Coastal DUNES

DUNE PROTECTION AND IMPROVEMENT MANUAL FOR THE TEXAS GULF COAST - *6th EDITION*

TXGLO

VERNON'S TEXAS STATUTES AND CODES ANNOTATED
NATURAL RESOURCES CODE
TITLE 2. PUBLIC DOMAIN
SUBTITLE E. BEACHES AND DUNES
CHAPTER 63. DUNES

SUBCHAPTER A. GENERAL PROVISIONS

SEC. 63.001. FINDINGS OF FACT

The legislature finds and declares:

(1) that the mainland gulf shoreline, barrier islands, and peninsulas of this state contain a significant portion of the state's human, natural, and recreational resources;

(2) that these areas are and historically have been wholly or in part protected from the action of the water of the Gulf of Mexico and storms on the Gulf by a system of vegetated and unvegetated sand dunes that provide a protective barrier for adjacent land and inland water and land against the action of sand, wind, and water;

(3) that certain persons have from time to time modified or destroyed the effectiveness of the protective barriers and caused environmental damage in the process of developing the shoreline for various purposes;

(4) that the operation of recreational vehicles and other activities over these dunes have destroyed the natural vegetation on them;

(5) that these practices constitute serious threats to the safety of adjacent properties, to public highways, to the taxable basis of adjacent property and constitute a real danger to natural resources and to the health, safety, and welfare of persons living, visiting, or sojourning in the area;

(6) that it is necessary to protect these dunes as provided in this chapter because stabilized, vegetated dunes offer the best natural defense against storms and are areas of significant biological diversity;

(7) that vegetated stabilized dunes help preserve state-owned beaches and shores by protecting against erosion of the shoreline; and

(8) that different areas of the coast are characterized by dunes of various types and values, all of which should be afforded protection.

Acts 1977, 65th Leg., p. 2499, ch. 871, art. I, Sec. 1, eff. Sept. 1, 1977.
Amended by Acts 1985, 69th Leg., ch. 814, Sec. 1, eff. Aug. 26, 1985; Acts 1991, 72nd Leg., ch. 295, Sec. 18, eff. June 7, 1991.

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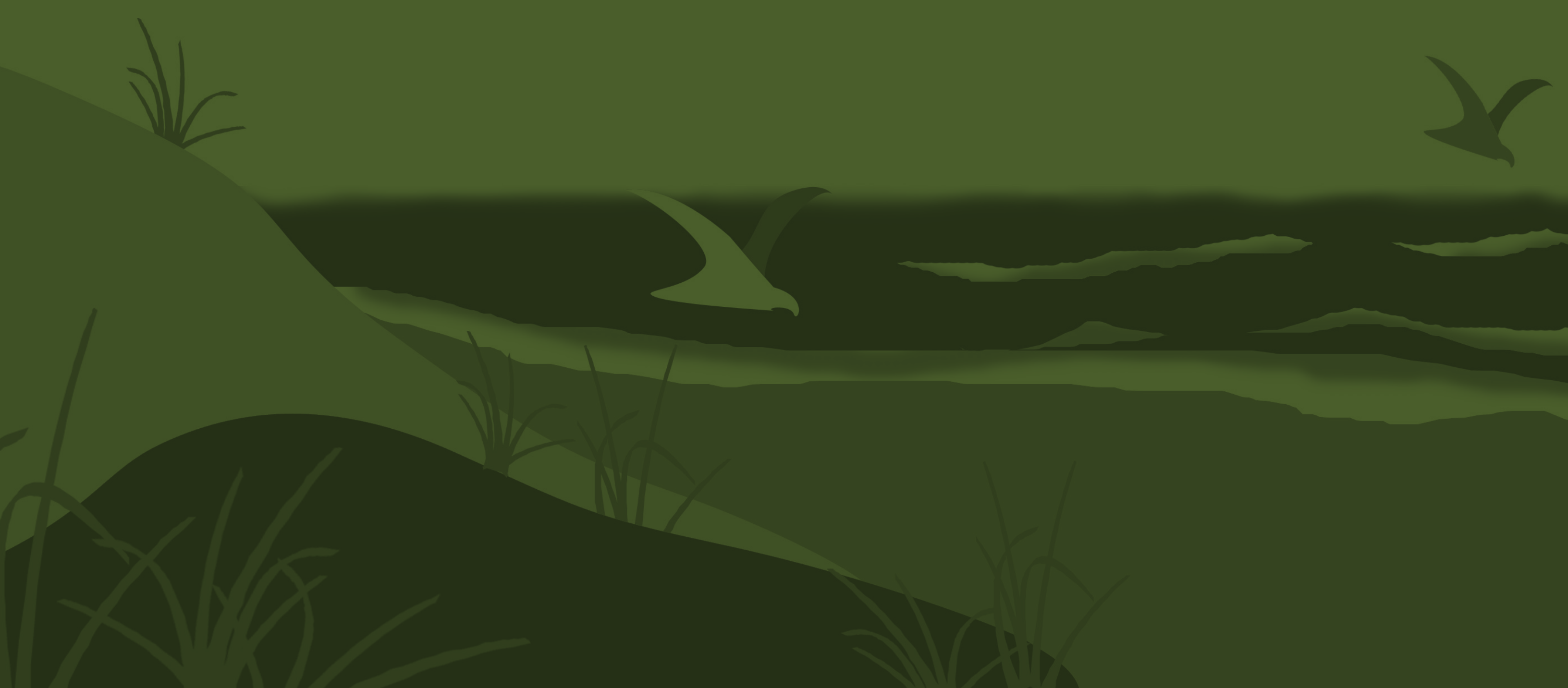
FOREWARD

The Texas Coast is an environmental and economic treasure composed of interlocking, interdependent ecological systems. Coastal sand dunes are a crucial part of that system. Dunes serve not only as a vital habitat for numerous native plants and animals, but an irreplaceable recreational resource upon which humans must tread lightly.

But the coast is changing. With every passing hurricane or tropical storm our coastline is physically altered through erosion and accretion. New mapping systems and new technologies help us predict and mitigate the effect of these changes. As we consider these changes, we must also take into account the effect of human development along the coast. That is why this booklet is so important.

