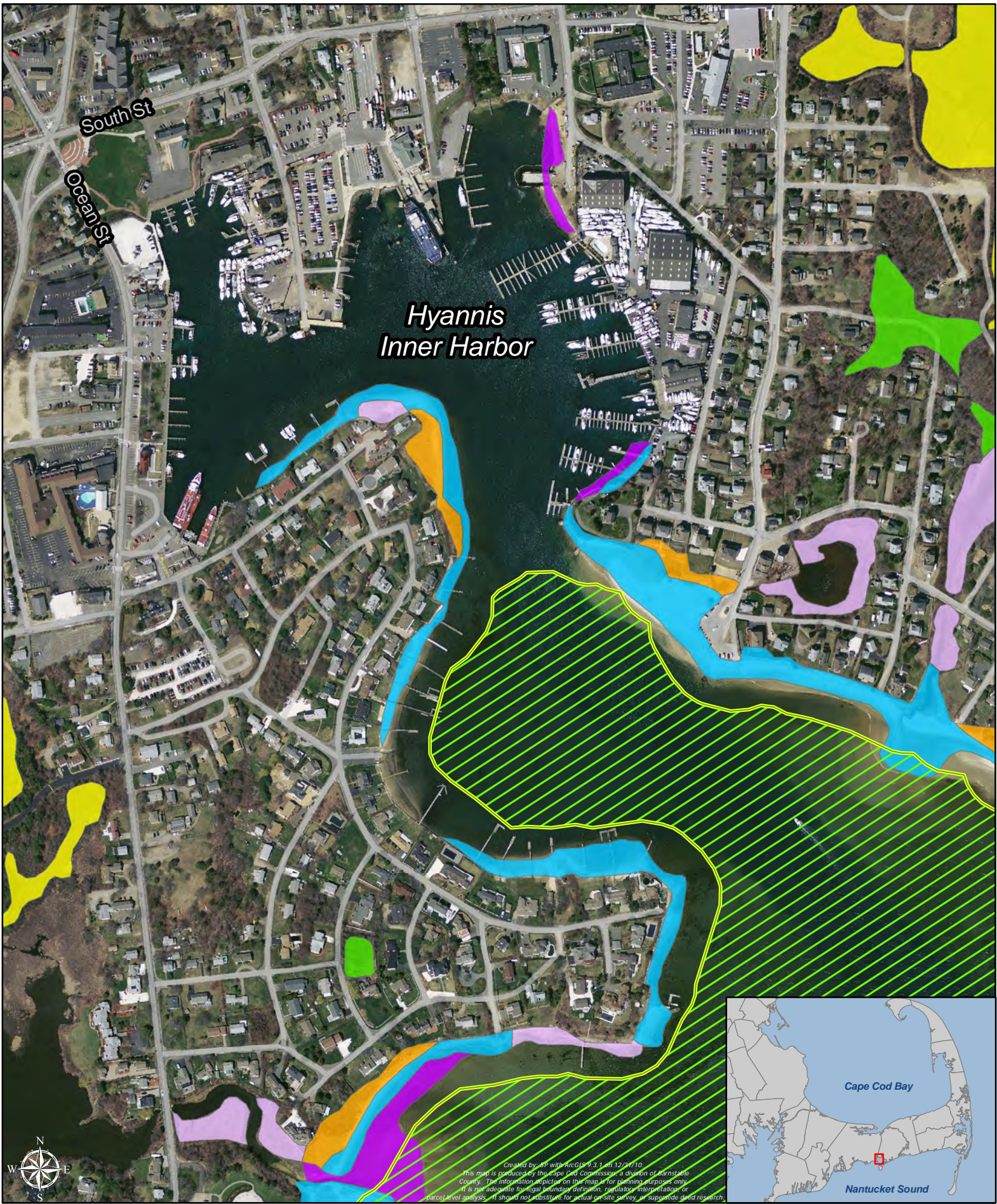









0 250 500
Feet


Created by: SP with ArcGIS 9.3.1 on 12/31/10. This map is produced by the Cape Cod Commission, a division of Barnstable County. The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

