

Duxbury Beach Management Plan



Revision Date: March 2003

Submitted to:
Duxbury Conservation Commission

Submitted by:
Duxbury Beach Reservation, Inc.

DUXBURY BEACH RESERVATION, INC.
P. O. Box 2593
Duxbury, Mass., 02331

March 20, 2003

Duxbury Conservation Commission
Town Hall
Duxbury, Mass., 02332

Subject: Duxbury Beach

Dear Commissioners:

Duxbury Beach Reservation, Inc. (the Reservation) is pleased to submit the enclosed Duxbury Beach Management Plan (DBMP) and Notice of Intent (NOI) for activities on Duxbury Beach. This DBMP was prepared by the Duxbury Beach Technical Committee which consists of Duxbury residents and environmental professionals who are very experienced in the management of beaches. This document is a revision of the Beach Management Plan that was originally filed in 1997 and it updates and substantially enlarges that earlier submission.

The Reservation a 501 (c) 3 not for profit organization, and its predecessors have owned, maintained and improved the property known as Duxbury Beach for many years. The property consists of about 4.8 miles of barrier beach stretching from the northerly entrance of Duxbury Beach Park on Gurnet Road to the Gurnet area in Plymouth.

The northerly 3.8 miles is situated in the Town of Duxbury and contains paved roadways and parking areas, several buildings, miles of fencing, two handicapped access ramps, numerous pedestrian paths to the front beach, three vehicle crossovers to the front beach and a continuous improved roadway along the back of the beach complete with turnouts and several ramps to the bay side of the beach.

The southernmost mile of the beach is in the Town of Plymouth. In this portion of the beach, the improved roadway continues with a few turnouts providing access to the Gurnet Gate, but with no access to the front beach. The Reservation constructs and maintains the above mentioned improvements to a lesser degree in the Town of Plymouth than in the Town of Duxbury portion of the beach.

The Reservation's goal is to protect the beach and make it available as an unsurpassed resource for conservation, wildlife and recreational use. We share the Commission's interest in improving our techniques when possible and pride ourselves in being in the forefront of Beach Management in the State. The accompanying 2003 Beach Management Plan is intended to describe in considerable detail projects and activities currently in operation on the Beach.

The attached Notice of Intent (Appendix K) references the sections of the Management

Plan which describe many activities in which the Reservation is currently engaged. It is also prepared so as to allow the Reservation, with proper approvals, to adopt new or innovative methods it feels will improve our management techniques. This Notice of Intent references some activities which in our opinion are not actually subject to regulation, but it is important that their purpose and value to the program be fully understood. These activities are listed on Sheet 2c of the Notice.

This Notice of Intent is for work in the Town of Duxbury only, and a separate Notice will be filed to cover work on that portion of the beach in the Town of Plymouth.

Over the years, the beach has benefited greatly from the co-operation of the many different agencies and groups having either jurisdiction or an interest in it's operation, and with everyone's help and input, we hope to maintain the beach as an asset to the Towns of Duxbury and Plymouth for many years into the future.

We look forward to discussing the enclosed with you and we thank you in advance for your upcoming work with us on this important matter

Very Truly Yours,

Duxbury Beach Reservation's Beach Technical Committee
Alan C. Vautrinot, Jr. and Lester B. Smith, Jr. co-chairs and Vice Presidents of DBR

Duxbury Beach Management Plan

Revised and updated in 2003
by the
Beach Technical Committee
of the
Duxbury Beach Reservation, Inc.

Daniel W. Baker
Donald C. Beers
Shawn M. Dahlen
Kay S. Foster
Scott S. Hecker
Margaret M. Kearney
James F. O'Connell
Lester B. Smith, Jr., co-chair
Alan C. Vautrinot, Jr., co-chair

Table of Contents

1. Introduction.....	1-1
1.1 Goals of Management Plan	1-1
2. Description of Duxbury Beach	2-1
2.1 Geological History and Processes	2-1
2.2 Management History	2-2
2.3 Current Management of Duxbury Beach	2-8
2.3.1 Summary of Management Structure.....	2-8
2.3.2 Duxbury Beach Reservation, Inc.	2-8
2.3.3 Duxbury Beach Study Committee.....	2-9
2.3.4 Town of Duxbury Lease Agreement	2-10
2.3.5 Relationship Between Town and Duxbury Beach Reservation, Inc.	2-11
2.3.6 Town of Duxbury: Boards, Commissions, and Committees.....	2-11
2.3.7 Town of Duxbury: Departments	2-15
2.3.8 Town of Plymouth	2-17
3. Environmental Statutes	3-1
3.1 Summary of Statutes and Regulations	3-1
3.2 Duxbury Conservation Commission.....	3-2
3.2.1 Massachusetts Wetlands Protection Act and Regulations	3-2
3.3 Duxbury Harbormaster/Coastal Natural Resources Department.....	3-13
3.3.1 Town of Duxbury, Beach Rules and Regulations	3-13
3.3.2 Town of Duxbury, Shellfish Regulations.....	3-13
3.3.3 Town of Duxbury, Harbor Regulations	3-13
3.4 Massachusetts Natural Heritage and Endangered Species Program	3-13
3.5 Massachusetts Environmental Policy Act (MEPA) Office.....	3-14

3.6 Massachusetts Coastal Zone Management (MCZM) Office	3-14
3.7 U.S. Fish and Wildlife Service: Federal Endangered Species Act	3-15
3.8 U.S. Army Corps of Engineers: Clean Water Act, Section 404	3-15
4. Beach Use and Management	4-1
4.1 Off-Road Vehicle (ORV) Access	4-1
4.1.1 Established Track Program	4-1
4.1.2 ORV Limits	4-2
4.1.3 Protection of Resources from ORV Use	4-
4.2 Dog Access	4-7
4.3 Marine Access	4-8
4.4 Shore Access	4-9
5. Endangered Species Program	5-1
5.1 Environmental Statutes and Regulations Applicable to Endangered/Threatened Species on Duxbury Beach	5-1
5.2 Scope of Endangered Species Programs	5-2
5.2.1 Coastal/Natural Resources Endangered Species Officer	5-2
5.2.2 Coastal/Natural Resources Endangered Species Monitors	5-4
5.2.3 Coastal/Natural Resources Beach Patrol Officers	5-5
5.2.4 Endangered Species Scientist	5-5
5.3 Replicated Habitats	5-6
5.3.1 Background	5-6
5.3.2 Project History	5-6
5.3.3 Future Plans	5-7
6. Beach and Dune Maintenance and Restoration Program	6-1
6.1 Dune Maintenance and Restoration	6-1
6.1.1 Beach Grass Planting	
6.1.2 Woody Vegetation	

6.1.3 Fertilization	6-4
6.1.4 Sand/Snow Fence Installation.....	6-5
6.1.5 Symbolic Fencing.....	6-5
6.2 Sacrificial Dunes.....	6-5
6.2.1 Background	6-5
6.2.2 Sacrificial Dunes on Duxbury Beach	6-7
6.2.3 Sacrificial Dune Parameters.....	6-8
6.2.4 Sacrificial Dune Construction	6-8
6.2.5 Interests to Be Protected	6-9
6.3 Vehicle Corridor.....	6-10
6.3.1 Post and Cable Fencing	6-11
6.3.2 Surface Maintenance.....	6-11
6.4 Beach Cleaning	6-12
6.5 Maintenance of Duxbury Park Pavilion Area	6-12
6.6 Maintenance of Duxbury Beach Resident Parking Lot	6-14
6.7 Elevated Access Ramps (Handicapped Accessible).....	6-14
7. Public Education and Outreach	7-1
7.1 Duxbury Beach Reservation, Inc.....	7-1
7.2 Duxbury Beach Preservation Society	7-1
7.3 Harbormaster/Coastal Natural Resources Department	7-2
7.4 Town of Duxbury Schools.....	7-2
7.4.1 Elementary School.....	7-2
7.4.2 Middle School and High School	7-3
7.5 Duxbury Before and after Dark.....	7-4
7.6 Brockton Special Program for Special Needs Students	7-5
7.7 Mass. Audubon's Education Program	7-5
7-8 Mass. Beach Buggy Association.....	7-8

1

Introduction

1.1 Goals of Management Plan

- Serve as a reference document for use by managers of Duxbury Beach.
- Provide a management program that is consistent with federal, state, and local laws and regulations for the various potential uses of the beach.
- Provide a document that serves as the basis for Notice of Intents to be filed with the Duxbury and Plymouth Conservation Commissions for the ongoing management of wetland resource areas protected by the state Wetlands Protection Act and local Wetlands Bylaws.
- Describe the existing management structure of the beach and the role of the various parties.
- Provide management guidelines that are flexible enough to be adapted, refined, and implemented on a daily basis by the on-site management staff of the beach.
- Protect endangered and protected species and their habitats while recommending guidelines that allow reasonable off-road vehicle and other uses.
- Provide an outline of the beach restoration and management program, including the required year-to-year program as well as the coastal storm response program.
- Define the public education and outreach program, which is an important component of the management plan.

2

Description of Duxbury Beach

This chapter provides a detailed history of Duxbury Beach, including the history of the beach, a description of existing conditions including ownership and lease agreements, and a description of the existing management structure.

2.1 Geological History and Processes

Duxbury Beach is a four and a half mile long barrier beach, which is to say it is a narrow, low-lying strip of land consisting of coastal beaches and coastal dunes that extend roughly parallel to the trend of the coast. The beach is separated from the mainland by a narrow body of fresh, brackish or saline water or a marsh system. This low-lying coastal landform system is comprised of beach, dunes, and adjacent salt marshes. It was formed and currently is shaped by coastal processes.

Duxbury Beach was formed at a lower stand of sea level as a result of erosion of glacial headlands and shallow glacial deposits. As the rate of sea level rise slowed, Duxbury Beach tied itself to the glacial deposits of Gurnet Point, High Pines, and the mainland to the north. The continued evolution of the beach occurs mainly in response to storm overwash and wind transport of sand. Storm overwash always carries beach sediment into the dune area and can sometimes carry sand from the exposed beachface on the ocean side of the barrier across and through the dunes to the landward side into Duxbury Harbor.

As seen from an airplane, a boat, or the mainland, Duxbury Beach appears to be a landform of great delicacy and fragility. Yet during storms, this thin barrier beach withstands violent assaults by huge breaking waves. The fact is that this landform was formed and is maintained by wave and wind action.

Duxbury beach is always changing. It changes from one tide to the next, from season to season, and from year to year. Each wave that breaks on the beach at an angle carries sand along the shore. Some of the sand that used to be transported to Duxbury Beach has been blocked by the construction of jetties to the north. Other sand sources are no longer available because seawalls have been constructed over glacial banks to the north. Some sand is transported to the beach from nearshore sand bodies and bars. Eastern quadrant winds that blow across the beach pick up sand and carry it landward to build dunes. Beach grass and other vegetation help to build dunes by trapping wind-blown sand and stabilizing the dune surface.

During the course of the year, seasonal changes to Duxbury Beach are quite evident. In summer, when the waves are low and long, the beach builds itself up, becoming higher and wider. During spring and summer, sand moves toward the beach from the offshore bars that formed during the winter. During the summer, the seaward edge of the dune may also grow and extend onto the beach. Storms, which usually occur from fall to early spring, produce steep waves that cut into the beach and cause it to narrow and flatten. After a storm, the sediment particles on the beach appear to be much coarser in grain size, because steep storm waves have picked up the finer

sands from the beach and moved them seaward to build the offshore bar. In some locations the beach consists entirely of cobble size material after a storm, particularly during the winter months.

Storms can narrow the beach to the extent that a near vertical face, called a dune scarp, is cut into the dune. Large storms, especially those that coincide with higher than average tides, can cause extensive erosion of the beach and dunes and at times can overwash the entire barrier landform. When storm overwash occurs, sand that erodes from the beach is carried landward by the surging water and is deposited in fan-like deposits known as washover fans. These areas are recolonized by beach and marsh grasses, and eventually the barrier beach is restored to its pre-storm form. However, the storm overwash process causes the beach to migrate landward.

Another much slower process that is affecting Duxbury Beach is a gradual rise in relative sea level. Since the last ice age (about 15,000 to 20,000 years ago) in this general area, global warming has caused the gradual melting of the ice caps and released waters to the oceans, resulting in a rise in the sea surface relative to the land surface. Relative sea-level rise, resulting from the combined effects of worldwide ocean levels rising and the landmass of Massachusetts sinking, is presently occurring at an approximate rate of one foot per 100 years.

Another factor that is impacting barrier beaches such as Duxbury Beach and cliffed coasts such as Gurnet-Saquish is the balance of sediment supply and loss. Sediment supply to Duxbury Beach has diminished over the years due to the construction of sea walls to preserve bluffs (contain sediment) to the north and diminishing natural offshore sediment sources. Based on an analysis of historic shoreline change spanning 150 years (between the mid-1800s to 1994), the approximate high-water line along Duxbury Beach is migrating landward. The most rapid movement is occurring along the beach between the Duxbury Beach Park pavilion and the Powder Point Bridge, at an approximate average annual rate of one foot per 100 years.

Sea-level rise causes relatively stable barrier beaches like Duxbury Beach to retreat landward. Recent scientific reports have concluded that worldwide sea levels are accelerating due to global warming. Projections by international experts predict that sea-level rise worldwide may double by 2100. Higher water levels will produce frequent overtopping and rapid landward migration of barrier beaches, including Duxbury Beach. This rise in sea level has important implications for the future management of all coastal areas, especially barrier beach shorelines.

2.2 Management History

The least understood aspect of Duxbury Beach by the general public is its ownership and its special relationship with the Town of Duxbury. The following is a brief history of the years of ownership. The early history of the beach is based in part on an article in the May 1969 issue of the Duxbury Clipper, by Ted Pratt, at that time head of the Duxbury Beach Association.

1600s - Early 1900s

According to the earliest available records, Duxbury Beach was divided in the 1640's into lots privately owned by a number of individuals. This arrangement continued until the 1830's, when the Town of Duxbury acquired the entire property. In 1872, the Town of

Duxbury transferred ownership of the Beach to a private individual, subject to “the right-of-way in the Town in some proper location for the passing of teams, carriages, or foot passengers to be laid out by the Grantee along said premises from Cut River to the Gurnet, but implying no obligation on the Grantee to make said road or right-of-way or keep the same in repair.” The Powder Point Bridge was built in 1892 and maintained jointly by the towns of Duxbury, Kingston, Marshfield and Plymouth, and Plymouth County.

A few houses and hunting stands had been built and plans had been drawn up for 200 house lots on the beach when, in 1919, the executor of the estate of Georgianna Wright offered Duxbury Beach for sale. Some 18 to 20 concerned Duxbury families, upon hearing of the proposed 200 house lots and fearing the type of development that had occurred along barrier beaches such as Revere Beach and Coney Island in New York, raised enough money to purchase the beach. In November 1919, title was taken in the name of the Duxbury Beach Association, a common law trust organized for the purpose of acquiring the beach and protecting it for the benefit of the Town of Duxbury. Technically a “private enterprise,” the Association paid town taxes. No dividends were ever paid on the shares, and the trustees served without compensation.

Duxbury Beach Association operated the beach from 1919 until 1975. During its first ten years, the Association acquired many acres of bordering marshlands, financed by additional subscriptions from the shareholders. Through negotiation and litigation, the trustees gradually removed 12 of the 18 houses and all of the shooting stands from the beach.

1930s

As beach use increased, visitors began to park their cars on the bridge and Powder Point roads, creating a dangerous traffic situation. To alleviate this problem, the Town in 1931 asked the Association to provide parking on the beach. In response, the Association paid for the construction of a free resident’s parking lot at the East End of the Powder Point Bridge, and a public lot at the northern end of the beach. The town agreed to police the lots. Thus began the traditional division of responsibility between the owners of the beach and the Town.

The early 1930s saw the Association’s first sporadic attempts at erosion control with the erection of snow fence and the use of old bridge planks donated by the Town. From 1933 to 1934, the Association was able to purchase beachfront in the Town of Plymouth from the Duxbury line to the Gurnet, plus large tracks of marshland.

1940s

In 1941, the Town approved taking over the full cost of maintaining the Powder Point Bridge. The Town and the Association evenly shared the cost of the legal work. Also in 1941, the Association built the pavilion at the public parking lot at the north end of the beach. A daily parking fee provided the funds necessary to maintain and improve the beach. With the help of volunteers, some limited erosion control measures were undertaken.

1950s

In 1950, to cover the increasing cost of policing the lot at the east end of the bridge, the Selectmen initiated parking fees, charging residents \$1.00 per season for each beach sticker. The Association continued to assume the costs of the maintenance and gradual enlargements of the beach parking lots.

In 1958, it became apparent to the Town of Duxbury Selectmen and the Beach Trustees that the beach was being damaged. The primary cause was the increasing number of four-wheel drive vehicles using the beach without proper controls. Driving over the dunes was killing the vegetation and destabilizing the dune structure. In 1959, at Town Meeting a motion to appropriate \$800 to provide summer police patrols failed.

Despite prevention efforts by the Town of Duxbury and the Beach Association, the beach continued to deteriorate at an alarming rate. The use of the beach for recreational purposes was proliferating faster than the ability of authorities to manage such use.

1960s

In 1961, the Beach Association provided the Town of Duxbury with a jeep for police patrols on the beach, and the Town voted a patrol budget of \$4,500. In 1969, Richmond Poole of Duxbury, for his master's degree, published a detailed study of the beach and its environmental problems. The study, which covered the time period from 1951 to 1964, focused on the area of beach from the Blakeman Pavilion southward for 6,000 feet. A major conclusion of the study was the need to protect the dunes and their beach grass vegetation. The report documented that over the duration of the study period, the number of dune "blowouts" had increased from 9 to 19, with the width of these blowouts increasing from slightly less than 300 feet in 1951 to 1,743 feet in 1964. On average, 35 percent of the vegetated dunes had disappeared during this period, and in the most used areas in front of the Town parking lots, 60 percent of the dunes had disappeared.

The report concluded that increasing recreational demands were seriously damaging Duxbury Beach. The dunes were diminishing to such an extent that coastal storms were washing over the beach with increasing regularity.

1970s

In 1972, the Duxbury Selectmen appointed a Beach Study Committee to study beach problems. After a yearlong study, the committee made the following recommendations:

- The Association should try to contain and reverse dune erosion by restricting pedestrian and vehicle access.
- The Town should lease the beach from the Association to provide additional funds for beach restoration.
- The Town should establish a Town Beach Conservation Department to provide a much-needed enforcement function.

The 1973 annual Town Meeting voted to lease the beach from the Association for \$12,000 a year and to create the position of Beach Conservation Officer.

In 1973, the Beach Operations Committee was created to coordinate the efforts of the Town and Beach Association. It consisted of the three Town Selectmen, three Beach Association Trustees, and three concerned citizens. The Town Beach Conservation Officer was hired the same year.

The new cooperative effort worked well. Continuing the traditional division of responsibilities first established in the 1930s, the Association provided the funds and heavy contracting work and the Town provided the much-needed enforcement and education functions. Volunteers contributed greatly to the effort. A total of 150 volunteers initiated the annual beach grass planting project in 1974 with the planting of 50,000 culms of beach grass.

The Beach Association expanded its conservation efforts by installing post and cable fencing to restrict vehicle traffic to the beach right-of-way. By 1974, the Association had installed snow fence along the front of the dunes and post and cable fencing along the right-of-way from the Town parking lot to the present location of the second crossover.