Through helpful definitions, concise standards and photographic examples, this book aims to raise awareness of the fragile beach/dune system and provide concise guidelines for dune protection and improvement along the Texas Gulf Coast. Now in its sixth edition, this publication continues to be updated to reflect the needs of the ever-changing Texas Coast. The Texas Coast belongs to you. Consider this your Owner's Manual. Use it well.



INTRODUCTION

As a resilient natural barrier to the destructive forces of wind and waves, sand dunes are the least expensive and most efficient defense against storm-surge flooding and beach erosion. Dunes absorb the impact of storm surge and high waves, preventing or delaying intrusion of waters into inland areas. Dunes hold sand that replaces eroded beaches after storms and buffer windblown sand and salt spray. This natural defense can be strengthened by increasing the height and stability of existing dunes and by building new dunes.

Beach and dune protection is important along the Texas Gulf Coast, particularly in areas experiencing shoreline erosion and concentrated urban development.

The growth of mainland coastal population centers and the increasing development and recreational use of the barrier islands can impact the stability of the dune environment. Construction and heavy recreational use of the beaches can contribute to fragmentation of the beach/dune system and deterioration of dunes. The vegetation that secures sand is destroyed, sand is lost, and the dune line is breached by roads, trails, and storm runoff. Dune damage that results from human activities accelerates the damage caused by wind and wave erosion.

Inland areas become more vulnerable to hurricanes and tropical storms when the dune line is weakened. Protecting dunes helps prevent loss of life and property during storms and safeguards the sand supply that slows shoreline erosion. Protecting dunes also preserves and enhances the beauty of the coast and coastal ecosystems.

To succeed, dune improvement and protection efforts must be undertaken by federal, state, and local governmental entities. But even more valuable are efforts by those who live on the coast.

The Texas Coast will continue to attract Texans and other visitors in ever-greater numbers for years to come. This manual describes measures that landowners, city and county planners, developers, and industry can use to preserve sand dunes and promote dune restoration on the coast so that future generations can enjoy the natural beauty of the Texas Coast.

BEACHES & DUNES

TERMINOLOGY

The **beach** extends from the mean low tide line to the line of natural vegetation along the shoreline (Figure 1).

The **foreshore** (wet beach) is the area affected by normal daily tides.

The **backshore** (dry beach) is inundated only by storm tides and the higher spring tides. The backshore also supplies sand to the dunes.

Coppice mounds, the initial stages of dune growth, are formed as sand accumulates on the downwind side of plants and other obstructions on or immediately adjacent to the beach. The mounds are a source of sand that is exchanged via water with offshore bars. Coppice mounds may become vegetated and eventually increase in height, becoming foredunes.

Foredunes (also called fore-island dunes or primary frontal dunes) are the first clearly distinguishable, vegetated dune formations landward of the water. They are also the first to dissipate storm-generated wave and current energy. Although foredunes may be large and continuous, they typically are separate rounded knolls.

The **foredune ridge** is high, continuous, and well stabilized by vegetation. This ridge normally rises sharply landward from the foredune area but may rise directly from a flat, wave-cut beach immediately after a hurricane. The foredune ridge helps block storm surge and prevents it from washing inland.

Critical dune areas are all portions of the beach/dune system that contain dunes and dune complexes (including coppice mounds, foredunes, foredune ridge, backdunes, and swales) that are essential to the protection of public beaches, submerged land, and state owned land. Critical dune areas include, but are not limited to, the dunes that store sand to replenish eroding public beaches.

Backdunes–The dunes located landward of the foredune ridge which are usually well vegetated but may also be unvegetated and migratory. These dunes supply sediment to the beach after the foredunes and the foredune ridge have been destroyed by natural or human activities.

A **dune protection line** is established by a local government to preserve critical dunes and may be set no farther than 1,000 feet landward of mean high tide of the Gulf of Mexico. Special criteria apply to construction activities seaward of this line.

The **beach/dune system** includes all of the land from the line of mean low tide to the landward limit of dune formation.

A **public beach** is any beach, whether publicly or privately owned, extending inland from the line of mean low tide to the natural line of vegetation bordering on the Gulf of Mexico or such a larger contiguous area to which the public has acquired the right of use. This definition does not include a beach that is not accessible by a public road or public ferry.

Blowout is a breach in the dunes caused by wind erosion.

Washover areas are low areas that are adjacent to beaches and are inundated by waves and storm tides from the Gulf of Mexico. Washovers may be found in abandoned tidal channels or where foredunes are poorly developed or breached by storm tides and wind erosion.

Swales are low areas within a dune complex located in some portions of the Texas coast which function as natural rainwater collection areas and are an integral part of the dune complex.