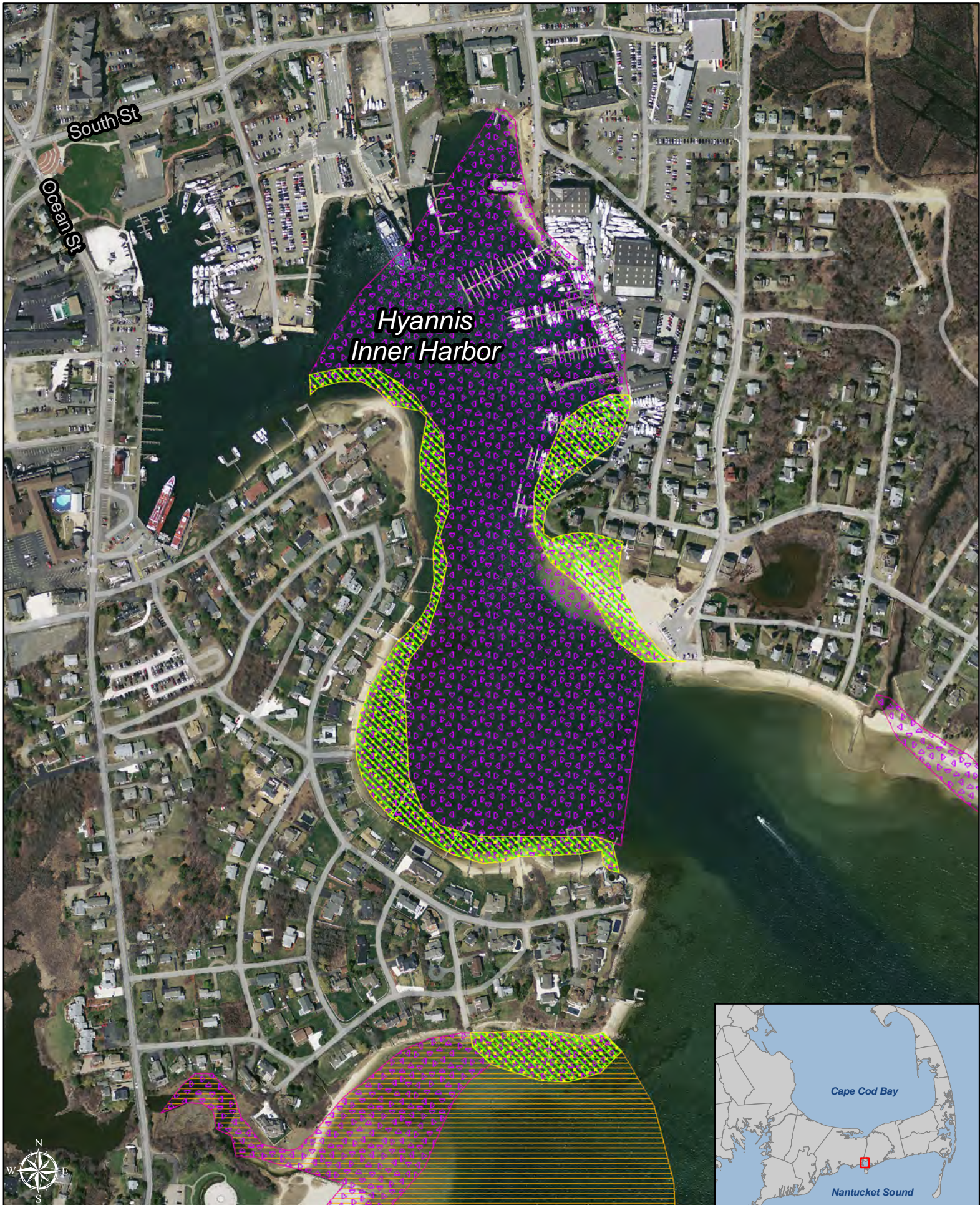


**Figure 2: Study Area
- Hyannis Harbor**







- | | | | | | |
|---|---|---|--------------|---|------------------------|
|  | NHESP Estimated Habitats of Rare Wildlife |  | COASTAL DUNE |  | TIDAL FLAT |
|  | COASTAL BEACH |  | SALT MARSH |  | WOODED SWAMP DECIDUOUS |
| | |  | SHRUB SWAMP | | |

 **Figure 3: Natural Resources**



Shellfish Suitability Areas

	American Oyster		Bay Scallop		Soft-shelled Clam
	Quahog				

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Figure 4:
Shellfish Habitat



FEMA 100-year Coastal Floodplain

- A zone = areas of 100-yr flood
- V zone = areas of 100-yr coastal flood with velocity (wave action)



Figure 5: FEMA Flood Zones

Woods Hole/Great Harbor Maps



0 200 400
Feet

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Figure 6: Study Area - Woods Hole