In 1975, the Beach Association decided that a more permanent organization was needed to manage the beach. The Duxbury Beach Reservation, Inc., was thus formed, and the five or so remaining families who owned the beach transferred ownership to the new, nonprofit Massachusetts charitable organization. In its charter, the newly formed Reservation stated its purposes as follows:

to acquire by purchase, gift or otherwise all or any part of Duxbury Beach and Saquish Beach in the Towns of Duxbury, Marshfield and Plymouth and any salt marshes and upland adjacent to or in the vicinity of such beaches and also conservation easements or any other interest in or to any such property; to restore and to preserve these beaches (whether owned or not) so far as reasonably possible in their natural state as host to marine life, native and migratory birds and indigenous vegetation, as barrier beaches for the protection of Duxbury and Kingston and as a priceless environmental asset to the Commonwealth and the nation; and to operate for the benefit of the people of Duxbury and the general public a public recreational beach with all necessary and incidental facilities, while preserving the right to limit and regulate such use so as to be consistent with the corporation's primary ecological objective.

The Duxbury Beach Reservation continues to carry out the mission set forth above, principally to preserve Duxbury Beach. (See Section 2.3.2 for a full description of the Duxbury Beach Reservation, Inc.)

In 1978, the infamous "Blizzard of '78" caused extensive beach damage and erosion. Three of the remaining six houses were destroyed, along with all of the snow fencing and most of the existing dune structure. One of the first steps the Duxbury Beach Reservation took was to disallow reconstruction of these houses, the goal of the Reservation being to eliminate houses on the beach whenever possible. The Reservation also began to build its first storm damage reserve fund following the Blizzard of '78.

1980s

Throughout the 1980s, the Duxbury Beach Reservation met annually to conduct the business of maintaining and improving the beach. During reconstruction of the Powder Point Bridge, the work road between the pavilion at the Duxbury Beach Park at the north end of the beach and the Resident Parking Lot was left open to allow all traffic, including two-wheel drive vehicles, access to the beach. When the new bridge opened, the Gurnet Road neighbors asked the Reservation to leave the road open (gates unlocked) for two-wheel-drive vehicles. (Four-wheel drive vehicles can go around the gates on the sand road). The Reservation granted this request for one year as an experiment, but found that the increased use was degrading the beach and requiring the expenditure of limited funds. At the end of the year, the Reservation closed the road. To protest the closing, the Gurnet Road neighbors appealed the Orders of Condition under which the Duxbury Conservation Commission permitted the Reservation to do its routine beach maintenance. During the several years of the appeal process, the Reservation was prohibited from doing any work on the beach. The matter was eventually resolved in favor of the Reservation.

With the exception of the Gurnet Road problem, the 1980s were a quiet, peaceful time for the Reservation and the beach. There were no major management problems, and the weather was uneventful.

1990s

The October 30, 1991 No Name or Halloween Storm, later made famous as Sebastian Junger's *Perfect Storm*, changed everything. Essentially, the entire length of Duxbury Beach, except for a few places at the east end of the Powder Point Bridge, High Pines, and the Plum Hills area was overwashed again and again by several tides over the course of several days. Giant waves completely cut through the dunes and swept away every bit of post and cable, snow fence, signage, and much of the woody vegetation and beach grass. The Reservation's modest storm damage reserve fund was quickly depleted as the Reservation, with help from the Army Corps of Engineers and FEMA, immediately began making emergency repairs. The Herculean efforts of individual members of the Reservation who coordinated beach operations, negotiated the labyrinth of the many permitting agencies, and juggled bills and held off creditors as reimbursements trickled in cannot be overemphasized. A second hundred-year storm hit the beach in December 1992, and the whole process had to be repeated. (The two dune rebuilding projects associated with these storms are described later in this document under the heading of "sacrificial dune")

With an annual income from public parking at the Duxbury Beach Park pavilion of about \$150,000 and a Town lease payment of \$20,000, Duxbury Beach Reservation lacked the financial resources necessary to build first one sacrificial dune, followed three years later by a second sacrificial dune. Town Meeting responded by covering a projected shortfall of \$95,000 in addition to the \$20,000 lease payment and by voting to raise the lease payment to \$100,000 for the next year. The Reservation took out a very large, unsecured loan and, for the first time, asked for donations. A few of the Reservation's trustees assembled a group of volunteers from the Town, who named themselves the "Save the

Beach Committee.“ Through their efforts, thousands of additional dollars were raised to offset the reconstruction costs. Save the Beach was so successful at increasing awareness of the beach in addition to raising money that the Reservation voted to perpetuate the group as a subcommittee of the Reservation. The committee renamed itself the “Duxbury Beach Preservation Society,” and over the years it has increased its membership. The mission of the Duxbury Beach Preservation Society is to raise funds for preserving the beach and building the storm damage fund, as well as to educate the public about all aspects of the beach.

At the same time the Reservation was dealing with the damage from back-to-back devastating storms, it was also becoming aware of endangered species legislation and the potential impact of such legislation on beach management. The Reservation responded with a proactive campaign to aggressively protect least terns and piping plovers in order to allow recreational use to continue on the beach. The Reservation funded the appointment of the first plover monitors and the Duxbury Harbormaster/Coastal Natural Resources Department began educating beach guests about the guidelines that had to be followed, especially guests who used off-road vehicles (ORVs).

The 1990s will be remembered as the time when managing Duxbury Beach became extremely complex and very costly. During the 1990s, the Reservation and the Harbormaster/Coastal Natural Resources Department found it more and more difficult to reconcile the increasing numbers of beach guests, vehicles, and dogs with the requirements of public safety and the protective policies associated with the Endangered Species legislation. More and more regulatory bodies and environmental advocacy groups such as Mass Audubon Society had great influence over management decisions on Duxbury Beach. In 1997, the Duxbury Conservation Commission added to the Orders of Condition under which the Reservation operates the stipulation that the Reservation assemble a Beach Technical Committee of knowledgeable people to keep track of the number of vehicles accessing the beach and to study the various areas of the beach impacted by pedestrians and vehicles. The various traffic, geological, and biological studies that the Technical Committee has assembled are listed and described in Appendix I. The work of the committee is ongoing.

2.3 Current Management of Duxbury Beach

2.3.1 Summary of Management Structure

Duxbury Beach Reservation, Inc,

- Owns beach
- Leases beach to Town of Duxbury
- Maintains and improves dunes
- Pays for endangered species monitors through a grant to Town

Town of Duxbury

- Leases beach (except for Duxbury Beach Park) from the Reservation
- Sells parking permits for Resident Parking Lot
- Sells oversand permits for residents and nonresidents
- Establishes regulations for use of beach

Harbormaster/Coastal Natural Resources Department

- Patrols beach, enforces rules, educates beach guests
- Oversees endangered species monitoring program

2.3.2 Duxbury Beach Reservation, Inc.

When the Duxbury Beach Reservation was formed in 1975, its by-laws created a board of trustees, who elect directors, and a board of directors, the majority of whom must be Duxbury residents. The trustees elect 10 of the 11 members of the board of directors. The eleventh director, the only one specifically named in the charter, is the chairman of the Board of Selectmen for the Town of Duxbury. Representatives of the Duxbury Conservation Commission, the Duxbury Rural & Historical Society, Inc., the Massachusetts Audubon Society, the Trustees of Reservations, and a nonprofit land conservation organization may be nominated as directors. Also specified by the by-laws to be directors are a Gurnet Point or Saquish landowner and at least three residents of Duxbury, one of who shall be a resident of Powder Point. The directors are responsible for the management and operation of the beach and, with the trustees, serve without compensation.

Although the Reservation's bylaws restrict the number of directors, they do not restrict the number of trustees. In recent years the Reservation has increased the number of trustees to include more members of the community and coastal specialists from outside the community. Two professional coastal geologists are currently trustees of the Reservation, and one of these geologists is a director. All of the trustees and directors have dedicated themselves to preserving Duxbury Beach.

The Reservation currently has biannual meetings (fall and spring), at which time the major issues affecting the beach are discussed and voted on. The agenda items typically include:

- election of officers and executive committee members
- appointment of DBR committees and Town Beach Committee designees
- discussions of ongoing projects
- consideration of the authorization of the Town of Duxbury beach lease
- consideration of authorization of the contract for the public beach parking lot and Pavilion
- establishment of annual public parking fees for the public beach parking lot
- consideration of funding a grant to the town to provide additional patrols
- consideration of providing funds to the town and the Massachusetts Audubon Society, Inc. for the Endangered Species Program
- consideration of funding for the public education program on Duxbury Beach conducted by the Massachusetts Audubon Society, Inc.
- review and approval of operating budget
- reports of officers
- reports of committee chairs
- report on behalf of Reservation's designees to the Town Beach Committee
- report of Harbormaster/Coastal Natural Resources Department
- report of Conservation Administrator
- report of Gurnet/Saquish Association

During the course of the year, the Reservation works actively with the Town of Duxbury in the management of Duxbury Beach. The Reservation uses the revenues from the town lease, the public beach parking lot, and donations to maintain and improve the beach, provide recreational access, and protect the natural resource attributes of the beach.

The Reservation holds title to the beach, which is run, consistent with the charter, for the benefit of the town residents and the general public. The makeup of the Board of Directors and Trustees assures that the Reservation will continue to have a strong environmental conviction and cooperative attitude toward the Town of Duxbury.

2.3.3 Duxbury Beach Study Committee

The Duxbury Beach Study Committee was formed as the result of a motion from the floor of the March 8, 1986 Town Meeting, following an overwhelming majority vote to reconstruct the Powder Point Bridge. The motion called for the moderator to appoint a committee of seven members to "recommend a comprehensive management program for

Duxbury Beach to enhance its use for passive recreational enjoyment of the people, to protect its aesthetic values, to ensure preservation of its functions as a barrier beach and to better manage vehicular traffic.”

The committee held meetings on a biweekly to monthly schedule from June 1986 to March 1987. The following key issues were identified in their report:

1. The Town of Duxbury does not own the beach; it is leased on a yearly basis from the Duxbury Beach Reservation. Residents of the town appear to be unaware of this very important fact.
2. The Duxbury Beach Reservation has been doing a very good job of managing the natural resources of this barrier beach. The trustees care a great deal about the beach and they are committed to managing the beach so that its natural resources are protected while providing the public, including residents of Duxbury, with the opportunity to utilize it as a recreational resource.
3. The Town of Duxbury’s Land and Natural Resources Department manages use of the beach under the yearly lease agreement with the Duxbury Beach Reservation. Management of the beach is getting more and more difficult every year due to increased usage. There are serious questions whether this department has been given sufficient resources by the town to continue to carry out the difficult task of managing the very intensive use of this valuable natural resource.
4. Serious safety problems were identified relating to the use of the beach. A conflict exists between the present intensive use of the front beach by vehicles and people using the beach for walking, bathing and sunning. The newly constructed back road to Gurnet-Saquish hopefully will alleviate some of the front beach conflicts. There is a concern that opening the new Powder Point Bridge will bring much heavier vehicular traffic to the beach and that this will overcome any positive benefits that the improved back road will provide.
5. There is a need to monitor the beach and beach users to gather information on vehicular use and the adequacy of town staffing, equipment, and facilities to provide effective beach management. In addition, there is a need to determine the costs to the town of providing beach management versus the revenues, which the town receives, from beach stickers.

After a year of data gathering, the committee recommended to town meeting that a permanent town committee be established to develop a long-term beach management program.

2.3.4 Town of Duxbury Lease Agreement

The Town of Duxbury Lease Agreement is a simple three-page document that defines the Town’s annual lease with the Reservation (see Appendix C). The area leased includes all of the Reservation’s land in both Duxbury and Plymouth (excluding a couple of dedicated parcels) southward from a line that runs east-west from the northerly edge of the Resident Beach Parking area at the east end of the Powder Point Bridge. In addition to the

Resident Beach Parking, it includes beach and dune areas, parking lots, and the improved roadway from the Powder Point Bridge to Gurnet-Saquish). The annual lease is currently for the sum of \$150,000.

2.3.5 Relationship Between the Town and Duxbury Beach Reservation, Inc.

The Town and Duxbury Beach Reservation cooperate to manage the beach in a unique partnership, which has evolved over time. In simplest terms, the Reservation pays for materials and contractors to maintain and improve the beach and its man-made structures, and the Town pays for personnel to manage the daily use of the beach. In recent years, the Reservation has also paid the town to provide and manage the Endangered Species Program.

Duxbury Beach Reservation holds title to the beach, which it leases to the Town. The Reservation operates on income it receives from the public parking lot at the north end of the beach, from the Town lease payment, and since the October 1991 "No Name" Storm, from donations. The Reservation uses its resources to maintain and improve the dunes by the placement of snow fence and post and cable fencing, and the planting of vegetation. It is also responsible for the upkeep of parking lots, rights-of-way, and the public Pavilion at Duxbury Beach Park. Since the damage from the "No Name" storm and subsequent storms, the Reservation has increased the size of its grants to the Duxbury Harbormaster/Coastal Natural Resource Department for off-season patrols and endangered species monitors. The Reservation has also assumed responsibility for the installation of snow fence and grass/shrub planting, which used to be responsibility of the Town's Beach Conservation Officers.

The Town leases the beach from the Reservation for one-year periods. It sells permits for resident parking, and resident and non-resident oversand vehicle permits, and sets the rules for beach users. Income from permit sales (which, in recent years has been in excess of \$1 million) is used for direct and indirect beach-related costs of the Harbormaster/Coastal Natural Resources, Police, Fire, DPW, and other departments. Revenue from permit sales was also allocated for paying the major portion of the Powder Point Bridge reconstruction debt, a 15-year bond that has now been paid.

Since the severe storms of the early 1990s, the Town has supported the Reservation's reconstruction efforts by voting at successive annual town meetings to increase the amount it pays to lease the beach. In 2002, the Annual Town Meeting voted to pay the Reservation \$150,000. The Reservation is required to expend the Town lease monies on beach maintenance and improvement. The Reservation must provide an annual accounting for the expenditures of the lease monies. Expense items typically include the following:

- dune maintenance and improvements
- public beach parking area and Pavilion maintenance
- right-of-way maintenance
- beach grass and shrub planting

- snow fence installation
- post and cable fencing
- Endangered Species Program (management and monitoring)
- educational program funding
- post-storm dune, beach, habitat and road restoration.

The arrangement between the Reservation and the Town has worked well. The Trustees and Directors of the Reservation are able to focus on the beach, whereas the Selectmen must give equal or greater consideration to other Town Departments.

The Reservation tries to build a reserve of money for emergencies and was able to begin restoration work within hours after the 1991 storm. By way of comparison, area beaches in public ownership were not able to respond as quickly, if at all. Following the devastating storms of the 1990s, the Reservation established a subcommittee named the Duxbury Beach Preservation Society. As a charitable corporation, this group of volunteers can and has raised substantial sums of money for the storm reserve fund. The Town cannot solicit donations. Over the years the Reservation and Town have had a very cooperative relationship. Any minor disagreements between the two parties have always been resolved in the best interests of protecting the beach.

2.3.6 Town of Duxbury: Boards, Commissions, and Committees

2.3.6 (a) Board of Selectmen

The Board of Selectmen represents the Town of Duxbury on all major management decisions relative to Duxbury Beach and oversees all town departments involved with beach management. The chairman of the Board of Selectmen serves as a director of the Duxbury Beach Reservation, Inc. (DBR), as designated in DBR's bylaws. The Selectmen are also responsible for negotiating the annual beach lease with the Reservation. The Board also votes approval of all beach rules and regulations.

2.3.6 (b) Town Manager

The Duxbury Town Manager assists with the management of Duxbury Beach by aiding the coordination of town departments.

2.3.6 (c) Beach Committee

The Duxbury Beach Committee was established by the 1987 town meeting at the recommendation of the Duxbury Beach Study Committee. It consisted of nine members, as follows:

- Conservation Administrator or designee
- Harbormaster/Shellfish Warden or designee

- Chief of Police or designee
- Three designees of Duxbury Beach Reservation
- Three members appointed by the Town Moderator (one of whom must be a year-round resident of the Gurnet Road area)

At the request of the Beach Committee, the 2001 annual town meeting amended the membership of the committee by increasing the membership to 12 members, adding three more community members to be appointed by the Town Moderator.

The Beach Committee meets monthly. Its duties are as follows:

1. To advise the Board of Selectmen, Town Manager, and relevant town boards on the use, management, and needs of the town-leased portion of the beach and the Powder Point Bridge, and to make recommendations when needed. To this end the Committee shares minutes of all of its meetings with the Selectmen and the Duxbury Beach Reservation, Inc., and meets with them when appropriate. Through its discussions with the Selectmen, the Finance Committee, and the Fiscal Advisory Committee, the Beach Committee was instrumental in establishing a higher lease amount to help rebuild the beach following the devastating storms of 1991 and 1992.
2. To consult with the following groups for the protection and preservation of the beach:
 - * Duxbury Beach Reservation, Inc.
 - * Gurnet-Saquish Association
 - * Duxbury Beach Association
 - * Mass. Beach Buggy Association (MBBA)
3. To prepare a Beach Use Management Plan and update the plan every five years thereafter.

The Beach Committee finished the first Beach Use Management Plan in 1992. In 1997, the Beach Committee prepared the second Beach Management Plan in cooperation with the Duxbury Beach Reservation, mainly because the plan had become so complex. Because of the technical complexities involved, the Duxbury Beach Reservation will be responsible for preparing future plans. The Beach Committee reserves the right to review the plan.

The Beach Committee, which brings together members representing the Town and the Reservation, with representatives of the Conservation Commission, Harbormaster/Coastal Natural Resources Department, and Police Department, ensures open communication among the concerned groups and acts as a clearing house for beach activities, giving recommendations to the selectmen, making sure that proponents confer with any other applicable town boards such as the Conservation Commission, and seeing that relevant activities have the approval of

the Natural Heritage and Endangered Species Program. The Beach Committee has been involved with the following major events:

Fourth of July

In 1999, the Duxbury Fourth of July Committee added an evening bonfire to the traditional afternoon parade. The event was held on the beach and considered such a success that the following year fireworks were added, as a special celebration of the millennium. Again, the event was extremely popular and attracted large numbers of spectators from surrounding towns. While considered another huge success, the event was not without problems. High tides narrowed the area where people could congregate, there were too many people to monitor movement around dune areas, there were traffic problems along the access roads and the Powder Point Bridge, and there were safety concerns over the hundreds of people walking back to the high school in darkness.

In 2001, the Beach Committee became involved, working to balance the enthusiasm of the Fourth of July Committee with the concerns of the Harbormaster/Coastal Natural Resources Department. There were no fireworks, which cut down on the crowds, and unfortunately vandals set the bonfire off the night before.

In 2002, the event was scaled back even more, with stricter requirements and more pre-planning required.

Triathlon

In 2001, the Police Athletic League hosted a major triathlon as a fundraiser for its youth programs. Initial plans called for use of the beach as a staging area for athletes and spectators, with booths selling food and gear. The Beach Committee was concerned about the appropriateness of using a natural resource for commercial purposes and suggested that the course be reconfigured to use the high school lots for parking, booths, and the start of the race. Changes were made and, from the point of view of the Committee, the event was a success in that the beach was not adversely impacted.