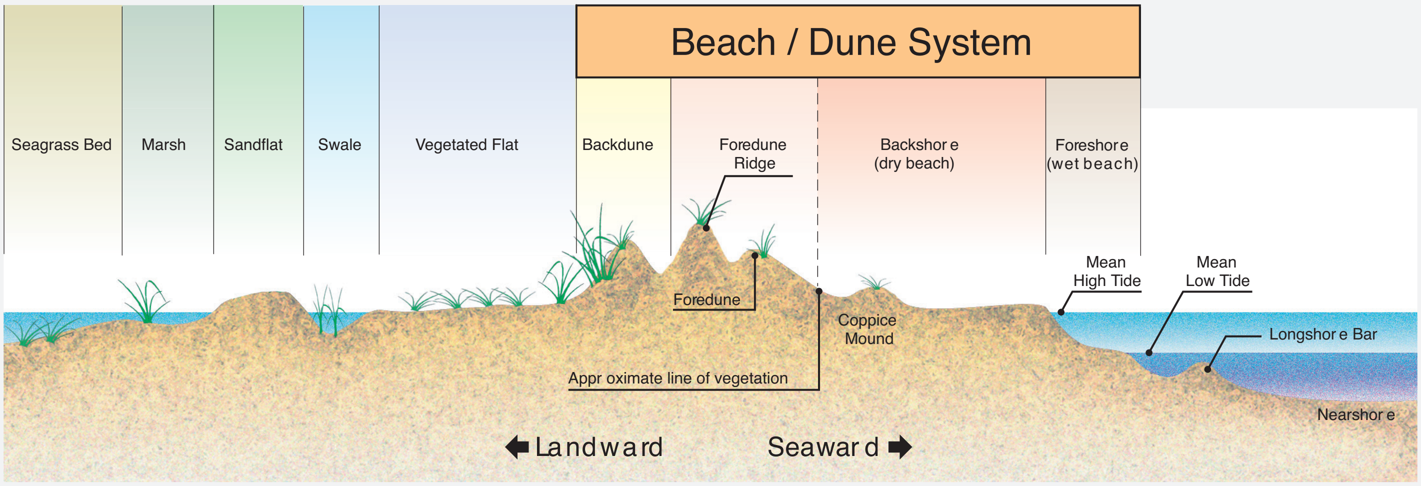


Figure 1. Typical cross section of a Texas barrier island. Actual conditions may vary.

THE SAND CYCLE

Beaches and dunes are integral parts of a dynamic environment in which sand is constantly exchanged.

During the calm conditions that prevail throughout most of the year on the Texas coast, waves average two to four feet in height and are less frequent than during storms. These calmer waves transport sand from offshore bars and the surf zone to the beach, causing the beach to gradually build up, or accrete. In time, sand is blown onto the foredune, where it is trapped by vegetation and stored until it is displaced by storms.

During a storm, high-energy waves flatten the beach. Waves washing against the base of the foredunes erode sand, undermining and collapsing the seaward dune face. In severe storms, the dune face commonly recedes several yards — in extreme cases as much as 100 yards — leaving a steep cliff (Figure 2). Sometimes dunes are completely destroyed. Retreating waves carry the eroded sand offshore and deposit it just seaward of the surf zone in large bars.

This process of dune erosion and sand movement dissipates much of the energy of storm waves. Sandbars also dissipate storm wave energy by causing waves to break further offshore thereby diminishing wave runup and attack on the dunes or backshore environments.

If the supply of sand remains constant, the natural exchange between the beach, dunes, and offshore areas will repair and rebuild dunes to an equilibrium height and width determined by local conditions. However, the loss of vegetation that traps and holds sand makes the beach and dunes more susceptible to wind and water erosion, thus inhibiting their recovery from storms. Bays, channels, marshes, and grass flats behind the weakened foredune are exposed to storm-surge flooding and to accumulating of windblown sand.

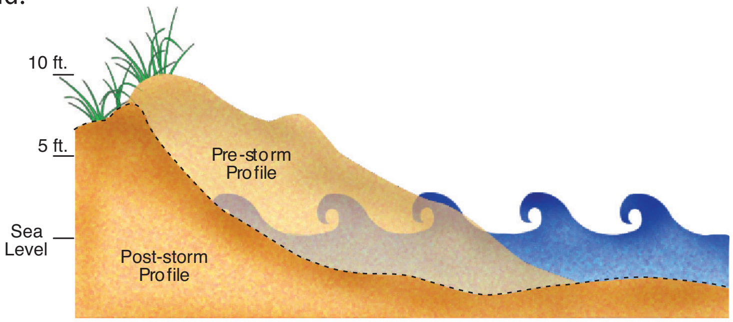


Figure 2. Result of storm waves on beaches and foredunes.

DUNE DAMAGE

When the height of approaching storm waves exceeds the height of depressions along the dune ridge, water overflows the low points and washes down the landward side of the dunes, eroding sand and carrying it inland **(Figures 3 and 4)**. These washover (or overwash) areas deepen and widen under continual wave attack, allowing larger volumes of water to spill across the dune line and flow farther inland. Eroded sand may be deposited behind the dunes or carried into the bay, channel, marsh, or grass flat. In very severe storms, washover waters may even inundate interior land areas.

Areas of frequent major washovers may regenerate dunes slowly because of the volume of sand removed through erosion and because vegetation has been scoured away. Dune development may be impeded if the sand in a washover is too wet to be blown by the wind. Evidence of hurricane washovers is apparent on many Texas barrier islands (**Figure 4)**.

Storms may also produce washouts in dune areas. These are similar to washovers, differing primarily in the direction of eroding waters. Generally, storm runoff from barrier islands and peninsulas is directed toward the bays. If there are breaches or depressions in the dunes, however, rainwater that collects in the swales (valleys between the dunes) may be channeled through these low points and overflow onto the beach, carrying sand with it.

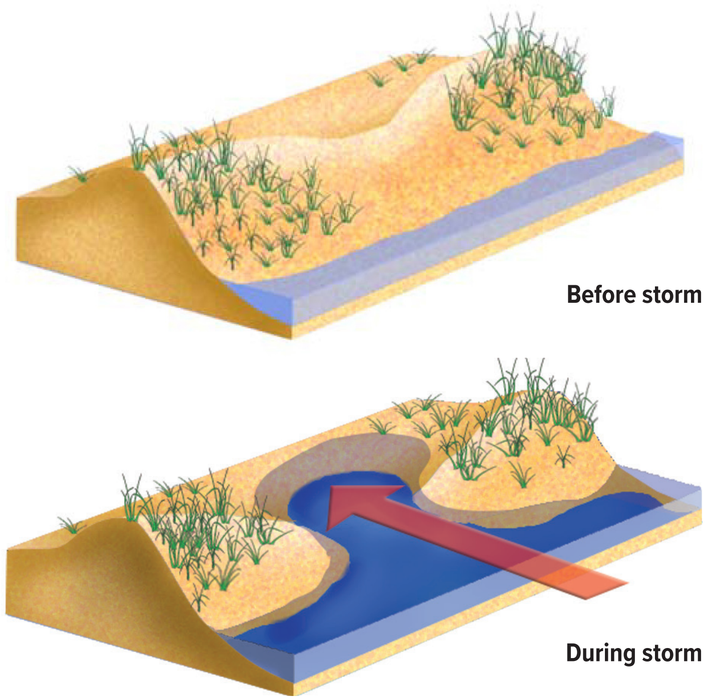


Figure 3. Washover from storm surge.