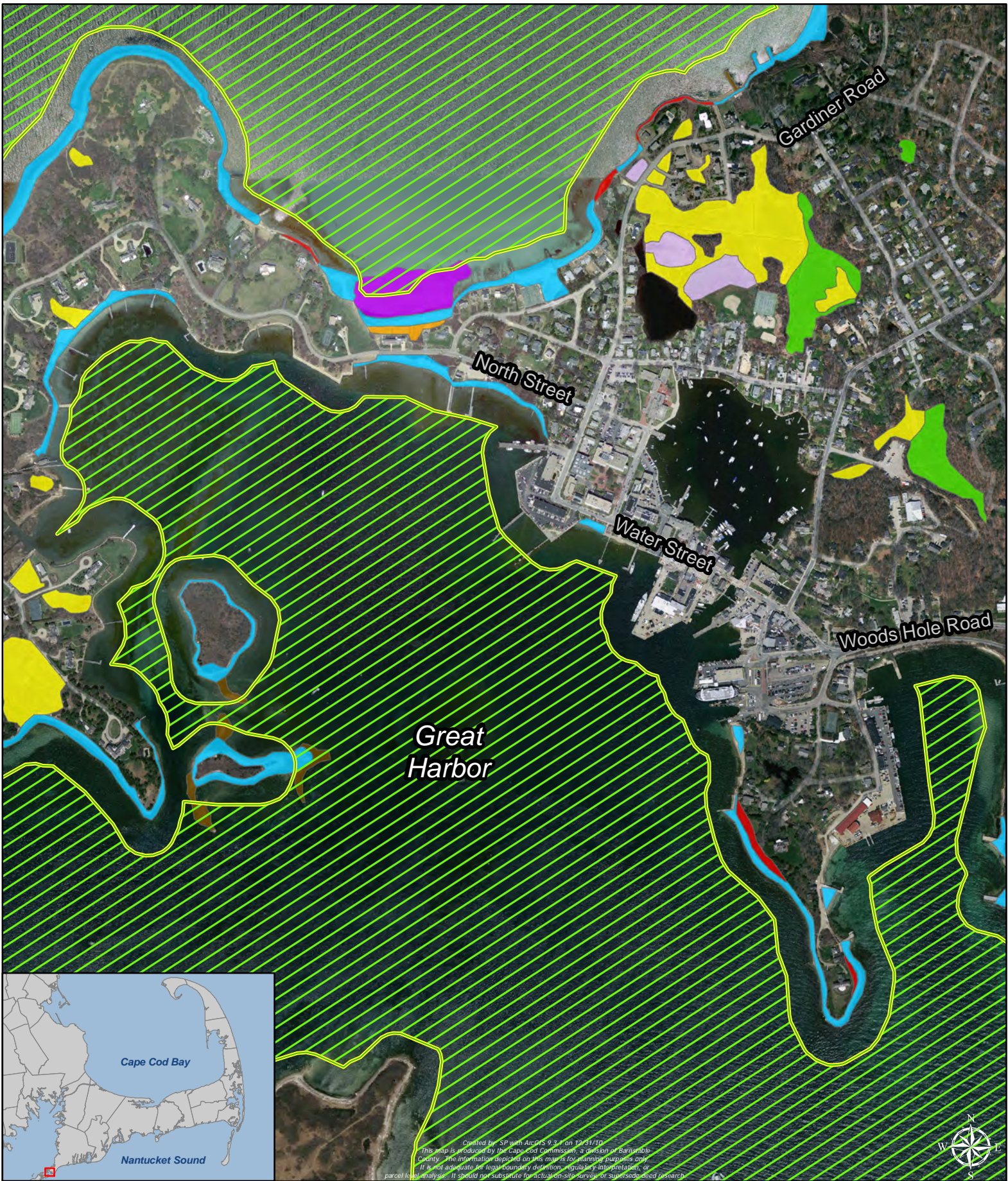
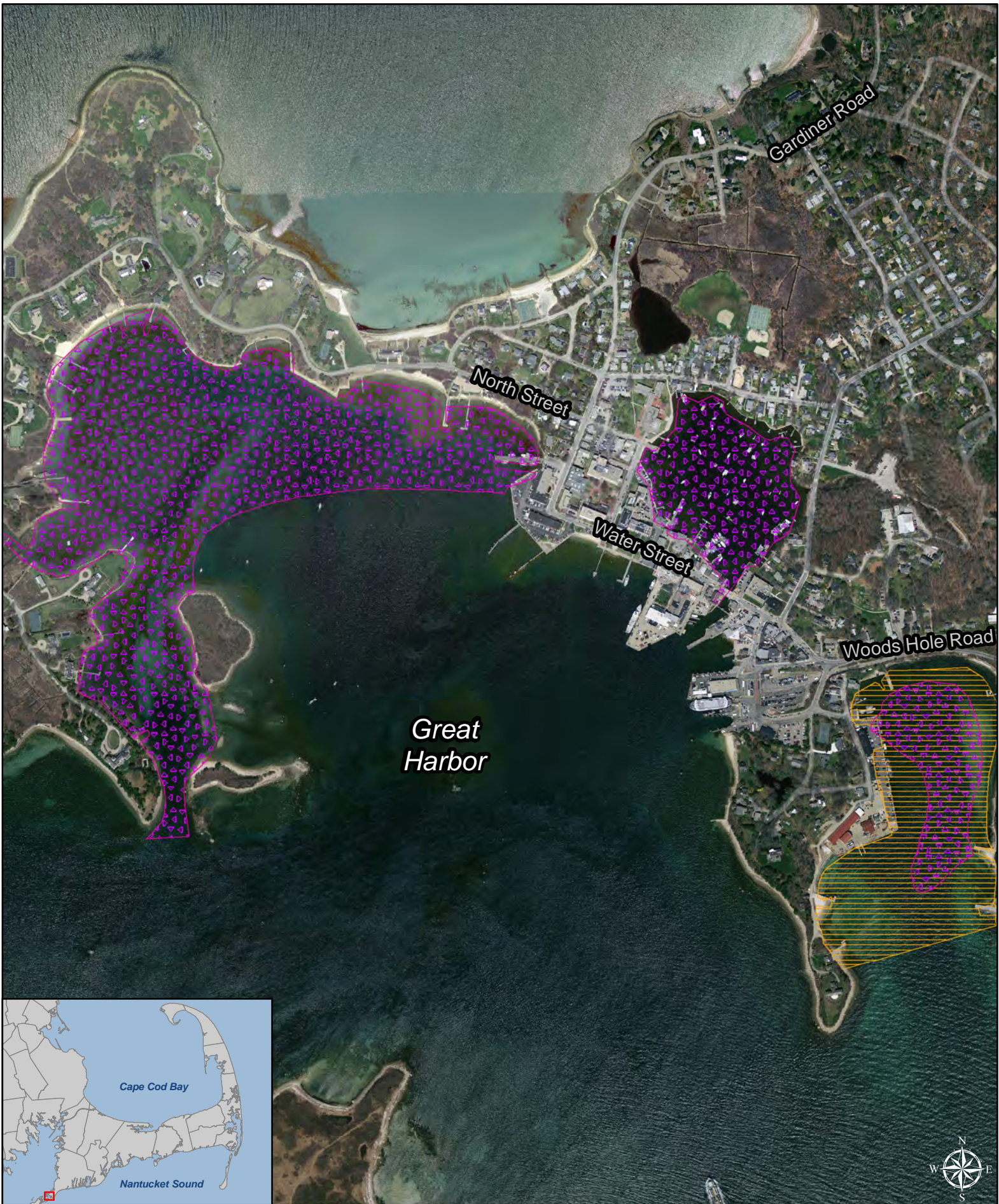