Rowing Races

In 2002, a local rowing club arranged for a series of races for pilot gigs and other rowing boats. The west end of the bridge was used as a launch site, and spectators watched from the bridge. The Beach Committee approved all plans in advance.

Hot Dog Stand

The Beach Committee held a discussion with the proponent and expressed concerns over the commercial nature of the proposed operation. The proponent withdrew the application.

Large Parties

Groups of 20 or more people are required to obtain a permit from the Harbormaster/Coastal Natural Resources Department a week in advance of

holding a large party on the beach. These gatherings are not considered to be major events and are not reviewed by the Beach Committee.

2.3.6 (d) Conservation Commission

The Duxbury Conservation Commission administers the state Wetlands Protection Act and the Duxbury Wetlands Bylaw. This involves the review of Notices of Intent that are submitted by the Duxbury Beach Reservation for improvements and maintenance of facilities, and the beach and dunes of Duxbury Beach. The Conservation Administrator, who works for the Conservation Commission, assists with the overall management of the Beach with emphasis on the environmental assets (see Conservation Department below).

2.3.7 Town of Duxbury: Departments

2.3.7 (a) Harbormaster/Coastal Natural Resources Department

The Harbormaster/Coastal Natural Resources Department is the lead town agency for the management of Duxbury Beach. This department provides the following functions in the overall management of Duxbury Beach:

- beach management - operations,
- Endangered Species Program
- off-road vehicle law enforcement/patrols
- marine law enforcement/patrols
- fishery/wildlife law enforcement/patrols
- emergency medical services
- traffic and crowd control
- rules and regulations for submission to Beach Committee and Board of Selectmen

2.3.7 (b) Conservation Department

The Conservation Administrator provides input on the overall management of the Beach, including the following:

- technical input on projects for compliance with state and local conservation commission regulations
- review of Notice of Intents under Wetlands Protection Act and Local Bylaw

2.3.7 (c) Police Department

Over the years, petty crime and public drinking, which were identified as problems on Duxbury Beach, have been curtailed as a result of the strong cooperative policing program that has developed between the Duxbury Police Department and the Duxbury Harbormaster/Coastal Natural Resources Department. The Police Department's role in patrolling Duxbury Beach has recently changed. Prior to

1995, each summer the Chief of Police designated Special Officers to patrol the Beach. During the winter months, for liability purposes, these officers were trained at the State Criminal Justice Training Council. This training, coupled with department-issued equipment, made the total cost of each officer prohibitive. Other necessary resources included the police 4-wheel drive vehicle, which had a life expectancy of about six to seven years. During the three years from 1992 to 1995, the department's average expenditure was approximately \$22,000 to cover the manpower hours needed to patrol Duxbury Beach and the Gurnet. These types of expenses forced the department to take a long look at other alternatives to patrol the beach area.

In 1995, the chief decided to freeze new appointments for the position of Special Police Officer. Instead, he encouraged and trained the Duxbury Harbormaster/Coastal Natural Resource Department personnel to play a more active role in this function on Duxbury Beach. Over the years, the Duxbury Police Department had limited its patrols of the beach region, and the Harbormaster/Coastal Natural Resources Department has increased its role. This has had a major impact on monies expended on beach patrol. It has eliminated duplication of Police and Harbormaster/Coastal Natural Resources Department staff on the beach, saving the taxpayers money while providing the same positive results - a safe atmosphere on Duxbury Beach.

If for some reason circumstances change, then the Police Department will review this policy. In fact, during the summer of 2002, when the dog access rules and regulations were instituted and the Fish and Wildlife Department officials demanded increased protection practices for the endangered species, the Police Department once again took an active role. The animal control officer, under the control of the Police Department, was on duty seven days a week, enforcing animal control regulations within the beach region. Police patrols were instituted in the beach parking lots and beach access roads seven days a week. The Police Department also assisted the Natural Coastal Resources Department in setting up radar checks on the improved roadway along the back beach.

2.3.7 (d) Department of Public Works

The Duxbury Department of Public Works (DPW) assists with the cleanup of the beach, and when possible, with the maintenance of the town beach parking lot. During the summer months, the DPW empties trash receptacles, provides lot sweeping at the town beach parking lot, and assists with the mobilization of the guard shack and lifeguard stands. The DPW also provides an important role in the Coastsweep operation by providing trucks to collect the bagged debris.

2.3.7 (e) Recreation Department

The Duxbury Recreation Department hires, trains, and supervises the Town lifeguards at Duxbury Beach (not including the public beach and Pavilion area, whose lifeguard program is run by the Duxbury Beach Pavilion concessionaire). The lifeguards begin working weekends on Memorial Day weekend, and start full-

time coverage (seven days per week 9:30 AM to 5:30 PM) when school ends. The lifeguard coverage ends on Labor Day.

Each lifeguard supervises an area 100 yards on either side of the lifeguard stand, or a total of 200 yards. It has long been the position of the Recreation Director that this is not sufficient coverage and that the Town should look seriously at increasing the staffing and budget that supports this function.

The Recreation Department makes use of Duxbury Beach for a portion of its "Kid's Camp." This summer program includes one day each week at the beach. The camp begins the first week in July and continues for seven weeks. The camp is usually attended by about 100 Duxbury children ages 6 - 12.

2.3.7 (f) Fire Department

The Duxbury Fire Department, in addition to its fire service, provides emergency medical care, ambulance transport, and paramedic service to people using Duxbury Beach. It also provides water rescue and recovery. It maintains two rescue boats that are the backup to the Harbormaster. Occasionally, the Fire Department responds to vehicle fires in the parking lot areas. It also responds to calls at the Gurnet/Saquish area in Plymouth, requiring rapid and safe travel on the improved road along the back side of Duxbury Beach.

The Fire Department works closely with the Harbormaster in planning for all potential emergencies, particularly weather- and ocean-related problems. The Fire Department has keys to town-owned locks on the gates at the beach in the event fire personnel need to travel through this area to get to houses to the north of the Duxbury Beach Reservation's property.

2.3.8 Town of Plymouth

A portion of land at the southern end of Duxbury Beach is in the Town of Plymouth. This land is Gurnet-Saquish, which is comprised primarily of private residences. Residents of Gurnet-Saquish and their guests have the right to pass over the right-of-way on Duxbury Beach.

The Town of Plymouth has played a very minor role in the management and maintenance of Duxbury Beach. Occasionally, the Plymouth DPW has plowed the portion of road in Plymouth in the Gurnet-Saquish areas. There have been many efforts over the years to try to obtain more help from various Plymouth town departments. So far no concrete programs with the Town of Plymouth have been implemented. In 2002, the Plymouth Police Department instituted an increased police presence within the Gurnet-Saquish peninsula.

The Plymouth Tree & Parks Department and the Beach Conservation Officer provide technical assistance and fencing to the Gurnet Saquish Association. Usually snow fence and beach grass are purchased from the Duxbury Beach Reservation.

When work is proposed on the Plymouth portion of the beach, wetland permits must be obtained from the Plymouth Conservation Commission.

3

Environmental Statutes and Regulations

Statutes, bylaws, and regulations at the local, state, and federal levels provide standards that, when properly applied, help protect the environmental resources of Duxbury Beach. This chapter reviews these environmental safeguards and describes how they apply and are implemented on Duxbury Beach.

3.1 Summary of Statutes and Regulations

The following is a listing of the most significant environmental statutes and regulations that apply to Duxbury Beach, organized according to the regulatory agency that oversees them.

Local

Conservation Commission

Mass. Wetlands Protection Act
Town of Duxbury, Wetlands Bylaw

Harbormaster/Coastal Natural Resources Department

Town of Duxbury, Beach Rules and Regulations
Town of Duxbury, Shellfish Regulations
Town of Duxbury, Harbor Regulations
Mass. Fisheries and Wildlife Statutes

State

Department of Environmental Protection

Wetlands Protection Program

Mass. Wetlands Protection Act (overview and appeal authority of Conservation Commission decisions)

Mass. Natural Heritage & Endangered Species Program

Mass. Endangered Species Act

Executive Office of Environmental Affairs

Mass. Environmental Policy Act (MEPA)
Coastal Zone Management Act

Federal

U.S. Fish & Wildlife Service

Federal Endangered Species Act

U.S. Army Corps of Engineers

3.2 Duxbury Conservation Commission

3.2.1 Massachusetts Wetlands Protection Act and Regulations

Duxbury Beach consists of coastal wetland environments that are subject to the jurisdiction of the Massachusetts Wetlands Protection Act (Ch. 131, s. 40) and its regulations (310 CMR 10.00). These wetlands are also protected by the Duxbury Wetlands Bylaw, Chapter 9, which closely follows the state wetlands regulations. The Duxbury Conservation Commission is the regulatory body responsible for the implementation of both of these environmental safeguards. Their jurisdiction encompasses any activity proposed or undertaken within a wetland resource area (as specified in 310 CMR 10.02(1)) or within 100 feet of a wetland resource that will remove, fill, dredge or alter a resource area. The Duxbury Conservation Commission is a 7-member board appointed by the selectmen. The Duxbury Conservation Department and its Administrator serve as staff of the Conservation Commission and provide the day-to-day administration of these wetland regulations.

The southern portion of Duxbury Beach beginning in the vicinity of the northern end of the glacial upland deposits of the Gurnet Point drumlin (at an identified boundary marker) is in the Town of Plymouth and falls under the jurisdiction of the Plymouth Conservation Commission. Work carried out on this portion of Duxbury Beach must be reviewed and approved by the Plymouth Conservation Commission. The Town of Plymouth does not play a very active role in the management of this area and the Gurnet-Saquish area, which is also in the Town of Plymouth, because these land areas are disconnected and remote from the mainland of Plymouth. Access is only across the Powder Point Bridge in Duxbury and ORV routes from Marshfield — there is no access from mainland Plymouth.

Duxbury Beach consists of the following protected coastal wetland resource areas:

- barrier beach
- coastal beach (including tidal flats)
- coastal dunes
- salt marshes
- land containing shellfish
- land subject to coastal storm flowage

In addition, the state has mapped many areas of Duxbury Beach as rare species habitat, which calls for special management considerations. See the current state map of “Estimated Habitats of Rare Wildlife and Certified Vernal Pools” in the rear of this document.

3.2.1 (a) Barrier Beach

Barrier Beach means a narrow low-lying strip of land generally consisting of coastal beaches and coastal dunes extending roughly parallel to the trend of the coast. It is separated from the mainland by a narrow body of fresh, brackish or saline water or a marsh system. A barrier beach may be joined to the mainland at one or both ends. (310 Code of Mass. Regulations 10.29)

Duxbury Beach is a barrier beach, which is identified as Db-1 by the state Barrier Beach Inventory Project (Mapping project conducted by the Provincetown Center for Coastal Studies for MA Coastal Zone Management, 1982).

Functions

Barrier beaches, including all of their coastal dunes, are significant to the public interests of storm damage prevention, flood control, and protection of marine fisheries, wildlife habitat, and, where there are shellfish, land containing shellfish. "Significant" means that they play a role in protecting these public interests of the Wetlands Protection Act.

Critical Characteristics

Since barrier beaches are composed of coastal beach and coastal dunes, the characteristics of a barrier beach that are critical to the protection of the public interests listed above are described below under the coastal beach and coastal dune subsections.

Performance Standards

When a barrier beach is significant to storm damage prevention, flood control, marine fisheries, or the protection of wildlife habitat, the following performance standards apply:

- All performance standards for coastal beach and coastal dunes.
- No project may be permitted which will have an adverse effect on state-listed rare vertebrate or invertebrate species (see subsection entitled Rare Species Habitat Protection later in this chapter for more information).

3.2.1 (b) Coastal Beach

Coastal Beach means unconsolidated sediment subject to wave, tidal and coastal storm action which forms the gently sloping shore of a body of salt water and includes tidal flats. Coastal beaches extend from the mean low water line landward to the dune line, coastal bankline or the seaward edge of existing man-made structures, when these structures replace one of the above lines, whichever is closest to the ocean. (310 Code of Mass. Regulations 10.27)

Tidal flats are the nearly level part of a coastal beach, usually extending from the low water line landward to the more steeply sloping portion of the coastal beach. On the bayshore they may end at the salt marsh line.

At Duxbury Beach, coastal beach resource areas are present along the Cape Cod Bay and Duxbury Bay shorefronts of the barrier beach, with tidal flats along portions of both of these shorefronts.

Functions

Coastal beaches, including their tidal flats, are significant to the public interests of storm damage prevention, flood control, and the protection of wildlife habitat. Where tidal flats are present, they are presumed significant to the protection of marine fisheries and, where there are shellfish, to land containing shellfish.

Critical Characteristics

The characteristics of a coastal beach that are critical to storm damage prevention and flood control are:

- the ability of the coastal beach to respond to wave action
- the volume and form of the beach

The characteristics critical to the protection of marine fisheries or wildlife habitat are:

- distribution of sediment grain size
- water circulation
- water quality
- relief and elevation

Performance Standards

When a coastal beach is significant to storm damage prevention, flood control, marine fisheries or the protection of wildlife habitat, the following performance standards apply:

- Any project on a coastal beach (with a few exceptions described in the Wetlands Protection regulations) must not have an adverse effect by increasing erosion, decreasing the volume, or changing the form of any coastal beach or an adjacent or downdrift coastal beach.
- Any groin, jetty, solid pier, or other solid fill structure which will interfere with littoral drift, in addition to complying with the above must also be constructed as follows:
 - * It must be the minimum length and height demonstrated to be necessary to maintain beach form and volume (this demonstration should be based on coastal engineering, physical oceanographic and/or coastal geologic information);
 - * Immediately after construction, any groin must be filled to its entrapment capacity in height and length with compatible sediment (brought in from an off-site location);

- * Jetties trapping littoral drift sediment must contain a by-pass system to transfer sediments to the downdrift side of the inlet, or when the inlet is redredged, the sediment should be used for beach nourishment to ensure that downdrift or adjacent beaches are not starved of sediments; and
- * Beach nourishment with clean sediment of compatible grain size may be permitted.

When a tidal flat is significant to marine fisheries or the protection of wildlife habitat, the following performance standards apply:

- Water-dependent projects must be designed and constructed using the best available measures to minimize adverse effects.
- Non-water-dependent projects must have no adverse effect on marine fisheries or wildlife habitat caused by:
 - * alterations in water circulation;
 - * alterations in the distribution of sediment grain size; and
 - * changes in water quality, including, but not limited to, other than natural fluctuations in the levels of dissolved oxygen, temperature, or turbidity, or the addition of pollutants.
- No project may be permitted which will have an adverse effect on specified habitat sites of state-listed rare vertebrate or invertebrate species (see subsection entitled Rare Species Habitat Protection later in this chapter for more information).

Protection of Coastal Beaches of Duxbury Beach

At Duxbury Beach, there are two coastal beaches: the Cape Cod Bay ocean beach and the Duxbury Bay back barrier beach. In some lower wave energy areas of the Duxbury Bay shoreline, coastal beaches are fronted by salt marsh. All projects undertaken by the Duxbury Beach Reservation on its coastal beaches are specifically designed to increase the storm damage and flood control characteristics of this resource, while protecting and sometimes enhancing wildlife habitat.

When dredging occurs at the Green Harbor inlet, the Reservation has requested that this sediment be placed on the downdrift coastal beaches. At present, the Army Corps of Engineers' dredging contractors dump the Green Harbor dredged material in approximately 15 feet of water at low water offshore of Green Harbor Beach. While not as optimum as direct beach nourishment, this action keeps the dredged material playing a role in the littoral system.

Furthermore, no activity that is designed to enhance the interests of storm damage prevention, flood control and wildlife habitat takes place on Duxbury Beach until approval is received by the MA Natural Heritage and Endangered Species Program and the Conservation Commission.

3.2.1 (c) Coastal Dunes

Coastal Dune means any natural hill, mound or ridge of sediment landward of a coastal beach deposited by wind action or storm overwash. Coastal dune also means sediment deposited by artificial means and serving the purpose of storm damage prevention and flood control. (310 Code of Mass. Regulations 10.28)

At Duxbury Beach, coastal dune resource areas are present along the entire length of the barrier beach.

Functions

Coastal dunes are significant to the public interests of storm damage prevention, flood control, and the protection of wildlife habitat. On barrier beaches all coastal dunes are deemed significant to these public interests.

Critical Characteristics

The characteristics of coastal dunes that are critical to the protection of storm damage prevention, flood control, and wildlife habitat are:

- ability of the dunes to erode in response to the beach conditions
- volume and form of the dunes
- vegetative cover
- ability of the dune to move landward or laterally
- ability of the dune to continue serving as bird nesting habitat

Performance Standards

When a coastal dune is significant to storm damage prevention, flood control, marine fisheries, or the protection of wildlife habitat, the following performance standards apply:

- Any alteration of, or structure on , a coastal dune or within 100 feet of a coastal dune shall not have an adverse effect on the coastal dune by:
 - * affecting the ability of waves to remove sand from the dune;
 - * disturbing the vegetative cover so as to destabilize the dune;
 - * causing any modification of the dune form that would increase the potential for storm or flood damage;
 - * interfering with the landward or lateral movement of the dune;
 - * causing removal of sand from the dune artificially; or
 - * interfering with mapped or otherwise identified bird nesting habitat.
- When a building already exists upon a coastal dune, a project accessory to the existing building may be permitted, provided that such work, using the best commercially available measures, minimizes the adverse effect on the coastal dune caused by the impacts listed above.

- The following projects may be permitted provided that they have no adverse effect on the coastal dune caused by the impacts listed above:
 - * pedestrian walkways, designed to minimize the disturbance to the vegetative cover and traditional bird nesting habitat;
 - * fencing and other devices designed to increase dune development, and to direct vehicular and pedestrian traffic; and
 - * plantings compatible with the natural vegetative cover.
- No project may be permitted which will have any adverse effect on the habitat of state-listed rare vertebrate or invertebrate species (see subsection later in this chapter entitled Rare Species Habitat Protection for more information).

Protection of Coastal Dunes on Duxbury Beach

At Duxbury Beach there is a very proactive program of coastal dune protection and, when possible, enhancement. Pedestrians and vehicles, which decades ago ran rampant across the dunes destroying stabilizing vegetation and affecting wildlife habitat, are kept out of dune areas through the use of snow fencing along the front beach and post and cable fencing along the right-of-way access roadway and parking lots. Symbolic fencing is used to keep vehicles and pedestrians out of tern and plover nesting areas. In addition, signage is used to educate the public concerning the value of dunes in storm damage prevention and to encourage protection of this resource area. Symbolic fencing is also placed at least 20 feet seaward of the seaward toe of dune vegetation to prevent vehicles and pedestrians from affecting pioneer beach and dune vegetation growth and subsequent embryonic dune establishment.

The Duxbury Beach Reservation has an active program of beach grass planting discussed in Chapter 6. In the piping plover habitat, a herring-bone planting pattern has been employed to help stabilize wind-blown sand while allowing piping plovers to migrate from ocean to bayshore and back (see figure below). Snow/sand fencing is used to build dunes where it is not deemed harmful to protected species habitat, for such species as piping plover and terns. Woody shrubs are planted in clumps in select locations in back barrier dunes to enhance their stability and provide greater habitat diversity. All of these activities have been designed using best available measures by the Reservation, in consultation with the MA Natural Heritage and Endangered Species Program.