Figure 4. Oblique aerial photo of washover channels on Padre Island following Hurricane Brett in August 1999. Photo courtesy of David M. Stephens.

Washouts may also be formed by retreating bay waters. Hurricanes, particularly slow-moving ones, may pile water into bay systems. If natural channels to the Gulf are too narrow to accommodate water retreating from the bays, washouts may cut across the low areas of least resistance in the barrier islands.

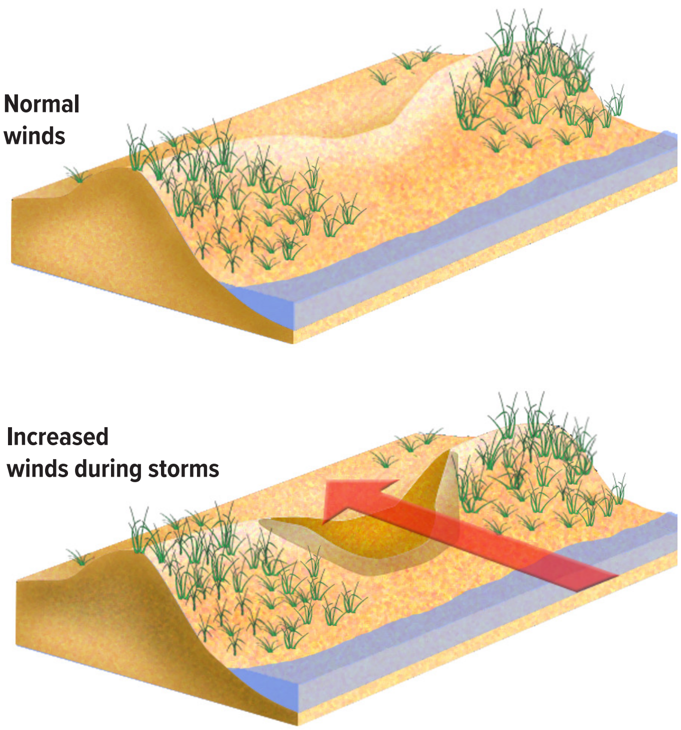


Figure 5. Formation of a blowout by wind in areas of a dune with little vegetative cover.

Blowouts are breaches in the dunes caused by wind erosion. They are aligned with prevailing southeasterly winds and are often cut down to the water table **(Figure 5)**. During storms, blowouts may become channels for storm-surge waters from the Gulf.

Eventually, following a storm, the natural beach/dune system can recover its pre-storm shape if enough sediment is available in the littoral system. In Texas, this process can take up to five years, first by beach accretion, then by dune formation, expansion, and vegetation colonization. Sometimes this process is interrupted by structures, such as buildings, that prevent winds from blowing sand necessary for dunes to form.

Human activities also take a toll on dunes. Construction, recreation, and grazing animals may accelerate or aggravate natural damage to the dunes by destroying vegetative cover and promoting development of breaches.

Seawalls, bulkheads, and groins may protect property landward of them against erosion. However, if waves persist, these structures can enhance shoreline erosion of adjacent properties and of the beach seaward of the structures. By withholding sand that would otherwise be transported alongshore, erosion control structures such as groins inhibit dune development in areas downdrift of them. In general, rigid structures are less efficient than the naturally resilient dunes as defense for the beach against storm surge. The beach directly in front of a vertical seawall may be eroded by waves rebounding off the structure during storms. The seawall itself may eventually be undermined via wave scouring at the toe of the wall, creating an unstable base for the structure.

Disturbance of the foredunes by vehicles, pedestrians, construction work, or grazing animals can promote wind erosion of the backdune environment as well. If unchecked, this erosion can lead to almost complete removal of dunes, depleting the supply of sand available for exchange during storms. Sometimes entire dunes are bulldozed to level a construction site or to lay pipelines. In these cases, damage is not limited to the immediate site, as adjacent dunes will also be exposed to increased wind erosion without the previous protection of the neighboring dunes.

Devegetation of dunes can ultimately be as damaging as direct removal or withholding of sand. Vegetation is often removed from a large area when a construction site is cleared. Plants are trampled and uprooted by pedestrian traffic, motor vehicles, horses, and grazing cattle **(Figure 6)**. As trails are established along frequently used routes through the dunes, the vegetation is destroyed and the wind begins to carry sand from the exposed area.

The continual loss of sand deepens the trail. Sloughing away of sand from the trail's sides widens it. As a greater area is exposed to wind erosion, a blowout, washout, or washover may develop.

Beach access roads through the dunes are subject to the same erosive processes and may become channels for storm surge.

Figure 6. Human influence on dune stability; access through critical dune areas on Mustang Island.

Texas Coastal Dunes

The Texas coastline is composed of barrier islands, ancient deltaic headlands and peninsulas, bays and estuaries, and natural and man-made passes **(Figure 7)**. These are mobile environments, constantly reshaped by the processes of erosion and accretion.

Figure 7. The Texas Coast.

Dune development varies with sediment supply to the beach. The supply is determined by the quantity of inner-shelf sand carried onshore by waves and wind, the amount and kind of sediment discharged by rivers, and the degree of human interference with natural sand transport (for example, the interruption of longshore currents by jetties and groins). Dunes are most likely to develop when there is an ample supply of sand brought onshore by waves and wind. Rainfall patterns also affect dune development by impacting dune vegetation growth and density. Dune vegetation is less likely to take hold in areas with less rainfall.

On the upper coast, in Jefferson and Chambers counties, beach and dune development is limited. The Sabine River carries silt rather than sand to the coast. The shoreline is characterized by low-lying marshes and tidal flats with intermittent thin, linear sand ridges (Chenier Plain). Dunes are also scarce along the Brazos-Colorado river headland—the southern portion of the Brazoria County shoreline. Here, too, little dune-building sand is available to the longshore current.