Figure 7: Natural Resources



Shellfish Suitability Areas



Bay Scallop



Quahog

0 250 500
Feet

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Figure 8:
Shellfish Habitat



FEMA 100-year Coastal Floodplain

- A zone = areas of 100-yr flood
- V zone = areas of 100-yr coastal flood with velocity (wave action)

0 250 500
Feet



Figure 9: FEMA
Flood Zones

Provincetown Harbor Maps

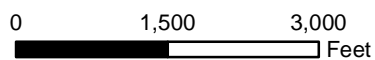
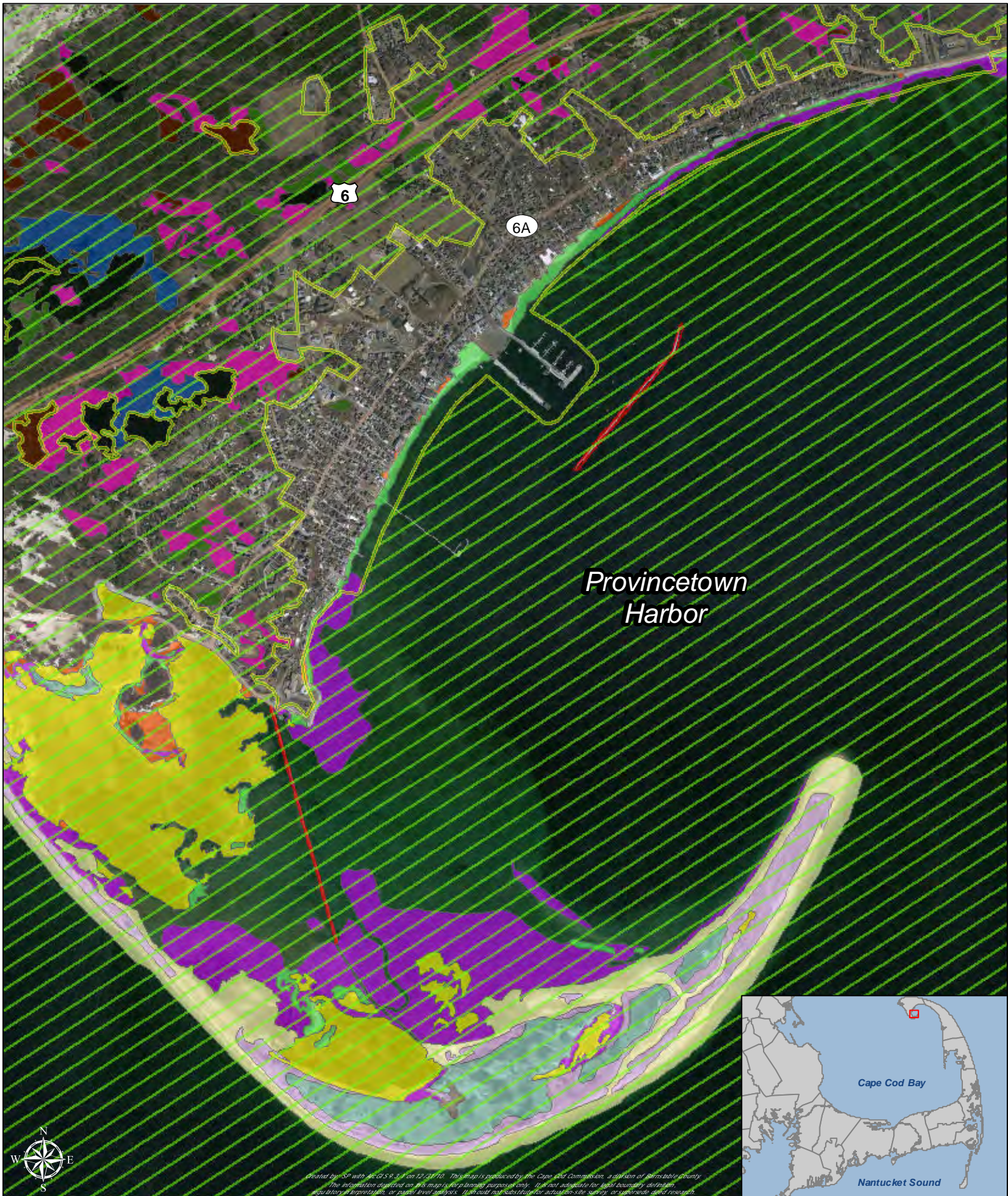
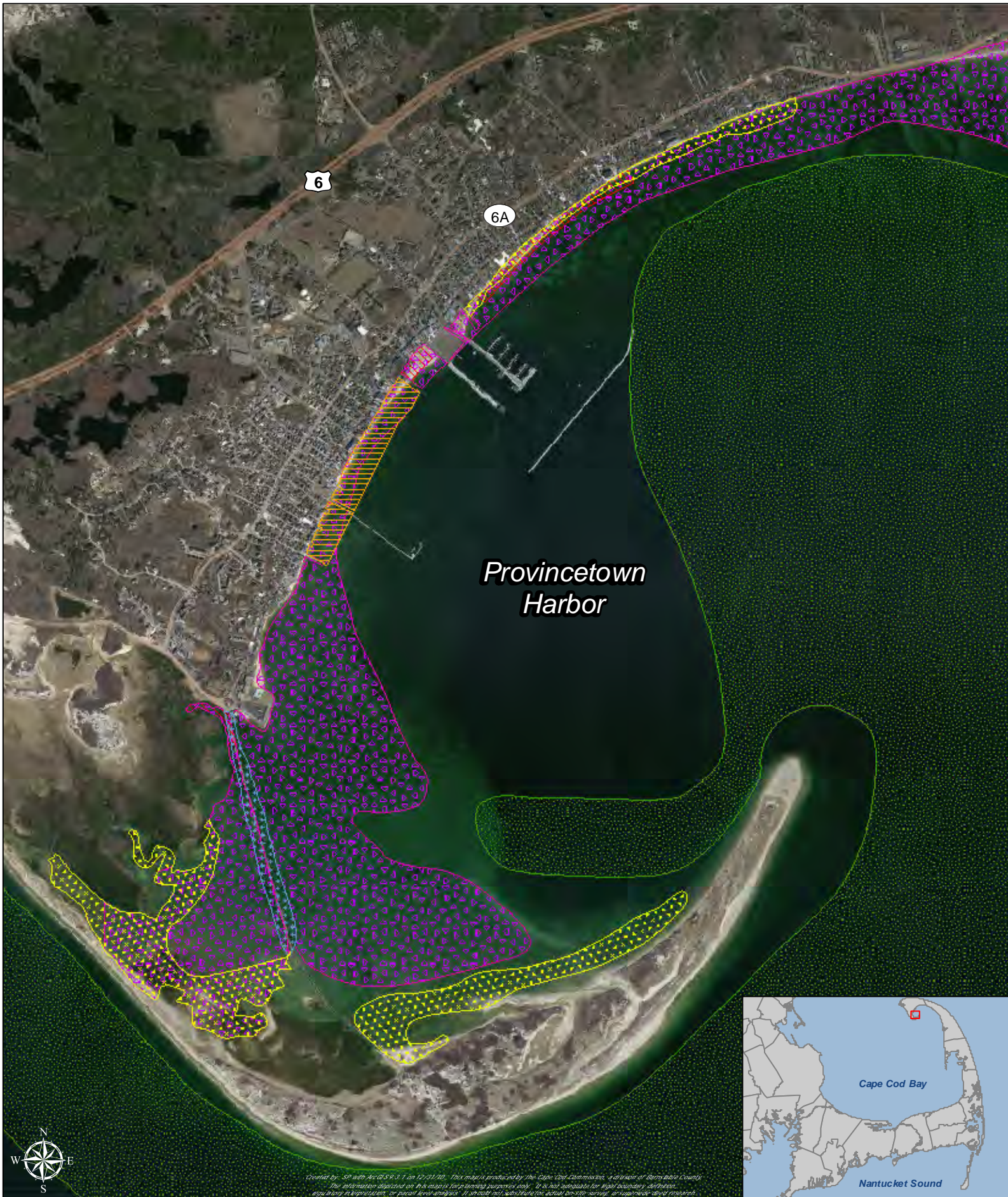