After the last two major coastal storms, the Reservation worked with the Federal Emergency Management Agency (FEMA) and Massachusetts Emergency Management Agency (MEMA) to rebuild the coastal dunes along portions of Duxbury Beach in what has been called the “Sacrificial Dune” program. This program has been very successful, and the Reservation intends to try to maintain the sacrificial dune by periodically nourishing dune areas where the dune crest is lowered by storm overwash (see Section 6 for details on the sacrificial dune).

3.2.1 (d) Salt Marshes

*Salt Marsh means a coastal wetland that extends landward up to the highest high tide line, that is the highest spring tide of the year, and is characterized by plants that are well adapted to, or prefer living in, saline soils. Dominant plants within salt marshes are salt meadow cord grass (*Spartina patens*) and/or salt marsh cord grass (*Spartina alterniflora*). A salt marsh may contain tidal creeks, ditches and pools. (310 Code of Mass. Regulations 10.32)*

At Duxbury Beach, salt marsh resource areas are present along portions of the Duxbury Bay shorefront of the barrier beach.

Functions

Salt marshes are significant to the public interests of protection of marine fisheries, wildlife habitat, and, where there are shellfish, to the protection of land containing shellfish, to the prevention of pollution, to storm damage prevention, and to ground water supply.

Critical Characteristics

The characteristics of salt marshes that are critical to the protection of the public interests listed above are:

- growth, composition, and distribution of salt marsh vegetation
- flow and level of tidal and fresh water
- presence and depth of peat

Performance Standards

When a salt marsh is significant to the protection of marine fisheries, to the prevention of pollution, to storm damage prevention, or to ground water supply, the following performance standards apply:

- A proposed project in a salt marsh, on land within 100 feet of a salt marsh, or in a body of water adjacent to a salt marsh must not destroy any portion of the salt marsh and must not have an adverse effect on the productivity of the salt marsh. Alterations in growth, distribution, and composition of salt marsh vegetation must be considered in evaluating adverse effects on productivity. The harvesting of salt marsh hay is not prohibited.
- A small project within a salt marsh, such as an elevated walkway or other structure, which has no adverse effects other than blocking sunlight from the underlying vegetation for a portion of each day, may be permitted if the project complies with all other applicable requirements of these regulations.
- A project, which will restore or rehabilitate a salt marsh or create a salt marsh may be permitted.
- No project may be permitted which will have an adverse effect on state-listed rare vertebrate or invertebrate species (see subsection

entitled Rare Species Habitat Protection later in this chapter for more information).

Protection of Salt Marsh on Duxbury Beach

Alterations to salt marsh are not permitted on Duxbury Beach. Salt marsh areas on Duxbury Beach are protected from potential impacts due to pedestrians and vehicles through the use of post and cable fencing along all parking areas and along the right-of-way access roadway for off-road vehicles.

3.2.1 (e) Land Containing Shellfish

Land Containing Shellfish means land under the ocean, tidal flats, rocky intertidal shores, salt marshes and land under salt ponds when any such land contains shellfish. (310 Code of Mass. Regulations 10.34)

At Duxbury Beach, land containing shellfish resource areas are present along tidal flats of the Duxbury Bay shoreline of the barrier beach.

Functions

Land containing shellfish is significant to the public interests of protection of shellfish resources as well as marine fisheries, when it has been mapped by the Conservation Commission or the Massachusetts Department of Environmental Protection, either based upon maps and designations of the Massachusetts Division of Marine Fisheries or upon maps and written documentation of the shellfish constable.

Critical Characteristics

The characteristics of land containing shellfish that are critical to the protection of the public interests listed above are:

- presence of shellfish
- water quality
- water circulation
- natural relief elevation or distribution of sediment grain size

Performance Standards

When the resource area is significant to the protection of land containing shellfish and marine fisheries, the following performance standards apply:

- Any project on land containing shellfish must not adversely affect such land containing shellfish by a change in the productivity of the land caused by:
 - * alterations of water circulation;
 - * alterations of relief elevation;
 - * compacting of sediment by vehicular traffic;
 - * alterations in the distribution of sediment grain size;

- * alterations in natural drainage from adjacent land; or
- * changes in water quality including, but not limited to, other than natural fluctuations in the levels of salinity, dissolved oxygen, nutrients, temperature, or turbidity, or the addition of pollutants.
- A project which temporarily has an adverse effect on shellfish productivity but which does not permanently destroy the habitat may be permitted if the land containing shellfish can and will be returned substantially to its former productivity in less than one year from the commencement of work.
- For land containing shellfish that is significant because it has been designated by the Mass. Division of Marine Fisheries or the municipal shellfish constable, a project may be permitted, if the shellfish are moved to a suitable location after consultation with the shellfish constable and the Massachusetts Division of Marine Fisheries. The project may not commence until after the moving and replanting of shellfish has been completed.
- Projects approved by the Massachusetts Division of Marine Fisheries that are specifically intended to increase the productivity of land containing shellfish may be permitted. Aquaculture projects approved by the appropriate local and state authority may also be permitted.
- No project may be permitted which will have an adverse effect on state-listed rare vertebrate or invertebrate species (see subsection entitled Rare Species Habitat Protection later in this chapter for more information).

Protection of Land Containing Shellfish on Duxbury Beach

In some locations, the tidal flats on the Duxbury Bay shoreline of Duxbury Beach contain productive shellfish beds. These areas are protected from vehicular impacts through the use of post and cable fencing on the right-of-way access roadway to keep vehicles off these productive resource areas.

3.2.1 (f) Land Subject to Coastal Storm Flowage

Land Subject to Coastal Storm Flowage is that area that is mapped by the Federal Emergency Management Agency (FEMA) on community Flood Insurance Rate Maps. On Duxbury Beach it includes velocity zones, overwash zones, and areas of still water flooding during the 100-year statistical storm. This land is an overlay resource area that includes other coastal wetland resource areas – coastal beach, coastal dune, and salt marsh.

Functions and Critical Characteristics

Land subject to coastal storm flowage is significant to the interests of storm damage prevention and flood control. The functions and critical characteristics of these resource areas are described earlier relative to their role in the protection of these interests.

Performance Standards

There are currently no performance standards for work in land subject to coastal storm flowage. For work on structures, compliance with the state building code is currently presumed to be adequate for this overlay resource area. Other work should not increase coastal flooding by redirecting floodwaters or by decreasing the ability of resource areas to provide their natural storm damage protection functions.

Land Subject to Coastal Storm Flowage on Duxbury Beach

All of Duxbury Beach is in the 100-year coastal floodplain. Some areas are in velocity zones, which are those areas that FEMA has mapped as being likely to have at least a three-foot wave with velocity moving across the beach or dune surface during the 100-year storm. All work that is carried out on the Pavilion Building must meet the state building code standards. Most other projects on Duxbury Beach are intended to increase the coastal storm prevention capability of the barrier beach resource area; therefore, these projects are consistent with the intent of the protection sought for land subject to coastal storm flowage.

3.2.1 (g) Rare Species Habitat

Estimated Habitat Maps (see attached map) of state-listed vertebrate and invertebrate occurrences are provided by the Massachusetts Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program as a service to municipal conservation commissions that are charged with protecting rare species habitat under the Wetlands Protection Act. These maps define the estimated geographical extent of all listed rare wetland wildlife species for which occurrences have been reported and documented to the satisfaction of the Natural Heritage Program.

The Mass. Department of Environmental Protection (DEP) defers to the scientific opinions of the Mass. Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program in determining the location and extent of actual habitat of state-listed rare species. The DEP also relies on the Natural Heritage Program to determine whether a proposed activity will have an adverse effect, whether short- or long-term, on the habitat of the local rare species population. The Natural Heritage Program's opinion is presumed to be correct and may be overcome only upon a clear showing to the contrary.

On Duxbury Beach, rare species habitat is currently identified for all portions of the barrier beach southward from the Powder Point Bridge.

Functions and Critical Characteristics

Rare species wildlife habitat provides all the requisites for breeding, nesting, foraging and resting for the species listed in 310 CMR 10.60. Certain rare, state-

listed species have specialized requirements that are met by the ecosystem on barrier beaches.

Performance Standards

When a project is proposed to alter a resource area that is part of the actual habitat of a state-listed species, the following performance standard applies:

- No project may be permitted which will have any short or long-term adverse effect on the habitat of the local population of that species.

Protection of Rare Species Habitat on Duxbury Beach

A very comprehensive program has been developed to protect rare species habitat on Duxbury Beach. It is described in the next chapter. Furthermore, no activity that will remove, fill, dredge or alter takes place without prior approval from the MA Natural Heritage and Endangered Species Program. This approval is provided to the Conservation Commission prior to any activity.

3.2.2 Town of Duxbury Wetlands Bylaw, Chapter 9

The Town of Duxbury has enacted its own wetland law through a local general bylaw passage entitled Chapter 9 Wetlands Protection. The local bylaw contains the same wetland resource areas previously identified under the state Wetlands Protection Act. However, two additional public benefits are included in the local bylaw: recreation and aesthetics. The bylaw allows the local Conservation Commission to adopt additional definitions, regulations, and performance standards deemed necessary to protect the interests of the bylaw. In April 1989, the Duxbury Conservation Commission adopted twenty regulations using the authority granted to them under the bylaw. Regulations number 9, 19, and 20, listed below, may apply to work proposed on Duxbury Beach.

9. All structures and substantial alterations proposed in an area subject to coastal storm flowage or flooding as determined by Flood Insurance Rate Maps (FIRM) shall comply with the Massachusetts Building Code Regulations for construction in a floodplain.
19. No new residential homes or commercial buildings shall be located on a dune area that is void of said inhabitable structures on the effective date of this regulation.
20. In all undeveloped barrier beach areas, no pavement or concrete or other impervious paving material may be placed covering the surface of the ground inhibiting the natural migration of sand.

3.3 Duxbury Harbormaster/Coastal Natural Resources Department

The Duxbury Harbormaster/Coastal Natural Resources Department implements the following Town of Duxbury Rules and Regulations, which are described in the sections that follow:

- Beach Rules and Regulations
- Shellfish Rules and Regulations
- Harbor Rules and Regulations

Since the department is responsible for the overall management of Duxbury Beach, it must ensure that users of the beach comply with other environmental statutes and regulations including the state Wetlands Protection Act and local Wetlands By-law, the state and federal Endangered Species Acts, the state Fisheries and Wildlife statutes, and the federal Clean Water Act.

3.3.1 Town of Duxbury, Beach Rules and Regulations

The Town of Duxbury Beach Rules and Regulations ([see Appendix B](#)) contain specific language concerning the following activities on Duxbury Beach: walking, swimming, boating, horseback riding, shellfishing, fishing, and hunting. General beach regulations describe other use restrictions, including those associated with drinking of alcoholic beverages, dogs, removal of natural material from the beach, trash, bonfires, camping, fireworks, loitering, and beach functions. The regulations have a detailed section on the use of oversand vehicles.

3.3.2 Town of Duxbury, Shellfish Rules and Regulations

The Town of Duxbury Shellfish Rules and Regulations describe the standards for the taking of eels, shellfish, and seaworms. They apply to all areas of Duxbury Beach that are open to the harvest of these resources.

3.3.3 Town of Duxbury, Harbor Rules and Regulations

The Town of Duxbury Harbor Rules and Regulations apply to boating activities for all areas of the Harbor and municipal waterways. These regulations apply to all areas of Duxbury Beach under the control of the Harbormaster/Coastal Natural Resources Department.

3.4 Massachusetts Natural Heritage and Endangered Species Program

The Massachusetts Barrier Beach Task Force's document entitled "Guidelines for Barrier Beach Management in Massachusetts" provides a succinct summary of the State Endangered Species Act. The state DEP also has issued guidance for barrier beach management. The state Natural Heritage and Endangered Species Program maps the Duxbury Beach barrier beach area as "High Priority Sites of Rare Species Habitats and Exemplary Natural Communities" ([see Estimated Habitat Map in the appendices](#)). The endangered and threatened species that have

been of most concern in terms of managing off-road vehicles on Duxbury Beach are piping plovers and least terns. The Massachusetts Division of Fisheries and Wildlife, Natural Heritage & Endangered Species Program's document, "Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns and Their Habitats in Massachusetts" provides their guidelines for implementing the Massachusetts Endangered Species Act in beach areas.

Before an activity takes place on Duxbury Beach prior approval is obtained from the MA Natural Heritage and Endangered Species Program and is provided to the Conservation Commission. In this way, there is assurance that activities comply with these guidelines.

3.5 Massachusetts Environmental Policy Act (MEPA) Office

The Massachusetts Environmental Policy Act (MEPA) Office is the state program in the Executive Office of Environmental Affairs that oversees the Massachusetts Environmental Policy Act. This office reviews submissions, either Environmental Notification Forms or, for large and/or complex projects, Environmental Impact Reports. This program seldom applies to projects at Duxbury Beach, since most permitting of activities at Duxbury Beach is handled at the local level.

3.6 Massachusetts Coastal Zone Management (MCZM) Office

The Massachusetts Coastal Zone Management (MCZM) Office implements the federal Coastal Zone Management Act in Massachusetts in the Executive Office of Environmental Affairs. Projects requiring federal funding, or federal permitting that also exceed certain (MEPA) thresholds, must obtain a Coastal Zone Management Federal Consistency Certification and demonstrate that the project is consistent with the policies of this state agency. Since federal permits and/or funding are seldom required for projects on Duxbury Beach, there usually isn't the need to apply for MCZM consistency.

Another function of the MCZM office is to provide technical assistance, and MCZM staff often work with other state and federal agencies to provide input on topics of concern to coastal communities. The MCZM office was responsible for organizing and staffing the state's Barrier Beach Taskforce and the preparation of the document entitled "Guidelines for Barrier Beach Management in Massachusetts," which was used as the basis for this Management Plan. In the aftermath of the 1991 and 1992 coastal storms, the MCZM South Shore regional coordinator was very helpful in assisting the Duxbury Beach Reservation to obtain disaster assistance funds from the Massachusetts Emergency Management Agency (MEMA), the state agency responsible for the disbursement of federal disaster funds for coastal storm relief. It was these reimbursements which made possible the two sacrificial dune projects on Duxbury Beach.

The Coastal Zone Management Office sponsored a field trip to Duxbury Beach as part of the international CZ97 conference. Duxbury Beach was chosen because it serves as a good example of a beach with a comprehensive beach management program.

3.7 U.S. Fish & Wildlife Service: Federal Endangered Species Act

A summary of the Federal Endangered Species Act of 1973 is included in the U.S. Fish & Wildlife Service's document entitled "*Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid a Take Under Section 9 of the Endangered Species Act.*" The federal statute provides additional regulatory oversight for the management of endangered species. On Duxbury Beach this means additional emphasis on the protection of piping plovers.

3.8 U.S. Army Corps of Engineers: Clean Water Act, Section 404

Section 404 of the Clean Water Act provides the Army Corps of Engineers with authority for the protection of the nation's wetlands. Section 404 jurisdiction at Duxbury Beach applies to salt marshes along Duxbury Beach and all beach areas below the annual high water line. Since most permitted activities on Duxbury Beach occur above this line and no work occurs in salt marshes, Army Corps Section 404 permits are almost never required on Duxbury Beach.

4

Beach Use and Management

4.1 Off-Road Vehicle (ORV) Access

The deeds to Duxbury Beach stipulate a right-of-way over the beach for access for residents of the approximately 320 homes and cottages in the Gurnet-Saquish area at the south end of the beach. A court case confirmed this right, although the location of the right-of-way was not specified and the Reservation has no responsibility to maintain any such right-of-way. Off-road vehicle (ORV) use at Duxbury Beach has occurred for many years in conjunction with this access to Gurnet-Saquish, as well as for recreational beach use. ORV use is now well monitored and aggressively managed and regulated.

4.1.1 Established Track Program

The established track program was created in 1992 by the Duxbury Harbormaster/Coastal Natural Resource Department and the Duxbury Beach Reservation to organize ORV traffic and activities on the front beach and protect resource areas. Prior to the established track program, ORVs could travel anywhere within authorized areas, including on tidal flats, over the wrack line, in the water, in sun bathing and pedestrian areas, and on the crossovers, sometimes blocking access. The implementation of the established track program separated these incompatible activities and reduced impacts to the beach, dunes, and endangered species habitat.

4.1.1 (a) Front Beach

On the front beach, the established track is seaward or east of the toe of the dune, permanent symbolic fencing and the storm wrack, and landward or west of the daily wrack. The established track is about 24 feet wide and consists of two travel lanes, one running north and one running south. All ORVs on the front beach must travel in these lanes and park perpendicular to the established track between the established track and the daily wrack line. ORVs are never allowed to park on or travel over the daily wrack line and must never impede travel in the travel lanes. This system protects the various wrack lines and the toe of the dunes. It also creates a Safe Zone for pedestrians between the daily wrack line and the water's edge.

4.1.1 (b) Back Beach—Recreational ORVs

On the back beach or cobble area, all recreational ORVs are confined to the cobble area. Because this area is located just below the high water line, ORV use in this area is restricted to three hours before and after low tide. No ORVs are

allowed to travel on the tidal flats below the cobble. Recreational ORV access on the remainder of the 4 miles of back beach is prohibited.

4.1.1 (c) Back Beach—Commercial Shellfishermen

The Town of Duxbury has always supported a small number of residents who are commercial shellfishermen. To protect this group's historic access to Duxbury Bay, the Duxbury Harbormaster/Coastal Natural Resource Department and the Duxbury Beach Reservation conceived and implement a program of restricted access where commercial shellfishermen are allowed to travel by ORV out to the extensive shellfish areas on the back of the beach for the exclusive purposes of dropping off and/or picking up their gear and catch. Commercial shellfishermen are provided official instructions on access. They must travel the shortest distance to the beds over the closest available access way using one lane out and back provided that the ORV tire track is obliterated in two tide cycles (24 hours). They cannot park within the resource area. There are only three locations where commercial shellfishermen can access the shellfish beds: the cobble area, the second crossover (bayside), and the third crossover (bayside). All three of these access ways are barricaded and posted for authorized access only. Commercial shellfish ORV access is prohibited in areas where unfledged endangered species are present.

4.1.2 ORV Limits

South of the Powder Point Bridge, excluding the paved south parking lot, the Reservation has imposed the following ORV parking restrictions:

A maximum of 500 ORVs are allowed on the front beach at any one time. This restriction has been further modified by the Town of Duxbury to allow 250 ORVs with non-resident permits and 250 ORVs with resident permits. The 500 ORV limit is at times reduced by the Duxbury Harbormaster/Coastal Natural Resources Department when portions of the front beach are closed due to the presence of endangered species or when natural conditions (high tide or high seas) mandate further restrictions.

A maximum of 35 ORVs are allowed in the cobble area at any one time. Access is further restricted to 3 hours either side of low tide. A total restriction of 75 ORVs on the back side of the beach includes the 35 ORVs allowed in the cobble area and up to 40 ORVs in the turnouts along the roadway and the restricted areas within the vehicle cross-overs themselves.

ORV limits are managed and strictly enforced by the Duxbury Harbormaster/Coastal Natural Resources Department. As ORV limits are approached on any given day in any section of the beach, that section is shut down and further ORV access is prohibited. ORV access restriction controls occur throughout the beach. On busy days, ORV access restriction controls may be imposed at the west end of the Powder Point Bridge or at the flag pole at the intersection of St. George and Washington Streets. When ORV limits are approached and access restrictions go into effect, the Duxbury Harbormaster/Coastal Natural Resources Department posts notices of such restrictions in three off-beach areas and alerts Duxbury's Emergency/Public Safety Departments to stand by in case enforcement assistance is needed.