Few and smaller naturally occurring dunes can be found on Galveston Island and portions of Follets Island because many of the foredunes were wiped out during Hurricane Alicia in 1983 and subsequent storms such as Tropical Storm Francis in 1999, Hurricane Claudette in 2003 and Hurricane Ike in 2008. Shoreline development and high erosion rates have inhibited dune recovery **(Figure 8)**.

Vegetated and relatively stable dunes occur on Mustang Island and North Padre Island. On Matagorda and San Jose islands, where there is limited shorefront development, there is a continuous, well-defined foredune ridge averaging 15 to 20 feet above sea level. The most highly developed dune formations are found in Nueces and northern Kleberg counties, where there is a foredune ridge consisting of several rows of dunes that average 20 to 25 feet in height. Some dunes reach an elevation of 40 feet. Sandflats and areas of low coppice mounds are also characteristic of this region **(Figure 9)**.

As rainfall decreases southward along the Texas Coast, dunes have less of the vegetative cover necessary for stabilization. Migrating dunes—bare of vegetation and highly susceptible to wind erosion—are common in the arid environment of the lower coast **(Figure 10)**. Dunes of this type occur on Padre Island. In Kenedy, Willacy, and Cameron counties, the foredune ridge is generally poorly developed and breached by numerous washovers and blowouts. In the City of South Padre Island in Cameron County, dune restoration projects, included projects funded by GLO programs, have helped stabilize and restore the dune system.

Figure 8. Aerial imagery of natural dune formation adjacent to shorefront development on Galveston Island. Natural dunes exist where there is room for dunes to migrate.

Figure 9. Natural dune formations on Padre Island in Kleberg County.

Figure 10. Migrating dune at Padre Island National Seashore.

DUNE CONSTRUCTION, IMPROVEMENT, AND REPAIR

Several methods may be used to increase the height and stability of existing dunes, repair damaged dunes, encourage sand accumulation closer to the beach, or establish dunes where a low sand supply has inhibited dune formation or where dunes have been destroyed.

Where fresh sand deposits around obstructions such as grass clumps show conditions conducive to natural dune formation, plantings of native vegetation or structural barriers, such as sand fences, can be used to start and accelerate sand accumulation. Plantings of native vegetation should be the primary method for dune construction, improvement, and repair. Plant vegetation on natural grade of the dry backshore region and close to the existing line of vegetation. Sand fencing can help trap sand and stabilize dunes, but it should be used as a last resort and removed when vegetation is established.

In areas where the local sand supply is insufficient for these two sand-trapping methods to be effective, dunes can be artificially constructed with imported sand. Any sand brought to the site must be beach quality sand, the correct grain size for building dunes, and should be vegetated immediately in order to maintain stability.

Dune restoration projects must not extend more than 20 feet seaward of the line of vegetation in most cases or interfere with access to or use of the public beach easement, regardless of the type of dune restoration being undertaken. Any dune restoration projects occurring seaward of the line of vegetation must receive prior approval from the GLO.

Before any of the following procedures for dune construction or shoreline stabilization are employed, check with the local building official or the Texas General Land Office to avoid violation of state laws (see “Beach Access and Dune Protection Laws”).

USE OF VEGETATION

Only dune vegetation indigenous to the dune system in the area where the vegetation will be planted may be used in dune restoration projects. Three species of grass are recommended for dune restoration projects anywhere along the Texas coast: bitter panicum (Panicum amarum), sea oats (Uniola paniculata), and marshhay cordgrass (Spartina patens). **Table 1** lists additional species of dune vegetation that may be used for dune restoration projects, such as beach morning glory, and outlines the location in the beach dune system where each species should be planted.

TABLE 1

Vegetative Species for Coastal Dune Restoration in Texas

Species	Recommended Site	Comments
Marshhay cordgrass *Spartina patens*	**Frontal and back dune**	**Recommended plant spacing:** 1-3 foot center **Variety recommended:** 'Gulf Coast', 'Sharp'
Bitter panicum *Panicum amarum*	**Mid to upper areas of frontal and back dune**	**Recommended plant spacing:** 2-3 foot center Plant in high percentage with sea oats due to soil binding abilities. Recommended planting percentage: 20% sea oats, 80% bitter panicum. **Variety recommended:** Fourchon Germplasm, 'Northpa', 'Southpa'
Sea oats *Uniola paniculata*	**Mid to upper areas of frontal and back dune**	**Recommended plant spacing:** 2-3 foot center Plant in high percentage with bitter panicum due to soil binding abilities. Recommended planting percentage: 20% sea oats, 80% bitter panicum. **Variety recommended:** Caminada Germplasm
Beach morning glory *Ipomea pes-caprae;* *Impoea imperati*	**Lower area of frontal dune**	**Recommended plant spacing:** 2-3 foot center
Sea purslane *Sesuvium portulacastrum*	**Lower area of frontal dune and back dune**	**Recommended plant spacing:** 2-3 foot center
Seashore dropseed *Sporobolus virginicus*	**Mid to upper areas of frontal and back dune**	**Recommended plant spacing:** 1-3 foot center
Seashore Paspalum *Paspalum vaginatum*	**Back dunes**	**Recommended plant spacing:** 1-3 foot centers; generally Port Lavaca northward **Variety recommended:** Brazoria Germplasm

Dune plants are not always available commercially in Texas and may be transplanted from natural stands if the proper procedure is followed. Transplants from the vicinity of the project area are more likely to survive than imported ones. If suitable stands cannot be found on the property where the vegetation project will be undertaken, it may be possible to obtain plants from neighboring property by agreement with property owners or from a commercial vendor within the region. A permit from the county commissioners court or from a city may be required if the harvesting or planting site is seaward of a dune protection line (see "Beach Access and Dune Protection Laws").

The best time of year to transplant vegetation south of Corpus Christi is January or February. The optimum time for transplanting north of Corpus Christi is February, March, or April. Plants to be transplanted should only be taken from dense stands in areas that are not subject to erosion and should not be taken from coppice mounds or from foredunes that are sparsely vegetated. Be careful not to trample plants. Remove individual plants in a scattered pattern at intervals of no less than two feet. Dig them out with a "sharpshooter" shovel. Pulling plants damages the small hair roots needed for re-establishment. Obtain a good root structure to ensure plant survival.