Figure 10: Study Area - Provincetown


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NHESP Estimated Habitats of Rare Wildlife	BARRIER BEACH-COASTAL DUNE	COASTAL DUNE	SHRUB SWAMP
Wetland Resources	BOG	DEEP MARSH	TIDAL FLAT
BARRIER BEACH SYSTEM	COASTAL BANK BLUFF OR SEA CLIFF	ROCKY INTERTIDAL SHORE	WOODED SWAMP DECIDUOUS
BARRIER BEACH-COASTAL BEACH	COASTAL BEACH	SALT MARSH	



Shellfish Suitability Areas


 American Oyster

 Bay Scallop

 Blue Mussel

 Quahog

 Soft-shelled Clam



 Surf Clam



*Figure 12:
Shellfish Habitat*

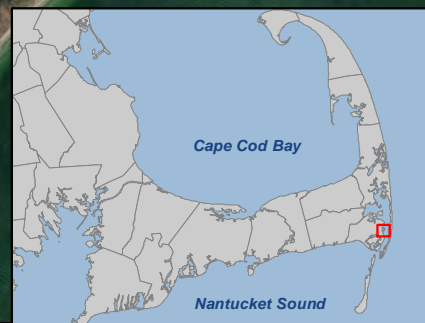


FEMA 100-year Coastal Floodplain

-  A zone = areas of 100-yr flood
-  V zone = areas of 100-yr coastal flood with velocity (wave action)