During the 2002 peak access season, the Harbormaster/Coastal Natural Resources Department documented the following ORV counts:

- 400 vehicles — average weekend
- 250 vehicles — average weekday
- 500 vehicles — July 4th weekend day

4.1.3 Protection of Resources from ORV Use

4.1.3 (a) Background

ORVs pose a threat to wetland resource areas if they are allowed to operate without proper management controls. Leatherman and Godfrey (1979) summarized the results of five years of research on the ecological and geomorphic effects of off-road vehicles on coastal ecosystems. This pioneering research was conducted in the Cape Cod National Seashore, and it was well documented that **uncontrolled** ORV use can destroy beach grass rhizomes and other coastal wetland plants. ORV use can cause geomorphic changes by lowering dune profiles and compressing the organic sediments of salt marshes. It can also interfere with coastal bird nesting areas and feeding areas.

The following recommendations, paraphrased from Leatherman and Godfrey, are provided for background information. These recommendations have been incorporated into specific management practices on Duxbury Beach.

Beach

1. Restrict ORV use, whenever possible, to the outer ocean beach, seaward of the drift-line zone and expanding dune edge of the upper backshore.
2. Close beaches when they are narrow, especially during exceptionally high tide events or sea conditions, because not doing so forces drivers to travel along the face of dunes or through shorebird nesting sites and embryonic dunes.
3. Protect nesting areas of least terns and other colonial shorebirds by:
 - * using fencing to enclose shorebird habitat areas;¹
 - * posting signs at least 100 feet on either side of a colony. Pedestrians are urged not to approach any closer than 100 feet; vehicles can pass somewhat closer, but people cannot leave their vehicles because doing so could scare the birds and lead to nesting failures;

¹ Although fencing was recommended by Leatherman and Godfrey, recent management recommendations from the state Natural Heritage and Endangered Species Program recommends against fencing use in colonial shorebird habitat areas.

- * restricting beach traffic to marked tracks;
- * enforcing strict leash laws for pets. (See Section xx)

Dunes

1. Prevent vehicle entry into previously closed dune regions.
2. Build dune ramps to permit vehicular and pedestrian access through dune zones.
3. Design dune ORV trails such that:
 - * the most sensitive beach and dune areas are avoided,
 - * trail orientation does not contribute to wind-induced blowout creation,
 - * sharp turns and steep grades are avoided,
 - * cable fencing is used to mark the route and restrict access, and
 - * the number of trails is minimized.
4. Maintain dune ORV trails in good condition.
5. Close existing trails in the most sensitive habitats, such as heathlands and shrubs.

Salt Marshes and Tidal Flats

1. Close all salt marsh and tidal habitat to ORV use.
2. Move ORV trails from the border zone between salt marsh and dunes to a more upland location.

Public Information Program

1. Develop signage and brochures that educate the public about appropriate ORV use and access.

Off-road vehicle management recommendations are provided in the Massachusetts Barrier Beach Task Force's document entitled, "*Guidelines for Barrier Beach Management in Massachusetts*". These recommendations summarize the vehicle management guidelines provided in the Mass. Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program's "*Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns, and their Habitats in Massachusetts.*"

The key to off-road vehicle management is **control**. Vehicles must be managed so that they are not allowed into coastal environments where they will cause destruction of stabilizing vegetation and/or significant changes to the geomorphic characteristics of coastal landforms. They must also be managed so that they do not adversely affect public safety, wildlife, rare species habitat, and rare species.

4.1.3 (b) Protective Actions on Duxbury Beach

The following areas of the barrier beach are the most sensitive areas, and ORV use is banned from these areas:

- Salt marsh. No vehicles are allowed in any of the extensive salt marsh on the back side of the barrier.
- Tidal flats. With the exception of commercial fishermen, who are occasionally allowed to follow one track out to the shellfish beds to pick up their catch, no vehicles are allowed on the tidal flats.
- Shellfish beds. No vehicles are allowed in the shellfish beds.
- Dune edge and foredune ridge. These areas are protected by the installation of snow fencing that runs almost the entire length of the beach. Also, permanent symbolic fencing is used to further protect the dune edge (see Section 6).
- Sensitive wildlife habitat areas.

These additional management actions are followed on Duxbury Beach:

- * **Define ORV Corridors.** ORV trails or corridors have been defined and sited to avoid salt marsh, dunes, the foredune ridge, wildlife habitat areas, and especially rare species habitat.
- * **Limit ORVs to Corridor by Fencing.** ORV travel has been restricted to corridors by the use of post and cable fencing and other effective fencing techniques, including the established track program. The landward edge of the ORV corridor on the outer beach is defined by the use of snow fencing so that vehicles are not allowed to access the edge of the dune. Symbolic fencing is used to define areas of bird nesting. Permanent symbolic fencing, which consists of posts spaced approximately 50 feet apart and 20 feet seaward of the toe of the dune, is maintained along much of the front beach available to the ORV's. It has proved to be especially effective in protecting the toe of the dune.
- * **Maintain ORV Corridor (The Improved Roadway to Gurnet-Saquish).** The main ORV corridor, the improved roadway to the Gurnet/Squish area, is maintained to prevent excessive ORV impacts to the rest of the beach. By maintaining this roadway and fencing, the Reservation has been able to confine all ORV traffic to a narrow area beyond the reach of the dunes.

Due to the ongoing landward migration of Duxbury Beach, it is necessary to move this improved roadway landward periodically to maintain the foredune ridge of the barrier.

- * **Parking.** Scenic parking areas have been provided along the improved roadway and are clearly designated with signs. With the exception of the restricted parking in the vehicle crossovers, all parking along the roadway is limited to these designated areas. On the outer beach, parking areas are designated and regulated within the established track program and with other management measures.
- * **Signage.** Regulatory, informational, and educational signs are conspicuously placed throughout the beach region to provide users with information regarding safe and appropriate access and resource protection. Sensitive areas are clearly marked and rigorously cordoned off from all users.
- * **Education.** Beach brochures of the rules and regulations are issued with every permit. The Duxbury Harbormaster/Coastal Natural Resources Department passes out handouts, including an endangered species brochure, to make sure that all beach guests receive appropriate and necessary information. On weekends, approximately 500-1,000 handouts are issued to beach guests each day. The Department also uses chalkboards throughout the beach region to provide updates of important information. The Department also maintains a web page of current information and material [www.duxburyharbormaster.org].
- * **Endangered Species Program.** This important component of ORV management on Duxbury Beach is discussed in the next chapter.

4.1.3 (c) ORV Speed Limits

The Reservation, with the concurrence of the Duxbury Board of Selectmen, has imposed the following speed limits on the beach and improved roadway:

- Nesting Season (April 15 to August 15)
- Front and back beach, unfledged chicks present: no vehicles allowed
- Front and back beach, no unfledged chicks present: 10 miles per hour
- Improved roadway, unfledged chicks present: 5 miles per hour
- Improved roadway, no unfledged chicks present: 15 miles per hour

Note: The presence of unfledged chicks is determined by an endangered species officer or plover monitor.

- Off-season (August 16 to April 14)
- Front and back beach: 10 miles per hour
- Improved roadway: 20 miles per hour

To further protect endangered species, the roadway and beach south of the first vehicle crossover is closed to all non-essential traffic from 8:00 PM to 7:00 AM

from April 15 to August 15. These speed limits are posted and strictly enforced by the Duxbury Harbormaster/Coastal Natural Resources Department. The Town of Duxbury gives a comprehensive summary of the Duxbury Beach Rules and Regulations, including approved ORV use, to everyone who purchases a permit (see Appendix xx).

4.2 Dog Access

Prior to 1998, dogs had access to all of Duxbury Beach with the exception of Duxbury Beach Park, also known as Blakeman's. Duxbury Beach Park, which is not leased to the Town of Duxbury and never has been, has had a "no dogs allowed" policy for decades. Dogs were allowed on the portion of Duxbury Beach that the Town of Duxbury leases from the Duxbury Beach Reservation, Inc. Because of pressures resulting from the Endangered Species Act and complaints from people using the beach with unleashed, uncontrolled dogs, the Duxbury Beach Committee recommended a new policy concerning dogs to the Board of Selectmen. This policy, implemented by the Board of Selectmen in 1998, was as follows:

- Dogs were prohibited from the front beach (the resident portion of the beach from the Duxbury Beach Park to the beginning of the ORV portion of the beach) from May 1 through September 15.
- Dogs were prohibited from the back beach north of the Powder Point Bridge and adjacent to the resident parking lot.
- Only dogs restrained by a leash were permitted on the beach properties as authorized.
- On June 26, 2001, a piping plover (protected by the Endangered Species Act) was killed on Duxbury Beach, causing a chain of events relative to dogs on Duxbury Beach. On October 30, 2001, the U.S. Fish and Wildlife Service and the State Natural Heritage and Endangered Species Program held a meeting to investigate the circumstances of this "taking." Officials from the Town of Duxbury, representatives from Mass. Audubon, and officers of the Duxbury Beach Reservation, Inc. attended the meeting.
- Although the taking was declared to have occurred under extenuating circumstances (during an extensive search and rescue mission), and the responsible parties (The Duxbury Beach Reservation and the Town of Duxbury) would not be held accountable, the officials from U.S. Fish and Wildlife made several recommendations to strengthen the endangered species protection practices on Duxbury Beach. Among those recommendations was that the Town of Duxbury ban dogs from the beach from April 1 to August 31, in keeping with state and federal guidelines regarding endangered species.

The guidelines referenced are contained in the Guidelines for Barrier Beach Management dated February 1994 and issued by Massachusetts Coastal Zone Management (MCZM). On page 208 of these guidelines is the following statement: "Pets should be leashed and under

control of their owners at all times from April 1 to August 31 on beaches where piping plovers or terns are present or have traditionally nested. Pets should be prohibited on these beaches from April 1 through August 31 if, based on observations and experiences, pet owners fail to keep pets leashed and under control.”

On January 14, 2002, the Board of Selectmen endorsed the proposed dog ban. A huge public outcry by dog owners ensued and resulted in the formation of a group who called themselves BARC (Beach Access Rights Committee). BARC lobbied hard, claiming that the present rules regarding dogs were sufficient if they were enforced and dog owners were educated about the rules. Eventually, all parties agreed to a new policy that state officials agreed to accept. The policy, which went into effect on April 1, contains the following provisions:

April 1 to August 31:

- All dog walkers will be registered (dog owners must apply for a permit at Duxbury Town Hall).
- All dogs on the front or back beach will be leashed and under the immediate control of their owners.
- Dogs may only be walked from 8:00 AM to sunset.
- Dogs are prohibited from the beach from sunset to 8:00 AM.
- Dogs may be walked in authorized areas only.
- Violators are subject to a \$25 fine for first violation.

September 1 to March 30:

- Dogs are permitted on the beach as long as they are leashed and under the control of their owners.

May 1 to September 15:

- Dogs are prohibited from the front beach (the resident portion of the beach from the Duxbury Beach Park to the beginning of the ORV portion of the beach)

The summer of 2002 passed with no major dog problems reported. Over 1,129 people obtained permits to walk their dogs. No fee was charged for the permits, but that may change for 2003 due to the impact of registering this many dogs on the staff at Town Hall.

4.3 Marine Access

Marine access is also closely managed on Duxbury Beach. Vessel access areas are defined for the following types of marine uses:

- jet skis and other motorized watercraft
- sailboats
- canoes and kayaks
- sailboards
- boats operated by commercial and recreational shell and fin fishermen

Post and cable fencing along the right-of-way and snow fencing on the outer beach are used to control access and limit adverse impacts to resource areas in vessel access areas. A buoy system has been created to aid in the management of marine use and access. Education and enforcement are also important components in the management of access for these uses.

4.4 Shore Access

Other forms of access are also managed closely, including the following

- Pedestrian: As with the improved roadway, the Reservation has closed all but a few of the former walkways through the dunes. The few not closed have been made narrower. Width reduction was accomplished by the use of 4-foot high snow fencing. The Reservation protects most of the dunes by snow fencing, maintaining about 16 miles of fencing.
- Access for the physically challenged: The beach has two pedestrian ramps to allow access to the front beach for physically challenged individuals. These ramps are 10-foot wide and allow two wheelchairs to pass and meet all state requirements for access ramps. Both ramps have proved highly successful and are used by the general public not only for access to the front beach but also as scenic view platforms.
- Horseback riding: allowed with a permit.
- Predator control: Posts (for the post and cable fencing, symbolic fencing, signs, etc.) have a single 20-penny nail installed vertically at the top to prevent predators from perching on the posts.
- Fin and shell fishing from beach: allowed with appropriate permits.
- Waterfowl hunting: Waterfowl hunting is allowed. A state license is required.
- Bird watching
- Shell collecting
- Kite flying: Restricted during the presence of endangered species.
- Cooking in containers and picnicking
- Dog walking: allowed in designated areas if the dog is on a leash and the owner has a permit from the Town (see above).
- Commercial vendors: allowed in designated areas with appropriate permits.
- Private functions: allowed with a special permit from the Town.
- Swimming: At posted times, lifeguards are on duty in designated areas.
- Ball playing and other games
- Surfboard and skimmer disk use: allowed in designated areas.
- SCUBA diving and snorkeling from shore: allowed in designated areas.
- Seaweed harvesting from shore

- Commercial filming: allowed with a special permit from the Town.

To reiterate, all ORV access to Duxbury Beach properties is controlled and managed by using fencing, enforcement, and education.

5

Endangered Species Program

The goal of the Endangered Species Program (ESP) is to protect piping plovers, least terns, and other endangered, threatened, or protected species, while allowing reasonable vehicle access and other appropriate uses and activities to occur on the Duxbury Beach Reservation (DBR) properties. Over the years, this program has proven to be a great success. The record shows that year after year the fledge rate of piping plover chicks on Duxbury Beach is better than the average rate in the state, and in many years it has been among the highest. In 1996, the fledge rate of 2.9 per nest was the highest in the state.

The record also shows that with the exception of three years, there has been an annual increase in the number of pairs of piping plovers nesting on Duxbury Beach since 1990. In 1990, there was only 1 pair, and in 2002, there were 14 pairs. This time frame (1990-2002) coincides with the inception and implementation of the current monitoring program. During this same time frame, recreational use of the beach has increased dramatically. The Reservation views these statistics as proving the worth of its program and demonstrates that if properly managed, humans and endangered species can co-exist in the same environment.

No activity described in this section will take place inconsistent with the Order of Conditions (OOC) from the Duxbury Conservation Commission and without prior authorization of the Massachusetts Natural Heritage and Endangered Species Program.

5.1 Environmental Statutes and Regulations Applicable to Endangered/Threatened Species on Duxbury Beach

The local, state, and federal laws that provide protection for piping plovers, terns, and other endangered, threatened or protected species on Duxbury Beach are listed below and are described in Chapter 3.

- Wetlands Protection Act (Ch. 131, s. 40 and 310 CMR 10.00)
- Duxbury Wetlands Bylaw, Chapter 9
- Town of Duxbury, Beach Rules and Regulations
- Mass. Endangered Species Act (Mass. General Laws Chapter 131A)
- Federal Endangered Species Act of 1973 (16 United States Code 1531)
- Massachusetts Barrier Beach Guidelines

5.2 Scope of Endangered Species Program

The Town of Duxbury Harbormaster/Coastal Natural Resources Department is responsible for managing and implementing the Endangered Species Program (ESP) on Duxbury Beach. This program is administered by the Coastal Natural Resources/Endangered Species Officer (CNR/ESO), who is under the supervision and direction of the Harbormaster. The Duxbury Harbormaster/Coastal Natural Resources Department administers the following services:

- environmental fisheries/wildlife law enforcement and management
- marine law enforcement, harbor management, and search and rescue
- emergency medical services
- law enforcement and beach management

5.2.1 Coastal/Natural Resources Endangered Species Officer

The town has a full-time Coastal Natural Resources/Endangered Species Officer (CNR/ESO), who manages and implements the Endangered Species Program. The CNR/ESO, a department shift supervisor, has training and experience in beach law enforcement, beach management, environmental fisheries/wildlife law enforcement and management, marine law enforcement, harbor management, search and rescue response, emergency medical response, and endangered species management and protection.

The CNR/ESO receives training in endangered species management by participating in the training program of the Massachusetts Audubon Society's Coastal Waterbird Program and the Massachusetts Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program. The CNR/ESO also receives academic training and/or experience in fishery/wildlife, beach management, ecology or biological sciences, and law enforcement. The CNR/ESO is charged with the overall management of all beach region access and uses as they relate to the protection and management of endangered/protected species.

The Duxbury Harbormaster/Coastal Natural Resources Department hires the CNR/ESO through the Endangered Species Protection Grant funded by the Duxbury Beach Reservation, Inc. The CNR/ESO is charged (in part) with implementing the Massachusetts Natural Heritage Program's "Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns, and Their Habitats in Massachusetts." At times the Duxbury Harbormaster/Coastal Natural Resources Department may adopt management procedures that can provide greater protection of the endangered/protected species and habitat areas. Some of the management responsibilities include the following:

- Enforcing federal, state, and local laws, rules, and regulations; and implementing terms, conditions, and guidelines as they relate to the protection and management of endangered/protected species and habitats.
- Coordinating activities of barrier beach storm repair and/or maintenance as it relates to the protection and management of endangered/protected species and habitats.

- Placing signs and symbolic fencing to identify and delineate habitats for breeding and nesting areas.
- Placing informational and regulatory signage and erecting barriers (e.g., fencing, barrels, cones or other barriers) as they relate to the protection and management of endangered/protected species.
- Assisting in the location/identification and protection of nest sites.
- Erecting predator exclosures around nest sites if determined necessary and appropriate by the Endangered Species Scientist. A permit is required from the state Division of Fisheries & Wildlife and the federal Fish and Wildlife Service.
- Certifying the location of the endangered species and directing and coordinating endangered species monitors.
- Authorizing and coordinating any and all beach access and activity as it relates to the protection and management of endangered/protected species.
- Cooperating with endangered species scientists by coordinating their activities and visits to habitat areas.

The CRN/ESO is also responsible for managing and implementing the policies and procedures of the Endangered Species program, including (but not limited to) the following:

- Coordinating training programs for program participants.
- Providing participant task descriptions (authorizations) and objective(s).
- Preparing lists of participants, agency descriptions, contact numbers, e-mail addresses, etc.
- Preparing and collecting participant directives and/or standard operating procedures (SOP's).
- Obtaining signed participant liability statements.
- Coordinating participant rosters and schedules.
- Preparing and keeping all records, maps, logs, etc. of participants.
- Preparing and coordinating the Endangered Species Program time line.
- Establishing chain of command of participants.
- Establishing communication network for participants.
- Holding and coordinating weekly, monthly, annual (other) meetings/hearings.
- Providing equipment inventory with descriptions.

In addition to managing and implementing the Endangered Species Program, the CNR/ESO also prepares reports in collaboration with the endangered species scientists and consultants for the Duxbury Beach Reservation, Inc. The reports summarize the Endangered Species Program and include (but are not limited to) the following:

- maps that show the location of nesting endangered/protected species;

- descriptions of endangered species habits, and survival and mortality data;
- list of management actions taken to protect the endangered species; and
- recommendations for improvements, if any, to the Endangered Species Program.