Project sites are best vegetated by hand to avoid impacting surrounding dunes and dune vegetation. Set single plants into individual holes at least 6 inches deep made with a shovel or dibble and pack each planting firmly. Each species should be planted at certain locations within the dune system based on species adaptation to the surrounding environment **(Table 1)**. There are multiple different plant configurations that can be used on a restored dune; an example is shown in **Figure 11**. Generally, grass species, such as bitter panicum, sea oats and marshhay cordgrass, should be planted at higher

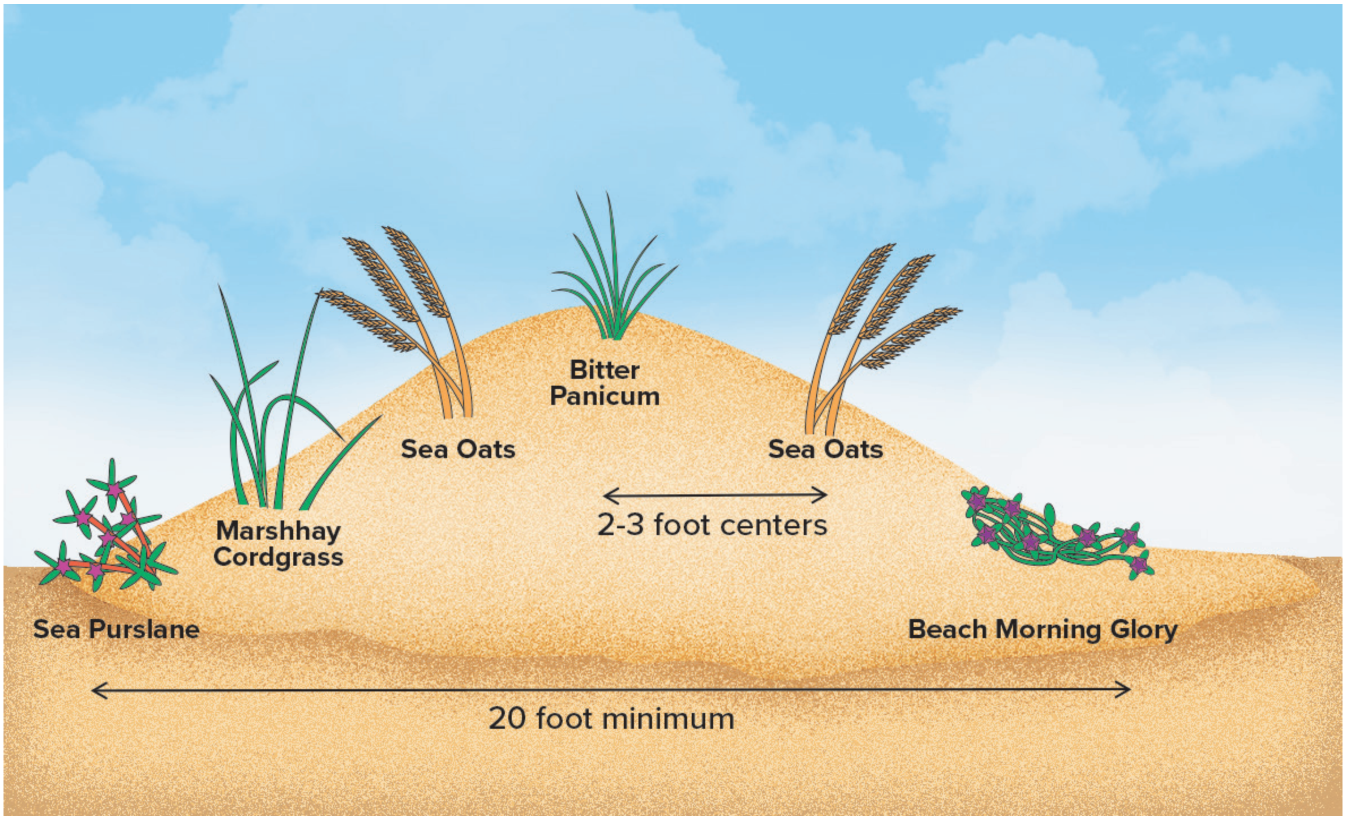


Figure 11. An example of a plant configuration on a restored dune.

Figure 12. Recently planted dune vegetation.

elevations on the dune crest and non-grass species, such as beach morning glory and sea purslane, should be planted on lower parts of the dune to provide groundcover for erosion reduction. One thousand plants should stabilize a 50- by 40-foot area within a year **(Figure 12)**.

Immediate watering of transplants is not imperative, but success is increased if planting is done after a rain or if the dune is watered before the planting. Continual watering of the newly planted vegetation, especially during drought conditions, is encouraged to help increase the likelihood of survival. Dune grasses should never be mowed as this destroys their ability to trap sand and may kill the plants.

Stabilizing materials may be applied either before or after planting to minimize wind erosion, moderate soil temperature, and help retain moisture. Hay, seaweed and mesh made of natural fiber may be used for this purpose. Hay is an economical stabilizing material when used properly but may contain nonindigenous seeds or vegetation and can easily become dispersed from wave and wind action. If hay is used, it must be locally sourced and packed into the sand to prevent it from blowing away.

In areas where high winds are common, mesh made of natural fiber anchored with wooden stakes is recommended instead of hay. All of these materials are biodegradable and will eventually break down over time. Stabilizing materials that contain seeds of nonindigenous dune vegetation may not be used.

Fertilization may be used during the planting if it is allowed by the local government's beach access and dune protection plan. An approved soil testing laboratory can provide fertilizer recommendations for a particular location. In general, a small amount of fertilizer may be placed in the hole where each plant is placed and subsequently buried by sand..

Figure 13. Sign for dune restoration project.