0 750 1,500
Feet

Chatham Harbor and Stage Harbor Maps













0 500 1,000 Feet


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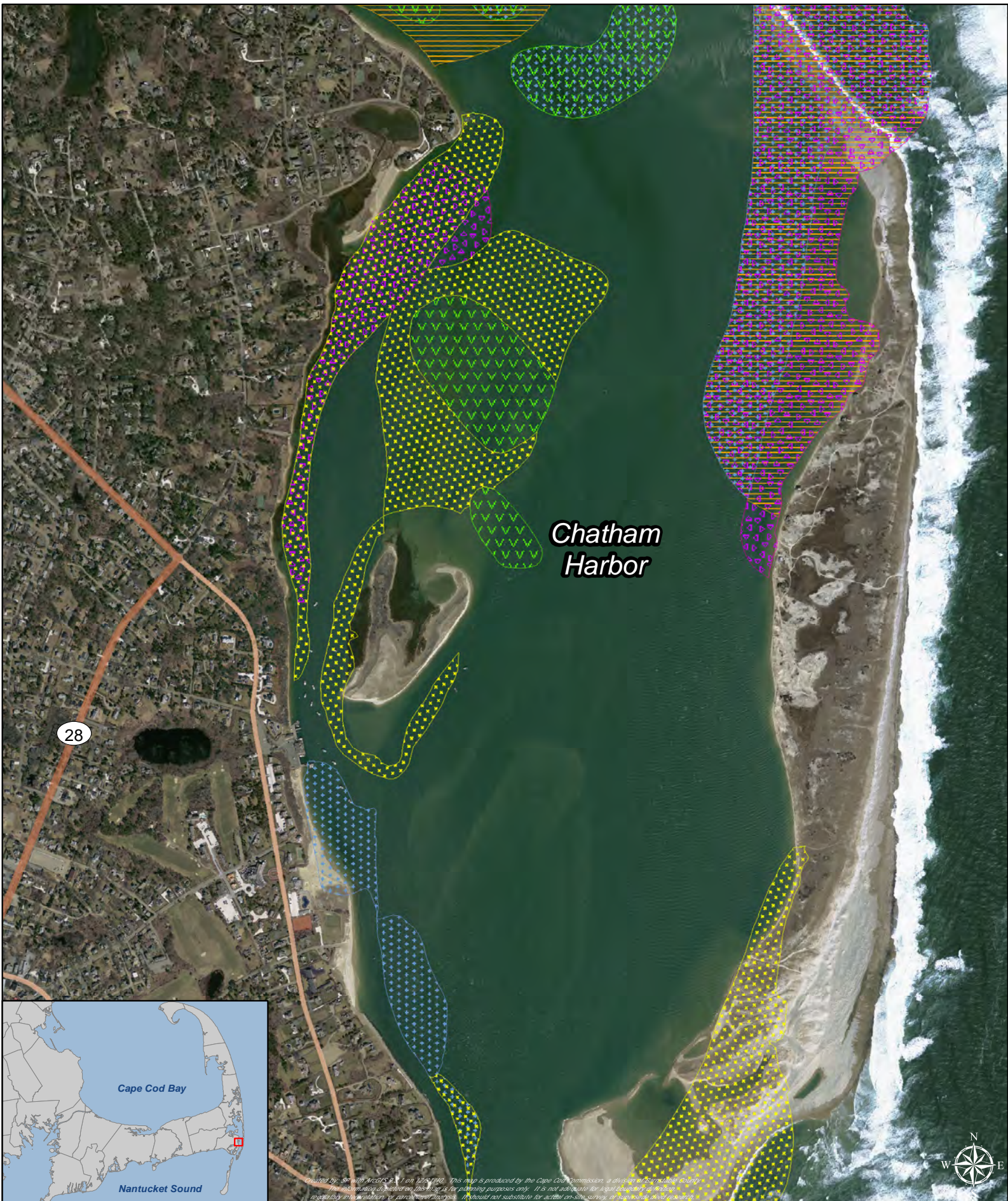


Figure 15:
Stage Harbor



- | | | |
|---|---|---|
|  NHESP Estimated Habitats of Rare Wildlife |  BARRIER BEACH-COASTAL DUNE |  SALT MARSH |
| Wetland Resources |  COASTAL BANK BLUFF OR SEA CLIFF |  SHRUB SWAMP |
|  BARRIER BEACH SYSTEM |  COASTAL BEACH |  TIDAL FLAT |
|  BARRIER BEACH-COASTAL BEACH |  COASTAL DUNE | |


Figure 16: Natural Resources





- Shellfish Suitability Areas**
- American Oyster
 - Bay Scallop
 - Blue Mussel
 - Quahog
 - Razor Clam
 - Soft-shelled Clam


Figure 17:
Shellfish Habitat



FEMA 100-year Coastal Floodplain

-  A zone = areas of 100-yr flood
-  V zone = areas of 100-yr coastal flood with velocity (wave action)