The CNR/ESO will prepare a Memo of Understanding that all parties (participants and authorities) involved with the Endangered Species Program will sign on or before April 1 of every year. This Memo of Understanding will include (but not be limited to) the following:

- goal(s) for the upcoming endangered species season
- site-specific actions and policies for improving or clarifying past practices.

5.2.2 Coastal/Natural Resources Endangered Species Monitors

The Duxbury Coastal Natural Resources/Endangered Species program includes an extensive system to monitor and protect any endangered species that use the beach. The beach is habitat for piping plovers and small, isolated colonies of least terns. About 6 to 8 pairs of piping plovers nest on the beach each year.

Endangered species may be present on the beach as early as mid-March. Continuous monitoring begins on March 1, so as to determine exactly when endangered species first appear on the beach. Nesting habitat is delineated by April 1. As the plovers arrive, monitors identify and observe each pair daily as the birds court, breed, nest, and lay eggs. The CNR/ESOs locate the nests and map their position using Global Positioning System (GPS). The number and date of any eggs (a pair typically lays 4 eggs) are noted, and the nests are checked in as per the guidelines. In most cases nest predation protection measures are taken. As soon as the eggs hatch, intense monitoring of the chicks begins and continues until the chicks fledge, which is about 28 days after they hatch. Usually all chicks have fledged by mid-August.

To ensure the success of the program, the Town of Duxbury Harbormaster/Coastal Natural Resources Department hires Endangered Species Monitors through the Endangered Species Protection Grant funded by the Duxbury Beach Reservation, Inc. The monitors are supervised by and report directly to the Coastal Natural Resources/Endangered Species Officer (CNR/ESO) or the CNR/ESO's designee (e.g., a supervisor or other officer from the Harbormaster/Coastal Natural Resources Department). The monitors assist the CNR/ESO and Scientist (if required) in implementing the Endangered Species Program. Monitors are trained in the field and attend other appropriate training programs that are available. Each monitor is issued a variety of necessary equipment and gear. Such equipment may include (but not be limited to) appropriate clothing, communication equipment, binoculars, clipboard, beach chair, and other items depending on the need.

The CNR/ESO reports to work each morning at 6:30 A.M. and immediately locates and identifies all clutches known to be present from the previous night's report/log. Monitors report each morning at 7:00 A.M. Once the CNR/ESO has located, identified, and certified all the clutches, he or she assigns a monitor to each clutch. Recreational beach use is not allowed until all the clutches have been located, identified, and certified, and all monitors are in place.

In an effort to better understand the birds, the monitors observe and record their habits and periodic movements. The monitors also record other pertinent data, such as habitat descriptions, environmental conditions, bird activities, disturbances, and predation, etc. The monitors are also responsible for protecting the birds. They report to the CNR/ESO any infractions of the rules and regulations or any terms or conditions that might threaten the endangered species. The CNR/ESO acts immediately to remove that danger. A certain side benefit to the presence of the monitors is that predation is greatly reduced while these monitors are on duty.

By utilizing two shifts, the Harbormaster/Coastal Resources Department is able to keep monitors on the beach from 7:00 A.M. until 3:00 P.M. (shift 1) and from 3:00 P.M. until 9:00 P.M. (shift 2). At 8:00 P.M. all non-essential traffic is prohibited south of the first crossover on the improved roadway.

Monitors on the second shift report (log) the location of all clutches before they leave for the night so that the birds can be found the next morning when the morning shift begins. In order to restrict access on the improved roadway to essential traffic only and to accommodate those beach guests who enjoy the beach after dark, a Deputy Endangered Species Officer is stationed in the area of the first crossover from 8:00 P.M. until 11:00 P.M., at which time the entire beach south of the bridge is closed for the night.

From the middle of March until the middle of August, no work is performed in any identified habitat area on the beach until the CNR/ESO sweeps and certifies that the specific area where the work is proposed is free of endangered species. The program is based on the premise that at any time when activity is occurring on the beach, the endangered species are protected.

Thus far, the program has yielded excellent results, with the only recent possible "take" by human activity occurring during a period of great turmoil on the beach related to a search conducted by the Mass. State Police and U.S. Coast Guard for a missing person. This incident, which occurred in the summer of 2001, lasted several days and involved state safety officials closing the beach to all civilians, including the endangered species monitors.

5.2.3 Coastal/Natural Resources Beach Patrol Officers

The Town of Duxbury uses Harbormaster/Coastal Natural Resource officers to enforce the Beach Rules and Regulations and other environmental and wildlife laws and regulations. These officers are authorized and appointed deputy Endangered Species Officers and are used to expand and augment the Endangered Species Program, as authorized by the Endangered Species/Coastal Natural Resources Officer or designee.

5.2.4 Endangered Species Scientist

The Duxbury Beach Reservation, Inc., through Mass Audubon, funds the services of an Endangered Species Scientist, who gathers data on endangered species during courtship, breeding, egg laying, and fledging periods. This scientist also acts as a monitor for the protection of the endangered species. The scientist provides information to and consults with the CNR/ESO in a timely manner to manage and protect endangered/protected species. This individual fills out Endangered Species Program daily data sheets, the ESP

log, and other materials as instructed by the Reservation or the Reservation's designee. This individual attends all appropriate meetings and/or hearings as instructed by the Reservation or the Reservation's designee.

The Endangered Species Scientist(s) prepares and submits an end-of-season scientific report to the Duxbury Beach Reservation, Inc., with copies to the Natural Heritage Program and the Coastal Natural Resources/Endangered Species Officer. This report describes the scientific data that was collected and any other appropriate information relative to the implementation of the endangered species program for that year.

5.3 Replicated Habitats

5.3.1 Background

During part of the year, Duxbury Beach is home to two threatened species: piping plovers and least terns. The birds begin arriving in March to court, nest, lay their eggs, and fledge their young. Preferred nesting sites are flat, unvegetated areas of sand or gravel where predators cannot hide. By 1998 it had become apparent to the Duxbury Beach Reservation that the success of grass planting efforts and six years of relatively quiet weather had resulted in a significant reduction of open areas of acceptable habitat. Birds were nesting on the front beach where there was less vegetation but more conflict with human recreational users and greater danger from high tides and storm waves. In an effort to replicate naturally occurring washover fans (barren, fan-like areas that form when storms push sand and cobble from the beach and dunes shoreward over the marsh), the Reservation undertook an experiment to create nesting habitat for piping plovers and least terns.

5.3.2 Project History

1999

The Reservation placed 1,700 cubic yards of quarry sand on the back beach between High Pines and the third crossover to form a large, open rectangle measuring approximately 300 feet by 150 feet. The quarry sand was slightly yellow in color compared with the grayer natural beach sand that closely matches the coloration of newly hatched plover chicks. Therefore, as part of the experiment, a roughly triangular half of the area was veneered with natural beach sand. In 1999, the first piping plover nest in Massachusetts was found on this patch of artificial habitat, on the portion covered with natural sand. Unfortunately, a predator enclosure covered with netting was inadequate to fend off foxes in a nearby den, and all four eggs were lost to natural predation.

On the basis of this experiment, the Reservation made two assumptions. First, plovers prefer natural sand to quarry sand. Second, the birds are somewhat territorial and, while the area was larger than necessary for one nest, it was not large enough for two.

2000

The Reservation created two new habitat areas, each 75 feet in diameter, on the bay side of the beach just north of High Pines. This time the Reservation removed and stockpiled sand and placed 100 cubic yards of quarry sand in each excavation. The excavated sand was then spread over the quarry sand. No birds nested on the northernmost area, possibly because the slope was too steep. Two eggs were laid on the other new area, but both failed to hatch. Farther south, on the natural sand portion of the original 1999 habitat area, a pair of piping plovers laid three eggs and successfully fledged three chicks. In 2000, predator enclosures had wire covers instead of netting. In addition, the Reservation used vials of coyote urine to deter predators. Monitors raked the sand around the enclosures each day but saw no sign of fox tracks.

2001

The Reservation created two more areas, each about 75 feet in diameter, on the bay side of the beach between the southern edge of High Pines and the 1999 replicated habitat, again by bringing in quarry sand and covering it with previously excavated natural beach sand. By 2001 there were a total of five artificial habitat areas on the bay side of the beach. No birds nested on either of the new areas, possibly because they were too near the end of the marsh behind High Pines. Unfledged plover chicks find it difficult to cross over marsh to reach food sources at the water's edge.

2002

Because of funding limitations, the Reservation was unable to create more habitat areas. Furthermore, the natural process of re-vegetation had filled in the five older areas with grass. Of the 14 pairs of piping plovers on Duxbury Beach in 2002, not one pair nested in a replicated habitat area.

5.3.3 Future Plans

The Reservation considers the habitat experiment to be a success and plans to maintain the areas already established and possibly create more if, in consultation with the Natural Heritage Endangered Species Program (NHESP) and Mass Audubon's Coastal Waterbird Program, the Reservation can identify and receive approval for appropriate future locations. Maintenance may involve importing more sand from off site; or, on the recommendation of NHESP, rototilling grass that has grown up in the replicated habitat areas, removing the grass by scraping it with a small bulldozer, or possibly burning the grass.

No work will be undertaken until the proposed scope of work has been submitted to the Natural Heritage and Endangered Species Program, with copies to the Duxbury Conservation Commission. These reports will include the location, design, scope, and timing of the proposed work; justification of why the work is believed to be necessary; and a detailed explanation of how the proposed work will meet the performance standards that state that there shall be "no short- or long-term adverse impacts on the habitats of piping plovers and least terns."² No work will commence without the approval of NHESP. The Reservation will notify the Conservation Commission before any habitat maintenance work begins.

6

Beach and Dune Maintenance and Restoration Program

Duxbury Beach has a very long history of beach and dune maintenance. The Town of Duxbury realized the importance of dune and beach vegetation as early as 1751 when it voted “to petition the General Court to get an act to prevent neat cattle going upon or feeding on Duxbury Beach for the future.” In 1851, Congress funded beach repairs and again in the 1930’s. As early as 1963, volunteers began installing fencing along the roadway to Gurnet-Saquish to control vehicle traffic. In the early 1970’s, beach grass planting and fertilization activities were performed on the beach. This work has evolved into a beach and dune maintenance and restoration program that today is used as a model for other beaches throughout the Northeast.

Beach and dune maintenance and restoration activities are important components of any management plan for a barrier beach. The program that the Duxbury Beach Reservation has developed utilizes annual maintenance activities and storm mitigation procedures necessary for maintaining the integrity of the Duxbury Beach barrier beach system, while protecting important wildlife habitat and permitting recreational use of this valuable resource area.

All maintenance and restoration activities are carefully coordinated with the federal, state, and local endangered species programs as described in Section 5 of the Duxbury Beach Management Plan. No activity described in this section will take place inconsistent with the Order of Conditions from the Duxbury Conservation Commission and without prior authorization of the Massachusetts Natural Heritage and Endangered Species program.

6.1 Dune Maintenance and Restoration

Human impacts and storms may alter the volume and form of barrier dunes. Several techniques are available to maintain or restore these dune systems. The following is a summary of the information presented in the handbook entitled *Barrier Beach Management Sourcebook*.*

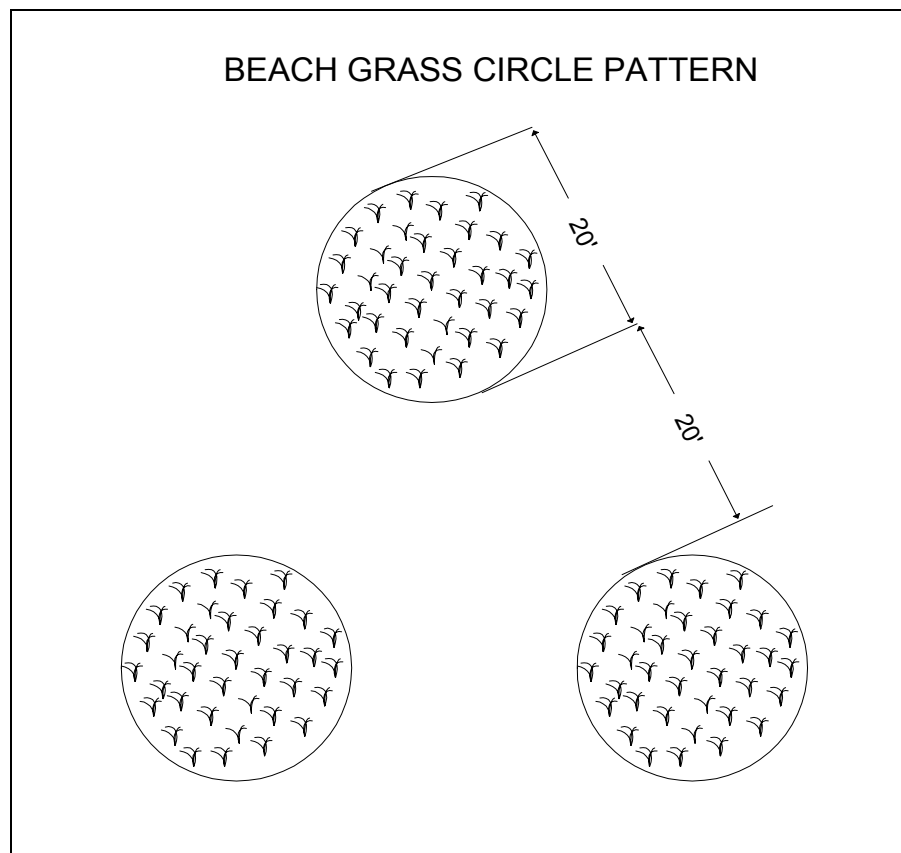
The three essential elements for the formation and maintenance of dune systems are wind, sand, and vegetation. In coastal areas, strong winds blow in off the water and pick up sand from the beach. This sand is carried landward by the wind until it hits an obstacle, such as beach grass, or until the wind velocity decreases. Beach grass traps the sand, causing it to form a mound. Nutrients carried by the wind and sand fertilize the beach grass, fostering its growth. The beach grass in turn stabilizes the hill of sand, trapping the wind-transported sand. Beach grass continues to grow up through the deposited sand and also sends out runners (rhizomes) that contribute to the lateral growth of the dune system.

*Smith, Lester B., Jr. Editor, 1983 *Barrier Beach Management Sourcebook*. Massachusetts Coastal Zone Management Office, Boston, 48 pp.

6.1.1 Beach Grass Planting

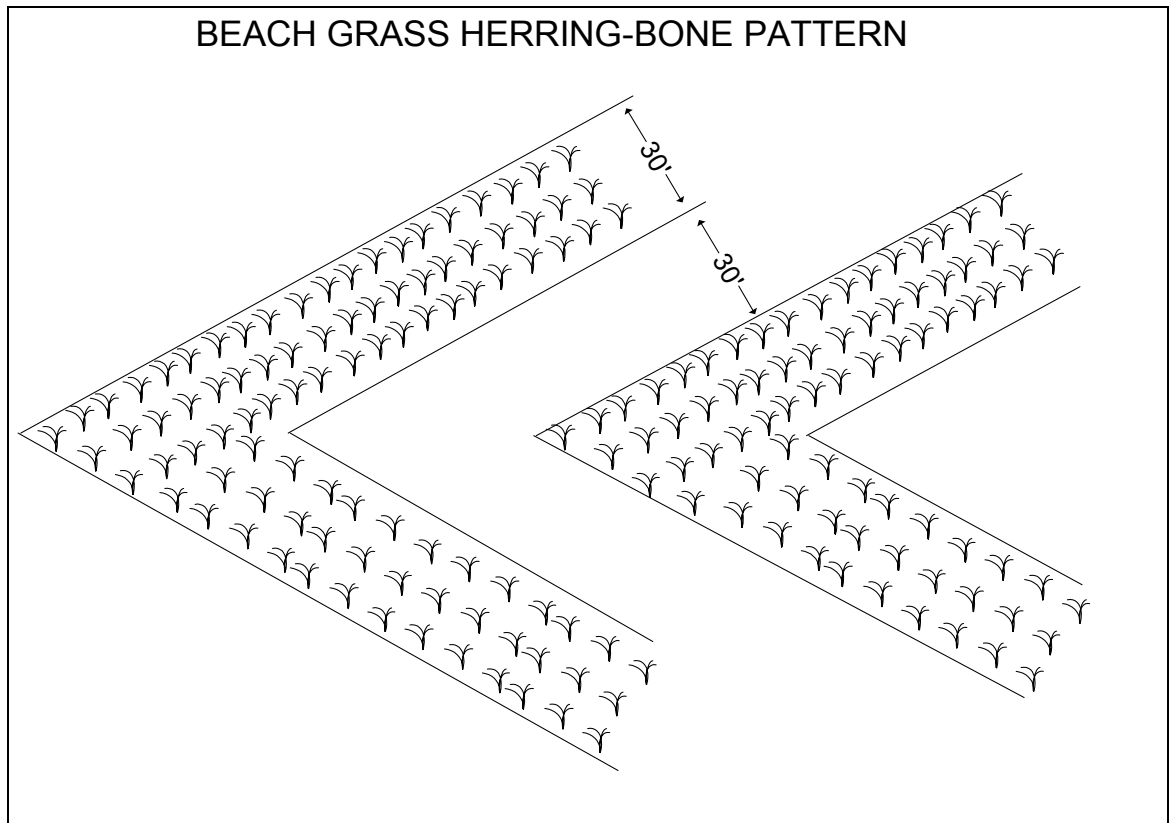
Human alteration, coastal storms, pests, or disease may destroy beach grass and other dune vegetation. When this occurs, the planting of beach grass vegetation may be required. Certain commercial nurseries stock beach grass for dune restoration purposes. For storm damage restoration of dunes in piping plover habitat, the Department of Environmental Protection's "*Recommended Conditions for Barrier Beaches*" indicates that the Natural Heritage and Endangered Species Program should be consulted. The Natural Heritage staff generally requires that some open, unvegetated areas be left where storm overwash has occurred. Their rationale is that leaving open areas allows the piping plover chicks to move across the barrier beach so they can feed on either the ocean or bay beaches.

The Natural Heritage and Endangered Species Program has allowed some vegetation plantings in overwash areas. For example, at Duxbury Beach after the "No Name Storm" (Halloween Storm) in October 1991, the Reservation planted over 500,000 culms of beach grass in 20-foot circles, 20 feet apart, leaving areas between the circles unvegetated (see figure below).



After the December 1992 storm, the Reservation planted approximately 500,000 culms of beach grass. This time a herring-bone pattern was proposed and approved, with zigzag plantings arranged such that there were no east-west bare sand areas to allow wind scour (see figure below). This pattern was proposed because the earlier circle pattern tended to

cause the wind to be funneled between the vegetated circles, causing wind-induced scour and lowering of the dune profile. The herring-bone pattern was successful because it stabilized the dune without causing wind and wave scouring. In addition, based on detailed field studies funded by the Duxbury Beach Reservation, this pattern did not appear to be an impediment to plover or tern movement from bayside to ocean and back. In the future, as a result of suggestions by the NHESP and Mass Audubon's Coastal Water Bird Program, the Reservation plans to increase the spacing between the herring-bone pattern from 20 to 30 feet, with individual culms planted at 36 inches on center in actual habitat areas to enhance habitat potential and bird traversing capability even further. In identified non-habitat areas, vegetation will be planted 18 inches on center.