Planted areas may be protected from vehicles, pedestrians, and grazing animals with temporary fencing. Signs may also be placed at the site to explain the purpose and importance of the project **(Figure 13)**. The placement of any fencing in the area seaward of the dune protection line must first be approved and permitted by the local government.

A transplant survival rate of 50 to 80 percent can be expected. If the survival rate is less than 10 percent, the area should be replanted. The vegetation should be fairly dense within one or two years. Any bare areas that remain after that time can be replanted with vegetation from the well-established sites.

Figure 14. Bitter panicum (Panicum amarum).

Bitter Panicum

Bitter panicum has proved to be the best species for dune stabilization on the Texas coast. This native beach plant has a higher salt tolerance than many other coastal species and is a hardy grower. Its leaves are smooth, bluish-green, 1/4 to 1/2 inch wide, and four to 12 inches long **(Figure 14)**. New plants are generated from tillers, or culms shoots that grow from nodes on the roots, or rooted stem cuttings. The seeds of bitter panicum are sterile and will not propagate new plants.

Bitter panicum plants taken for vegetation projects should be two to three feet tall. Cut off the tops of harvested plants about one foot from the roots to reduce water loss **(Figure 15)**. The plants can be stored for up to four weeks if the roots are wrapped in wet cloth or paper towels or immersed in fresh water.

Bitter panicum can be established in the fall with rooted cuttings, in the late winter or early spring with potted plants, or in the late spring and early summer with young tillers or culm shoots. Survival will be mainly dependent on adequate moisture. The plants can be placed in the ground either upright or horizontally. In areas of rapidly shifting sand, upright planting will prevent the plants from being buried. Generally, the plants should be planted on two-foot centers, but closer placement is recommended on the tops of dunes and on steep slopes. Nursery-grown plants should be planted 8 to 10 inches deep in moist sand, but unrooted stems should only be planted 4 to 6 inches deep, leaving 6 to 10 inches of the stem exposed. The transplant site must be protected from grazing animals, as bitter panicum is palatable to them.

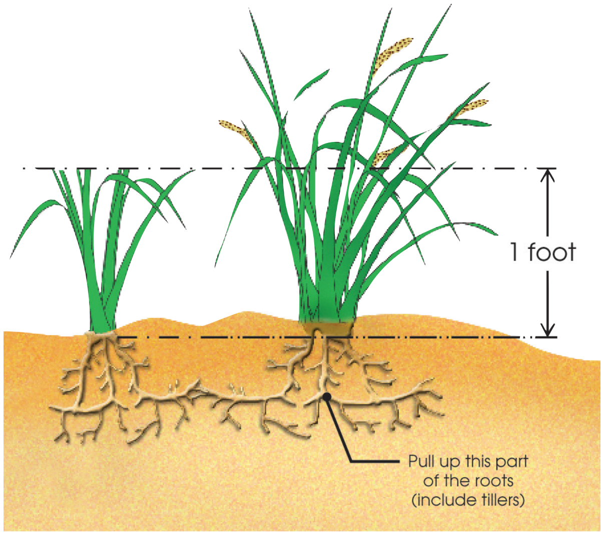


Figure 15. Harvesting and cutting bitter panicum.

Sea Oats

Sea oats, also native to the Texas coast, may be interspersed among plantings of bitter panicum. This grass has pale green, hardy leaves that die back each winter and stiff, seed- topped stems that grow to three feet or more in length **(Figure 16)**. Sea oats are less tolerant of salt spray than bitter panicum but grow rapidly enough to avoid being smothered in rapidly shifting sand. Sea oats have an extensive underground root system, which help stabilize the sand. Interplanting sea oats and bitter panicum will reduce the risk of disease or pest infestation.

Harvest only healthy, vigorous plants for transplanting. The younger sea oats have a greater success rate than the older, longer-rooted plants. Do not take a plant that has a seed head , since this plant is

Figure 16. Sea oats (Uniola paniculata).

likely older. Transplant the plants as soon as possible after they have been harvested. The plants will generally remain alive for up to four days if the roots are wrapped in wet cloth or paper towels or immersed in fresh water. As with bitter panicum, the tops of the plants should be cut to within one foot of the roots to reduce water loss.

Nursery-grown plant materials can be planted year-round, but the best time for planting is mid-winter to early spring. Bareroot propagules should be planted November through March. Place plants at least eight to 10 inches deep on 18-inch centers in the main area of the dune.

It is best to mix a sea oat planting with bitter panicum at a ratio of one to four. Sea oats usually take two growing seasons to fully stabilize a dune, while bitter panicum, which grows more rapidly, can become established in one year.

Figure 17. Marshhay cordgrass (Spartina patens).

Photo courtesy of Frederique Perret.

Marshhay Cordgrass

Marshhay cordgrass is a small, wiry perennial which spreads by rhizomes (**Figure 17**). This grass does well on the landward side of dunes. If planted on the beach side, the grass is easily buried and destroyed by shifting sands. The most appropriate use for marshhay cordgrass is to repair the more stable portions of existing and new dunes.

Late winter through early spring is the best time to plant marshhay cordgrass. Place the plants six to 10 inches deep and 12 to 36 inches apart to keep the base of each plant moist. Mixing marshhay cordgrass with plantings of bitter panicum produces best results.

Other Plants

Sea oats and bitter panicum, which commonly grow on the seaward face of foredunes, are highly erosion-resistant and easily established. However, other species of herbaceous plants also capture windblown sand and stabilize dunes.

Beach morning glory, sea purslane and seagrape vines can form a dense cover on the lower parts of a dune within a few growing seasons, providing groundcover for erosion reduction. Low-growing plants and shrubs found on the backside of the dunes include seacoast bluestem, cucumber leaf sunflower, rose ring gallardia, partridge pea, prickly pear, and lantana. Many of these are flowering plants, an attractive alternative to dune grasses though less effective as dune stabilizers.

Some of these species are available commercially in Texas. Contact the Texas General Land Office, the Kika de la Garza Texas Plant Materials Center, or the Lady Bird Johnson National Wildflower Center if you have questions regarding the use of a specific plant species for a dune restoration project (see “Where to Get Help”).