CAPE COD
COMMISSION

*Figure 18: FEMA
Flood Zones*

Squatucket Harbor and Wychmere Harbor Maps



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Figure 19: Study Area - Harwich



Figure 20:
Saquatucket Harbor

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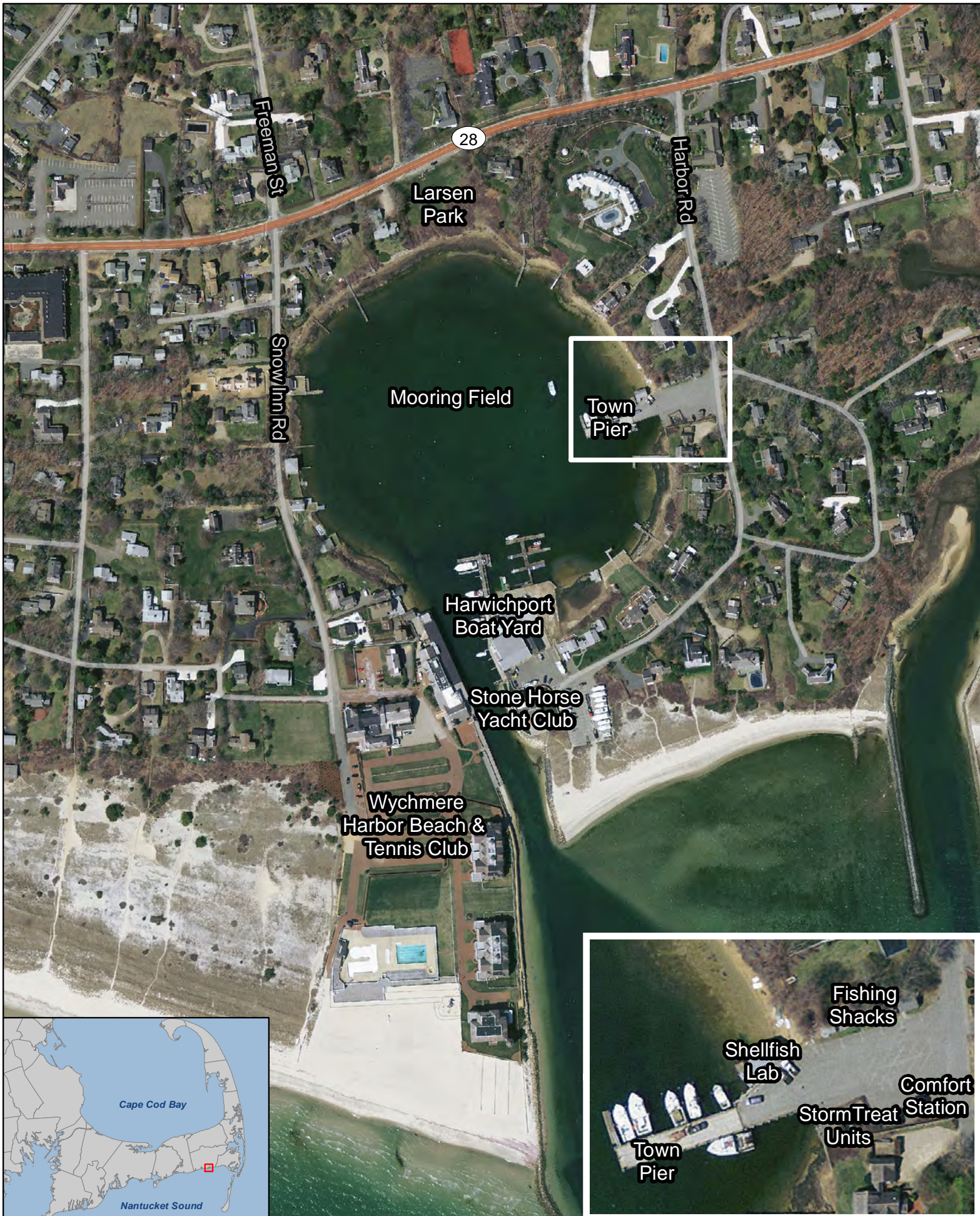


Figure 21:
Wychmere Harbor

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Shellfish Suitability Areas



Bay Scallop



Soft-shelled Clam



American Oyster



Quahog



Figure 23:
Shellfish Habitat



FEMA 100-year Coastal Floodplain

- A zone = areas of 100-yr flood
- V zone = areas of 100-yr coastal flood with velocity (wave action)