Recent small-scale grass plantings have employed a third pattern. Low-density planting with culms spread 3 to 4 feet apart on center and covering the entire site have been approved by the Natural Heritage and Endangered Species staff and have proved successful.

All grass planting is performed by hand. Teams of volunteers supervised by paid staff typically plant the beach grass in early spring after the threat of winter storm damage has passed but early enough to allow the plants to establish themselves before the hot dry summer.

In the future, either the herring-bone pattern or the low-density pattern will be used for beach grass planting on Duxbury Beach.

6.1.2 Woody Vegetation

For many years the Duxbury Beach Reservation has planted woody shrubs in the protected back dune areas of the beach. Beach grass does not grow well in these more stable areas or cobble areas, so the use of shrubs has been employed to develop sediment-holding vegetation in these zones. The most successful varieties have been rosa rugosa, bayberry, and beach plum, whereas black pine and red cedar have had a very high mortality rate. Woody shrubs are very slow growing in this shoreline environment. All work is performed by hand.

Woody shrubs not only hold existing dunes but also perform remarkably well during and after large storm events. The upright stalks slow overwash currents and as a result collect large amounts of sediment of all sizes. After storm events, wind-borne sand collects around the stems of these shrubs, as they are the only plant type that remain-upright after flooding and sediment washovers. The Duxbury Beach Reservation has recognized the role of woody shrubs in dune building for many years, and shrubs have always been an important component of the Reservation's dune restoration program.

6.1.3 Fertilization

Beach grass is a plant well suited for life on a beach, as implied by its scientific name Ammophila, meaning sand loving. It grows best in the active zones on a beach or after a storm event when and where sand stimulates growth. In back dune areas and during storm-free periods, beach grass begins to die. This die-back allows the wind and water to once again erode the beach. Research conducted by Cornell University revealed that aphids attack the grass in these areas. The Duxbury Beach Reservation has developed a program of fertilization to combat this problem and promote healthy vegetation.

Each spring the back dune areas of Duxbury Beach are fertilized. The Reservation uses a blend that contains a high percentage of slow-release nitrogen, usually around 90 percent. Research performed by the University of Massachusetts Cooperative Extension Service revealed that nitrogen applied at a rate of approximately 20 pounds per acre is sufficient to sustain a healthy crop of beach grass. Woody plants benefit from phosphate and potassium, so the blend contains a small percentage of each. For the past ten or more years, the fertilizer has been applied by hand, but the Reservation would like to have the option of aerial application. Hand application is very difficult work and may not always be feasible.

6.1.4 Sand/Snow Fence Installation

Snow fence installation is an effective technique for trapping wind-blown sand and promoting dune growth. Once vegetation is established, snow fence serves as an effective barrier against vehicle and pedestrian traffic. Because beach vegetation is very sensitive to any type of traffic, fencing is an effective way to protect vegetation from the large number of visitors to Duxbury Beach.

The Duxbury Beach Reservation has found the use of two or more parallel rows of dune fence, 8 to 10 feet apart, to be the most effective way to build dunes. However, the

Natural Heritage Program staff has historically recommended against the use of more than one row of snow fence in piping plover habitat, because they believe fencing creates an obstacle to piping plover movement. As a result, one row of fence is used in most areas on the beach. On Duxbury Beach, many plovers nests have been located in close proximity to snow fences, and snow fences do not appear to pose an obstacle to plover movement. The Reservation remains flexible with respect to the use of snow fence.

Snow fence is stapled onto wooden posts installed 10 feet apart by a rubber-tired backhoe, auger, or hand digging. The fencing is stapled to the posts by hand. Snow fencing is typically installed before the piping plover or least tern nesting season begins. However, at times after late season storms, the Reservation has received permission to do this work later in the season in the presence of an on-scene trained plover monitor.

The Duxbury Beach Reservation and the Town of Duxbury have a very comprehensive plover monitoring program. As more information becomes available on plover responses to both natural and artificial obstacles, the use of snow fence may prove to be the preferred technique of promoting dune growth while at the same time providing protection for plover chicks.

6.1.5 Symbolic Fencing

In recent years a new type of fencing called *symbolic fencing* has been used on the beach. There are two types – permanent and temporary. *Permanent symbolic fencing* is used on the front beach to protect the toe of the dune from all forms of traffic and to allow vegetation to grow and sediment to move in response to weather conditions. The area behind the fence also serves as wildlife habitat and is generally where the storm wrack collects. *Permanent symbolic fencing* consists of fence poles installed by backhoe on the upper beach face east of the snow fencing. Depending on beach conditions, the fencing is placed 10 to 50 feet east of the snow fence. The poles are placed at a distance of approximately 50 feet apart. String is strung between the poles during the summer season.

By April first of each year and continuing through the plover and tern nesting season, a second row of fencing called *temporary symbolic fencing* is installed on the front beach east of the permanent symbolic fence wherever nests are located. The temporary fence is positioned so that it prevents any vehicles from coming within 100 yards of an established nest. The fence consists of metal poles driven by hand with string strung between the poles. The exact location of temporary symbolic fencing can change from day to day.

6.2 Sacrificial Dunes

6.2.1 Background

Barrier beaches, which consist of beaches (including tidal flats and berm) and dunes, provide the critical function of storm damage prevention and flood control to landward structures and resources by acting as a buffer to storm waves and elevated sea levels. In addition, they provide wildlife habitat and protect landward wildlife habitat areas. They also provide aesthetic and recreational benefits. The volume, form, sediment characteristics, ability of waves to remove dune sediment and contribute this material to beaches and other adjacent dunes, vegetative cover, ability to migrate in response to wind and waves all contribute to the barrier beach's ability to provide these important functions.

Following major storms, barrier beaches respond by eroding, reshaping, possibly migrating landward, and supplying their sediment to other areas in order to dissipate storm wave and wind energy and prevent further alteration or damage in these areas. When dunes are severely eroded and lowered below certain critical flood elevations and vegetation is severely impacted as a result of storms, reconstruction or rehabilitation of the dunes may be necessary to prevent or avoid future damage to landward structures and resources. If a coastal storm were to make landfall in the same area soon after a previous major storm, and the dunes and vegetation have not been reestablished, landward property and resources would be highly vulnerable to irreparable damage.

Following the devastating coastal storms of the early 1990s (Hurricane Bob in August of 1991, The No-name Halloween or "Perfect Storm" of October 1991, and the December 1992 storm – all Presidential disaster declarations), the dune vegetation and elevation, and all of the snow fencing along the entire length of Duxbury Beach were severely damaged or totally eradicated, except in two locations – High Pines and Plum Hills. Even in these two areas, however, overwash and breakthroughs occurred. The dunes, which were already vulnerable from the severe erosion damage they had received during the Blizzard of 1978, were particularly devastated as a result of the No-name northeaster of 1991.

As a result of extreme vulnerability and high risk of potential damage to mainland structures and landward resources if another coastal storm were to strike in the near future, the Duxbury Beach Reservation, with assistance from a number of federal and state agencies and coastal specialists--most notably the Federal Emergency Management Agency (FEMA), Massachusetts Emergency Management Agency (MEMA), and the U.S. Army Corps of Engineers (USACE)-- implemented a "sacrificial dune" program on Duxbury Beach.

U.S. Army Corp of Engineers' policy guidance states that a protective dune is part of a sacrificial storm damage reduction system in which loss of material from the system during storms is anticipated. Storm damage protective systems are designed to sacrifice the beach berm and dunes to dissipate wave energy and prevent erosion from reaching

developed property behind the protective beach and dune system. The need for periodic nourishment is most often associated with replacement of erosive losses that occur during storm events.

The Guidelines for Barrier Beach Management in Massachusetts (February 1994) describe “sacrificial dunes” as low-lying man-made dunes that are designed to provide short-term storm damage protection to landward development. Because they are designed to withstand only a 5-year return frequency storm (as designed by the Corps of Engineers and financed principally by FEMA), the Guidelines state that the dunes will be sacrificed during a storm and therefore must be regularly maintained. As stated by the Army Corps of Engineers, maintenance includes planting dune vegetation, erecting sand fencing, grading, and reshaping the dune to the original design.

The Guidelines for Barrier Beach Management in Massachusetts further state, “On beaches and dunes that have been determined to be actual rare species habitat, alterations to the natural system are generally discouraged and often prohibited. However, there may be instances where erosion control projects such as dune and beach rebuilding and enhancement, including the installation of snow/sand fences, the planting of beach grass, and other soft solutions for beach and dune stabilization, may be necessary in order to protect public health and safety by preventing or minimizing an imminent threat from storm damage and flooding.”

FEMA has been the major source of emergency and disaster relief funds for rebuilding sacrificial dunes following a major storm. In order to receive such funds for rebuilding a sacrificial dune damaged from a major storm, the recipients must have maintained the dune to the original design parameters. FEMA requires maintenance records as documentation of a dune maintenance program.

6.2.2 Sacrificial Dunes on Duxbury Beach

Two sacrificial dunes have been constructed and maintained on Duxbury Beach. The first was constructed in 1992 as a result of beach/dune alterations caused by the October “No-name” (Halloween or Perfect) northeast storm. FEMA concluded that the very low post-storm elevation of the beach and dune posed a significant public safety concern and urged the Duxbury Beach Reservation to take immediate action to restore the storm damage prevention value of the beach and dune system. After consultation with USACE, FEMA recommended that the beach and dune be restored by construction of a “sacrificial dune.” The design called for approximately 80,000 cubic yards of sand to raise the dune to a consistent elevation of 16 feet National Geodetic Vertical Datum (NGVD) to prevent storm wave overtopping coincident with the 5-year storm. Approximately 500,000 culms of grass were planted on the dune.

FEMA reimbursed the Duxbury Beach Reservation 75 percent of the cost of constructing and planting this first sacrificial dune. But the December 1992 northeast storm struck, and much of the dune (and beach) sands were redistributed. These sands, however, remained within the Duxbury Beach “system” (landward and seaward transport) and continued to provide beneficial functions such as the creation of near-shore storm bars and overwash fans, establishing landward substrate for Duxbury Beach to continue its long-term landward migration.

A second sacrificial dune was constructed in 1994 as a result of serious erosion caused by the December 1992 northeaster. As with the previous determination, FEMA and USACE determined that sacrificial dune construction was necessary to abate a serious public safety and storm damage threat to landward structures and resources. The design of this second dune was similar to the first one. However, there was one change: approximately 120,000 cubic yards of compatible material were placed in a more landward location on the barrier beach to be farther from the reach of coastal storm waves. This design change was made to provide additional longevity and more closely align the sacrificial dune with the landward barrier migration. Approximately 500,000 culms of grass were planted on the dune. In April 1993, the Duxbury Beach Reservation filed Notices of Intent with the Duxbury and Plymouth Conservation Commissions and obtained Orders of Conditions shortly thereafter to allow this work to proceed.

Since construction of the sacrificial dune, the Reservation has obtained authorizations for additional dune plantings and snow/sand fencing, which have helped maintain, and in some locations increase, the volume of the dunes.

6.2.3 Sacrificial Dune Design Parameters

Sacrificial dune design has been developed by USACE, with FEMA providing support and substantial reimbursement funding (75%). It consists of creating a peak elevation of 16' NGVD to prevent wave overtopping from a 5-year return frequency coastal storm, with a top dune width of not less than 10 feet. As a result of consultation and recommendations from specialists with the Massachusetts Natural Heritage and Endangered Species Program (NHESP) and Massachusetts Audubon Society Coastal Water Bird Program, previous sacrificial dune slopes were constructed at a 6:1 grade to accommodate the behavioral patterns of the piping plover—that is to allow the plovers to traverse the dune to the seaward and landward inter-tidal feeding areas. Recently, however, NHESP suggested that the seaward and landward slopes of the dune be designed at a maximum of 10:1 on both sides. Therefore, DBR will design future sacrificial dunes with this recommended slope.

As mentioned earlier, the previous two sacrificial dunes were vegetated with culms of beach grass. NHESP recommendations on vegetation cover for beach grass planting of the first dune, the second, and any future maintenance or reconstruction of the present sacrificial dune are covered in Section 6.1.1 “Beach Grass Planting.”

6.2.4 Sacrificial Dune Construction

Material to be used in maintaining or reconstructing the sacrificial dune will be trucked in from off-site, stored in the parking lot near the Duxbury Beach Park Pavilion, and delivered to the required areas by truck. The trucks will cross through the dunes to the front beach only at existing crossovers, thus avoiding all vegetated areas. As little vegetation as possible, if any, will be disturbed. Any vegetation that is inadvertently disturbed will be immediately replanted. No work will take place until the Duxbury Conservation Commission and the NHESP have been notified and the work has been approved. The Reservation will give 48-hour notification to the Commission before any truck or machinery movements commence.

Material that will be used to maintain or reconstruct the sacrificial dune will be compatible with existing material. The beach and dunes sediments of Duxbury Beach consist of fine sand to cobble-sized material. Tests on existing dune sands and proposed nourishment material will be conducted and the most appropriately sized material will be used for dune nourishment. No material will be permanently removed from the beach or dune, and all work will occur above the extreme high water mark.

To provide maximum habitat potential and aesthetic characteristics, where appropriate, existing natural non-vegetated dune material will be excavated and stored temporarily in non-vegetated dune and beach areas and the imported off-site dune nourishment material will be placed in trenched area and subsequently covered with the natural material. The areas will then be planted as described above.

As this work will occur on a dynamic beach and dune, it is not possible to propose exactly where nourishment and plantings will be required until it is necessary. Beach and dune areas are generally surveyed following all storms, and particularly in late winter. The proposed scope of any work will be reviewed and approved by the NHESP and Duxbury Conservation Commission before any action is taken. Work would likely be performed in late winter.

No work will be performed in areas identified as “habitat” between April 1 and September 1, unless the NHESP, the Duxbury Conservation Commission, and/or the endangered species officer (ESO) has evaluated the area and approved the work. Some activities involving handwork only—for example, snow fence installation—may take place in the presence of the ESO. Also, in the event of an emergency, work activity will require the presence of the ESO. In both cases—handwork or any emergency work—the ESO will ensure that such work will have no immediate effect on any rare or endangered species. As outlined elsewhere in this plan, the Reservation maintains a plover-monitoring network on the entire beach so that no human activity disturbs plovers or other threatened and endangered species.

DBR will continue to use best management practices (BMPs) that involve state-of-the-art preservation, engineering, and geologic practices to create, maintain, and preserve the barrier beach to provide resource conservation while preserving the barrier beach beneficial functions concomitant with public access, use, and enjoyment.

6.2.5 Interests to be Protected

The Wetlands Protection Regulations at 310 CMR 10.28 (1) state that all coastal dunes on barrier beaches are per se significant to storm damage prevention and flood control. Coastal dunes are also often significant to wildlife habitat. In addition, no project may be permitted which will have any adverse effect on specified habitats of rare vertebrate or invertebrate species. Thus, storm damage prevention, flood control, and wildlife habitat are the “interests” to be protected.

The critical characteristics of dunes for protection of the “interests” cited above are:

- The ability to erode in response to coastal beach conditions (waves and wind);
- Dune volume;
- Dune form;

- Vegetative cover;
- The ability of the dune to migrate landward and laterally; and,
- The ability of the dune to continue serving as bird nesting areas.

The placement of sand for construction of the sacrificial dune (dune form and volume), planting of dune vegetation (vegetative cover), and the selection of locations for installation of snow/sand fencing are not conducted until approved by the NHESP. NHESP approval confirms that Therefore, the ability of the dune to continue to serve as a bird nesting area is protected. Construction of a sacrificial dune adds compatible sand (volume) to the dune system, and in association with plantings compatible with the natural vegetative cover and selective installation of snow/sand fencing enhances storm damage prevention and flood control. These actions do not prohibit the dune from migrating in response to wind and wave conditions and thus protects the interests of storm damage prevention and flood control.

The Duxbury Beach Reservation will maintain a valid, "Order of Conditions," issued by the Duxbury Conservation Commission. which allows the primary dune ridge to be maintained at the 16-foot elevation. It is essential that the dune be maintained in its original configuration and that surveys be conducted to document the existing conditions. In the event that another significant storm damages all or part of this vital dune, the Reservation will need to document existing conditions to be eligible for any federal or state aid.

6.3 Vehicle Corridor

As described in Chapter 4, Beach Uses and Management, there is a need to limit the number of ORV corridors on the barrier beach. The location of these corridors should be selected carefully. Each barrier beach is different, and as was pointed out earlier in Chapter 2, Description of Duxbury Beach, this particular barrier beach varies considerably from the north to the south end. One successful technique for restricting ORVs to corridors is the use of post and cable fencing. On Duxbury Beach, ORV use is restricted to the right-of-way to Gurnet-Saquish (referred to as the improved roadway in the Duxbury Beach Management Plan) and to certain restricted front beach and back beach areas.

6.3.1 Post and Cable Fencing

Post and cable fencing has been installed along both sides of the back-barrier gravel right-of-way vehicle corridor (improved roadway) to prevent ORV access into sensitive dune areas. Poles, approximately 12 inches in diameter, are used as posts on Duxbury Beach because they provide an effective physical deterrent to vehicles that might otherwise stray onto vegetated dunes or into other sensitive areas. Along the front beach, where vehicle access is permitted, snow fence, permanent symbolic fencing, and temporary symbolic fencing at and seaward of the toe of the dune restrict vehicle and pedestrian access into the dunes. The snow fencing also captures sand as part of the dune maintenance program.

6.3.2 Surface Maintenance

The gravel surface of the improved roadway must be kept smooth. Rutting of this surface can cause depressions that unfledged plover chicks may hide in during times when essential vehicles are allowed to travel in the improved roadway. The improved roadway is periodically smoothed using a woven steel cable mat that is towed behind a vehicle. More intensive rutting requires the use of construction equipment, such as a small grader or front-end loader. No road maintenance and work is scheduled or performed when unfledged endangered species are present.

Maintaining the improved roadway involves periodically adding gravel to maintain the roadway's elevation, grade, and crown and to minimize water retention on the road surface. The crown minimizes the frequency of grading required to maintain a smooth surface. All imported gravel shall be free of any contaminants and meet state highway gravel standards.

The westerly side of the improved roadway that runs along the beach channel is highly susceptible to erosion during southerly and westerly storm events. In order to maintain and repair the edge of the roadway in this area, the Reservation uses 6-inch crushed stone to better stabilize the roadway edge. Much cobble-sized material exists naturally along Duxbury Beach, and thus the imported gravel is compatible with the overall character of the beach.

All grading activities within the improved roadway will take place before April 15 or after August 15 to avoid disturbing or endangering the least terns and piping plovers. Grading of the roadway surface will be done to minimize the windrows of gravel at the edge of the roadway. In the event these windrows are unavoidably formed, the windrows shall be flattened to provide a smooth transition from the road to the adjoining dune or beach area. There will be transition areas a minimum of 3-feet wide, spaced every 50 feet along the roadway edges. These smoothed out transition areas are necessary to facilitate the passage of piping plover chicks crossing from east to west to access both the bay and the ocean.

It is important that the improved roadway be considered a temporary feature. Since barrier beaches migrate landward as storms overwash these landforms, it is necessary periodically to move the vehicle corridor landward to keep up with the natural migration process. The corridor was moved in 1977 and again in 1994 when the beach was most recently restored. The right-of-way is maintained as a gravel surface with no pavement so that it conforms as much as possible to the natural characteristics of the barrier beach.

6.4 Beach Cleaning

Each September, volunteers gather to help remove trash and assorted marine debris from Duxbury Beach. This community effort is held in conjunction with Coastsweep, a statewide project organized by the Massachusetts Coastal Zone Management (MCZM) Office. This is part of the international beach cleanup effort coordinated by the Center for Marine Conservation, located in Washington, D.C.

Annually in Duxbury, between 300 and 600 people walk the 4.5-mile beach for three hours collecting between 5,000 and 25,000 pounds of trash. Working in pairs, one partner wearing protective gloves picks up debris from the beach and places it in a trash bag. The other partner documents on data cards the number and type of debris found. At the conclusion of the cleanup these cards are sent to the Center for Marine Conservation for tabulation. The data are then used to identify the sources and types of marine debris that wash up or are left behind by visitors on the world's beaches. The information compiled by the yearly Coastsweep effort in the United States is reported to Congress and is used as input for legislation and regulations limiting the types and locations offshore of dumping activities, and to establish safeguards to protect beaches in the future.

Battelle Ocean Sciences, a contract research facility located in Duxbury, sponsored the annual Duxbury cleanup for seven years. Battelle provided refreshments and T-shirts, as well as staff to organize and direct the effort. MCZM provides gloves, bags, and data cards. In 1995, the Duxbury Beach Preservation Society (a subcommittee of the Duxbury Beach Reservation) took over sponsorship of the cleanup from Battelle. The Duxbury Harbormaster/Coastal Natural Resources Department transports volunteers to and from the five designated stations on the beach. The Duxbury Department of Public Works (DPW) trucks the bagged debris to the transfer station. The trucks are weighed empty and then full to provide an accurate accounting of the weight of the debris. All cleanup activity is closely monitored to prevent individuals from entering the dunes or other sensitive areas.

6.5 Maintenance of Duxbury Beach Park Pavilion Area

The Duxbury Beach Reservation maintains the Duxbury Beach Park Pavilion Area, including the public parking lots and Pavilion building. The Reservation pays a concessionaire a percentage of the annual income from parking revenues. The concessionaire collects the parking fees, runs a snack bar service, and provides lifeguards. The Duxbury Beach Park Pavilion Area is open to the general public through the gate at the north end of Duxbury Beach. The Duxbury Beach Reservation funds maintenance of this area in part through its percentage of the parking fees. The Reservation keeps parking fees at a competitive rate, generally lower than fees at other similarly equipped public beaches.

Maintenance of the paved parking areas requires removal of excess sand and gravel that blows or washes onto the pavement. This sand and gravel may be removed and stockpiled on an existing gravel parking lot for use in the maintenance of the vehicular corridor areas, including the soft sand transition areas. No material will be removed from the barrier beach.

Paved parking areas require periodic maintenance and/or repair. Repair and maintenance paving shall not exceed the geographical boundaries of the existing pavement.

6.6 Maintenance of Duxbury Beach Resident Parking Lot

The Duxbury Beach Reservation maintains the Duxbury Beach Resident Parking Lot, at the east end of the Powder Point Bridge, with assistance from the Town of Duxbury, Department of Public Works. Maintenance work includes sweeping, paving, and painting parking areas; and maintaining gates and the off-road vehicle access way to the Duxbury Beach Park pavilion area at the north end of the beach.

Maintenance of the paved parking areas requires removal of excess sand and gravel that blows or washes onto the pavement. This sand may be removed and stockpiled on an existing gravel parking lot for use in the maintenance of the vehicular corridor areas, including the soft sand transition areas. No material will be removed from the barrier beach.

Paved parking areas require periodic maintenance and/or repair. Repair and maintenance paving shall not exceed the geographical boundaries of the existing pavement.

6.7 Elevated Access Ramps (Handicapped Accessible)

The Duxbury Beach Reservation recently completed a major renovation of the Duxbury Beach Park Pavilion, including the installation of a handicapped-accessible toilet. In addition, the Reservation constructed a handicapped-accessible walkway to the beach in 1996, immediately in front of the Pavilion. The Reservation has provided this new access facility so that the many individuals who have not been able to gain access to the beach now have that opportunity. The Town of Duxbury, with the help of funds from the Duxbury Commission on Disabilities and the Reservation, built a new handicap-accessible walkway for the Duxbury Residents' Parking Lot at the east end of the Powder Point Bridge. Both walkways conform to American with Disabilities Act (ADA) standards. The walkway at the Residents' Parking Lot is wide enough for two wheelchairs to pass. In addition to providing access for the physically challenged, both ramps also serve as scenic view platforms and are well used for that purpose.

Parts or all of these structures are removed and replaced seasonally to prevent storm damage to the structures.

7

Public Education and Outreach

Duxbury Beach has several public education and outreach programs that are available to the general public, school children, and all guests of the beach. The Town and the Reservation work hard to educate all beach guests on the value of Duxbury Beach's natural resources. It is felt that if the public understands the processes by which the barrier beach provides a storm buffer protecting Duxbury Bay and the mainland, and understands its importance as a habitat for a multitude of coastal fauna and flora, including threatened and endangered bird species, then they will become active participants in its protection.

7.1 Duxbury Beach Reservation, Inc.

The Reservation seeks to keep the general public informed about the beach by means of periodic articles in local papers, and members of the Reservation are available to speak to groups when requested. The Reservation has set up and staffed exhibits at beach walkathons and environmental fairs to explain, by means of maps, documents, and informational posters, the biology of the beach, geological change, management techniques, the dune restoration projects, and the replicated habitat experiments. Other groups, such as Mass Audubon and the Massachusetts Beach Buggy Association, have been invited to participate in educational programs at the walkathons.

Some of the most effective education takes place informally when volunteers come to work on the beach, helping to put up snow fence and planting beach grass and participating in beach clean-ups. The paid crew and experienced volunteers teach the newcomers; after a few hours the newcomers are teaching the next group of newcomers. Working on the beach and learning its processes gives people a vested interest in ³their² grass, and they become strong advocates for beach preservation.

Each year the Reservation grants a sum of money, currently \$3,250, to Mass Audubon for a summer education program at Duxbury Beach, as detailed in the separate section below.

7.2 Duxbury Beach Preservation Society

The Duxbury Beach Preservation Society is a subcommittee of Duxbury Beach Reservation that evolved from the Save the Beach group, a group of concerned people who were instrumental in helping to raise money to help defray the cost of coastal storm repair work at Duxbury Beach following the 1991 storm. The Society has developed an education program, which includes a newsletter and other public information presentations. Meetings, held on the first Wednesday of each month, are open to all and include updates on the beach and occasional speakers. The Society sponsors activities to raise funds that go toward the preservation and protection of Duxbury Beach.

7.3 Harbormaster/Coastal Natural Resources Department

The Harbormaster/Coastal Natural Resources Department oversees daily operations on Duxbury beach and enforces the regulations pertaining to its use. Believing that beach guests will respect the resource if they understand the reasons behind the rules, the Department provides a multi-dimensional program of education.

7.3.1 Public Information Notification Program

Brochures

Each year the Department produces a brochure of Duxbury Beach rules and regulations (Appendix E). The brochure is given out with every vehicle permit. Copies are also available at the Harbormaster/Coastal Natural Resources Department office, the Town Hall, the Bluefish River Fire Station office of the Endangered Species Officer, and on the Department's website. In addition, brochures are handed out to beach guests coming onto the beach at the east end of the Powder Point Bridge. On an average weekend day, approximately 500 brochures are issued.

Signs

Informational signs are posted at the crossovers and throughout the beach region. When nests are present, signs explaining endangered species protection are placed in the area.

Department Website - www.duxburyharbormaster.org

The Harbormaster/Coastal Natural Resources Department maintains a web page containing comprehensive information about the beach.

Members of the Harbormaster/Coastal Natural Resources Department give informational talks to various groups visiting the beach including students of Duxbury elementary and junior high school, private school students, and participants in the Audubon summer education program.

7.3.3 Public Speaking

Members of the Department welcome the opportunity to speak to groups. They have made presentations for Rotary, Kiwanis, church, and senior citizen groups.

7.3.4 Media

Announcements and interviews have appeared in newspapers and been aired on radio and television. The Department tries to get information out to beach guests through every means possible.

7.4 Town of Duxbury Schools

7.4.1 Elementary School

Duxbury students use the natural resources of Duxbury Beach in a diverse curriculum that is aligned with the standards recommended by the Massachusetts Frameworks. As the scope and sequence changes to meet higher expectations, teachers and students work to address the key understandings and essential questions in Earth/Space, Life, and Physical Sciences.

Kindergarten - Students visit Duxbury Beach in the late spring to understand about living things and their environment. The students use observation, exploration, and discussion skills as they learn more about habitats and the relationships between those habitats.

Grade Two - Following their Duxbury Tour (part of the Social Studies Curriculum), students visit Duxbury Beach. There they learn about the importance of the bay and shoreline factors in Duxbury's economic development.

Grade Six - Students expand their knowledge with an in depth study of life in the ocean and ocean zones. With research and observation, they learn more about the impact of pollution on ecosystems and the use of field identification strategies to learn more about habitats. Grade six combines beach study in Duxbury and Brant Rock.

K-6 Science Fair - All elementary students draw upon the local resources of Duxbury Beach to enhance their opportunities for research study for the annual Science Fair. Students are able to draw on topics that touch on all categories: Experimental, Illustrative, and Inventions. Battelle Labs, which originally sponsored the Science Fair, continues to provide support by assisting in the judging of over 150 projects per year.

7.4.2 Junior/Senior High School

7th Grade - Life Science Program

The 7th Grade Life Science Program at the Duxbury Junior/Senior High School studies Duxbury's ecosystems in the spring term each year. A major part of this study is the final unit of study specifically focusing on the ecology of Duxbury Beach. After three weeks of preparation, students have a full day of field study on Duxbury Beach, followed by a week of follow-up lab work in the classroom. Prior to the field study, students learn about the formation of Duxbury Beach, the erosive forces upon the beach, beach flora and fauna, and relative environmental factors that have the greatest impact potential upon the preservation of Duxbury Beach.

The full day's field study involves making a comparative study of the Duxbury Ocean and Duxbury Bay microsystems. Data is collected onsite to make these comparisons. The Back River channel contour is surveyed yearly along Powder Point Bridge and data are

compared to the previous year's data. Dune and bay transect surveying is done onsite to obtain flora and fauna populations. Relative turbidity, temperature, geology, and salinity are compared from bay to ocean. Plankton samples from both sides of the beach are collected, surveyed, and compared through microscopic observation in the high school laboratory.

The ultimate goal of the unit is to provide an appreciation of Duxbury's great natural asset of Duxbury Beach. This is done through the direct interaction of the students with this environment. While at the beach, students meet the Harbormaster/Coastal Natural Resources Officers and learn about some of the innovative programs to enhance shorebird habitat while preserving the beach. Each year, a minimum of 60 parents/siblings/relatives/friends act as chaperone/recording ecologists to assist each team of student participants. This gets the whole community involved.

For two of the past four years, students from the 7th grade have spent a portion of a day in the early spring planting beach grass. Students have learned firsthand about how to prevent beach erosion.

Art Department

Grades 9-12 use sand, shells, and objects gathered at the beach to create still life compositions in Painting and Drawing classes. Students in Photography and Creative Imaging classes sometimes choose the beach for their subject area.

Oceanography

Due to the time constraints of getting to and from the beach, students taking the Oceanography course use marine environment of the Bluefish River Basin as their "laboratory."

The High School Ecology Club is involved in recruiting students for beach grass planting.

7.5 Duxbury Before and After Dark

This community education program offers many programs of interest to Duxbury residents. The classes dealing with topics related to the beach include shellfishing, finfishing, shell collecting, and astronomy.

7.6 Brockton Summer Program for Special Needs Children

Every summer, two buses bring 60 children and 60 aides from Brockton to spend a morning on Duxbury Beach. With special cooperation from the Coastal Natural Resources Department and the help of a local science teacher, the children participate in an informational scavenger hunt on the bayside. These children, who rarely see a beach, much less walk in one, get a chance to feel the muck between their toes and have a great, positive, hands-on experience.

7.7 Mass Audubon's Education Program

Every Tuesday, Thursday, and Saturday in July and August, Mass Audubon provides two-hour educational programs for adults and children on Duxbury Beach. These programs, funded by the Duxbury Beach Reservation, describe the natural and cultural history of the area, with a special emphasis on conservation.

Over 400 people participate annually in the Duxbury Beach series, many of them local, some newcomers, some from as far away as Florida and Australia. Adults explore the bay, ocean, salt marsh, and Gurnet Point through a variety of topics including shellfishing, birds, coastal geology, and beach management. They listen to lively, informative speakers and investigate seashore life firsthand by catching minnows, writing poems in response to the landscape, measuring the salinity of the salt marsh, daring to taste kelp chips, and so forth. On Saturdays, families with younger children have an opportunity to meet horseshoe crabs, form a human sundial, paint with sand, catch razor clams, and make wave bottles. The Saturday morning beach walks attract as many as 40 or 50 people. They offer a great way for kids and adults to develop and exercise their curiosity together.

The goal of the program is to reach the people who use the beach and teach them an appreciation for this valuable resource. Whereas most people tend to use the ocean beach, talks and activities usually focus on the bay side in order to present the coastal environment and barrier beach ecosystem as a whole. Programs are purposely diverse to reach people on different levels. Future programs will expand on the subject of natural changes in the geology and biology of the beach. Many visitors express appreciation for the program and say they look forward to each year's offerings.

Example from the program for the 2002 SUMMER ON DUXBURY BEACH was as follows:

Coastal Waterbirds

Scott Hecker, Director of the Massachusetts Audubon Society's Coastal Waterbird Program provided the latest news on nesting least terns and piping plovers.

KID'S DAY, At Home in a Shell

What is a shell, how is it made, and who lives in it? Learn lots about shells by examining some from the sanctuary's collection, and participate in a seaside scavenger hunt and see how many you can find on the beach.

Beach Potpourri

We will discover how many different ecosystems exist at Duxbury Beach as we leisurely walk and explore the bay and the outer beach.

Under the Bridge

On the pilings of Powder Point Bridge is a rich community of encrusting organisms that can best be seen at low tide. We will walk out toward the center of the bay, exploring the wondrous bridge life along the way. Wear old shoes that can get wet and muddy!

KID'S DAY, Meet the Mudflat

At low tide, mudflats reveal signs of the creatures living below. Learn to recognize these clues and you'll locate some familiar and bizarre animals. Messy, but fun.

The Salt Marsh

High marsh, low marsh, channels, and panes we'll explore the nooks and crannies of Duxbury's marsh with Robert Buchsbaum, Massachusetts Audubon Society's coastal ecologist.

More Pilgrim History on the Beach

Susanna Winslow (Regina Porter, curator of Historic Winslow House) will begin where she left off in 1634 relating what life was like in Plimoth Colony as she raised her children on the Careswell property in Marshfield and her Duxbury neighbors.

KID'S DAY, Seaweed Soup

Collect water from the bay, snails, sand, and smelly stuff from the beach and of course lots of seaweed, stir with a seagull feather, and what do you get? Famous Seaweed Soup! Join us to mix up a batch you'll even get a recipe!

Geology and History of the Beach

Coastal Geologist Jim O'Connell, Al Patriot of the Duxbury Beach Reservation, Inc., and Conservation Administrator Joe Grady will discuss the history of the formation of the beach including the results of recent geological studies.

Folklore of the Sea

From seashells to sailors, the ocean has been a part of written and oral folklore for centuries. Learn about sea-related superstitions and stories from storyteller Richalee Wiggs.

Family Storytelling Night

Join storyteller/naturalist Richalee Wiggs after the sun goes down to enjoy tales of the ocean. Bring something to sit on, a flashlight, and a story to share!

KID'S DAY, Clamdiggers

Learn which shellfish live in Duxbury Bay and how to find them. The program will conclude with a modest clambake on the beach.

Horseshoe Crabs

These living fossils have wonderful secret to share, including the fact that they are not really crabs! Learn about their life cycle, their important role in the Web of Life, and their usefulness to humans.

Shells, Sand and Security

Harbormaster Don Beers and Endangered Species Officer will describe the challenge of balancing Duxbury Bay's resources and users.

KIDS DAY-Sand Galore

A hike to the first crossover and back with a focus on sand- sand dunes, plants that grow in sand, sand crafts, and the sandy beach on the ocean side.

Irish Mossing and Beyond

John Galluzzo, Executive Director of the Scituate Historical Society, will share with us the fascinating 150-year old history of the Irish Mossing industry. Learn how this red algae is processed for use in many of the products we enjoy. John will also bring information from his recent excursion to Prince Edward Islands and talk about the newest exhibit at the Maritime and Irish Mossing Museum *Six Bells, Seven Masts: The Story of the Thomas W. Lawson*.

The Deep

Join Dr. David Gallo, Director of Special Projects at Woods Hole Oceanographic Institution, as he takes us on an arm-chair journey beyond the beach. He will recount many of his adventures over the horizon and into the deepest ocean.

KIDS DAY-Gifts From the Sea

Investigate the wrack line for plants and animals washed up by the sea; then make a craft using some of these objects.

Tidal Flats

Much more than mud! Come learn about the inhabitants and ecology of tidal flats. We'll explore the flats firsthand, so bring old shoes, please.

Beach Plants and Seaside Gardening

Learn how plants have adapted to harsh beach conditions; then let Duxbury resident Peggy Connors guide you through the basics of gardening near the shore. A final treat will be a visit to Peggy's nearby home garden.

Maritime Music

Join maritime musician/storyteller Will Whitely for an enchanting evening of lively tunes and tales about life at sea! Free CD's will be available.

KID'S DAY: Birdy! Birdy!

We'll use a spotting scope and binoculars, face the perils of migration (through a game) and create a bird craft.

History of the Gurnet

Gurnet resident Elaine Nudd will share local history and we'll visit the famous Gurnet Light. Transportation for this trip is limited, so please arrive early.

Shorebirds

Join South Shore Sanctuaries¹ Director, David Clapp, on an excursion along Duxbury Beach in search of migrating shorebirds. Seating is limited; binoculars are necessary for this adult program.

KIDS DAY: Crusty Crustaceans

From barnacles and amphipods to lobsters and crabs, crustaceans are very interesting creatures! We'll learn what makes them so special, and then search for examples along the shoreline.

Seaside Photography

Bring a camera (any camera!) and meet photographer Al Solomon of Kingston Photo Center.

Beachcombing

End the summer with a leisurely stroll along the beach, first on the bay side and then across to the outer shore. We will observe the many changes that have occurred as the beach prepares itself for winter.

KIDS DAY-Web of Life

It's a who-eats-who world! Join us as we explore (through games and activities) the many food chains that connect all life in, on, or near the ocean!

7.8 Mass. Beach Buggy Association

The active participation by the Massachusetts Beach Buggy Association (MBBA) on Duxbury Beach enhances the general knowledge of the beach users by supplying guidelines for proper beach travel, safety equipment, and beach etiquette. In 2002, the MBBA began offering a driving course to teach people the proper way to drive on the beach. The course includes instruction on the necessary equipment and tips to prevent getting stuck. The organization also supplies assistance to beach patrol and management personnel, as needed, with respect to the endangered species program. MBBA also sponsors a beach cleanup event in early spring. Typically 45-60 volunteers help to ready the beach for the peak season.

APPENDIX A

Map of Duxbury Beach