USE OF SAND FENCES

Sand fencing may only be installed for the purpose of building sand dunes by trapping wind-blown sand and the protection of dunes and dune vegetation. The planting of native vegetation to trap sand is always preferable to the use of man-made structures, but temporary, discontinuous sand fences may be used as a dune restoration material when site conditions are appropriate. Sand fences are most effective as a dune restoration method when they are placed at sites where there is a high amount of wind and wind-blown sand and at a high enough elevation to avoid regular wave action and washouts. Discontinuous sand fencing creates wind and sand corridors for sand deposition between the fencing and also allows wildlife, such as sea turtles, to be able to access the habitat behind the fencing.

For reasons of aesthetics, safety, and possible interruption of public access, sand fences must be removed as soon as they have served their purpose, become at least 50% buried by sand, or are damaged or no longer functioning. While sand fences can help trap sand and increase the dune width at the base of the fence, they can also prevent sand accumulation in the area behind the fence, limiting the extent and height of the developing dunes and natural dunes behind the fence. Removing or relocating the fencing after it is semi-buried or damaged will help allow any accumulated sand to migrate towards the natural dunes.

Standard sand fencing consisting of wooden slats wired together with space between the slats is an ideal dune-building material because it has been proven to be effective and is inexpensive, readily available, easy to handle, and can be erected and removed quickly.

Sand fences are typically two to four feet high measured from the ground surface after installation. In most areas, three-foot high sand fencing is recommended. In areas where the beach is narrow or there is a low amount of wind-blown sand, a height of two feet is more appropriate.

The fencing can be supported with wooden posts at 10-foot intervals. The minimum practical length for posts is 6.5 feet; a length of 7 to 8 feet is optimum. Wooden posts should be no larger than three inches in diameter **(Figure 18)**.

Secure the fencing material by fastening it to each post with four ties of galvanized wire (no smaller than 12 gauge), and weave the material between the posts so that every other post has fencing on the seaward side.

If the base of a sand fence is placed at ground level, dunes will build over the structure. If the base is elevated four to six inches above the ground, dunes will build on the downwind side of the structure, and the fencing can be retrieved for reuse as the dunes are formed.

Sand fencing located on the public beach must be located as far landward as possible and may not extend more than 20 feet seaward of the line of vegetation, contingent upon GLO approval.

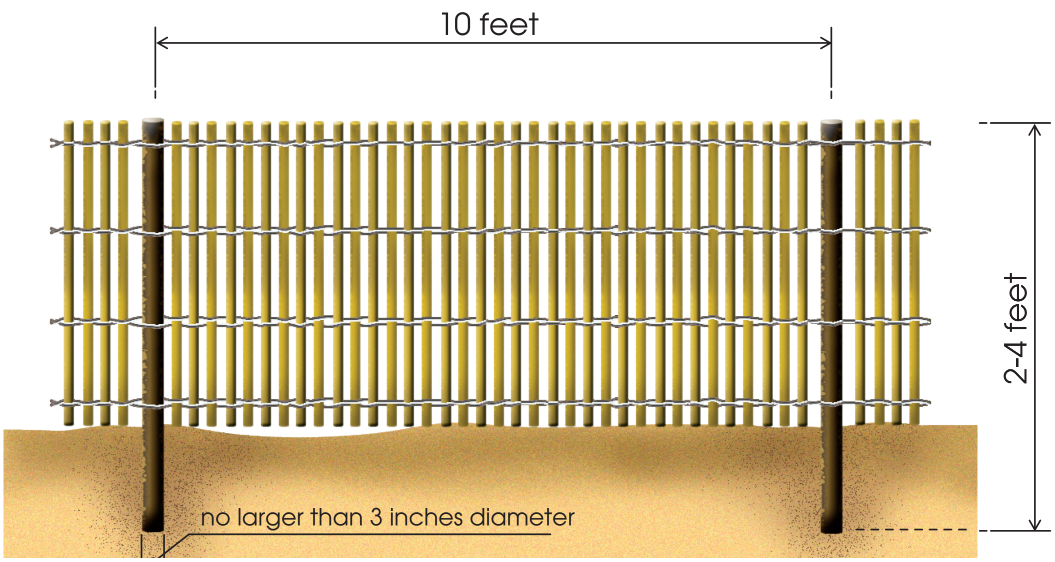


Figure 18. Sand fencing specifications for dune construction.

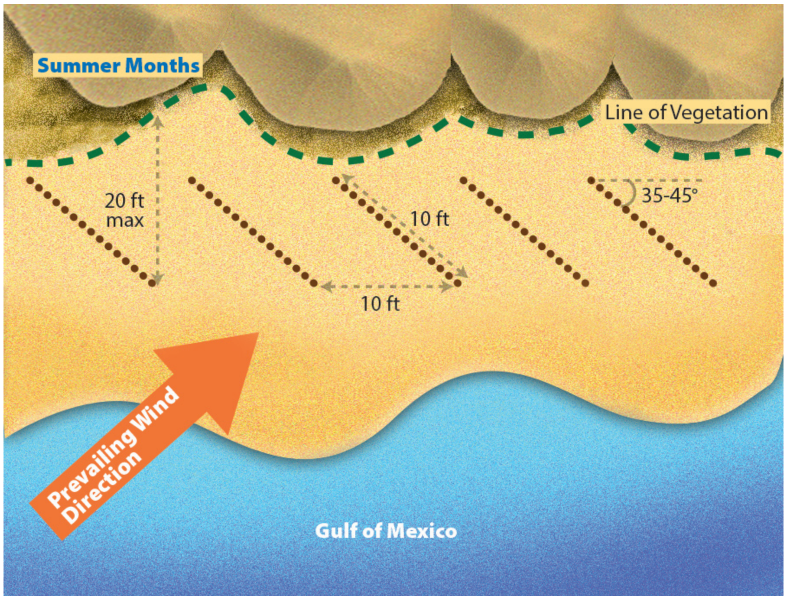


Figure 19. Recommended placement of sand fencing during sea turtle nesting season.

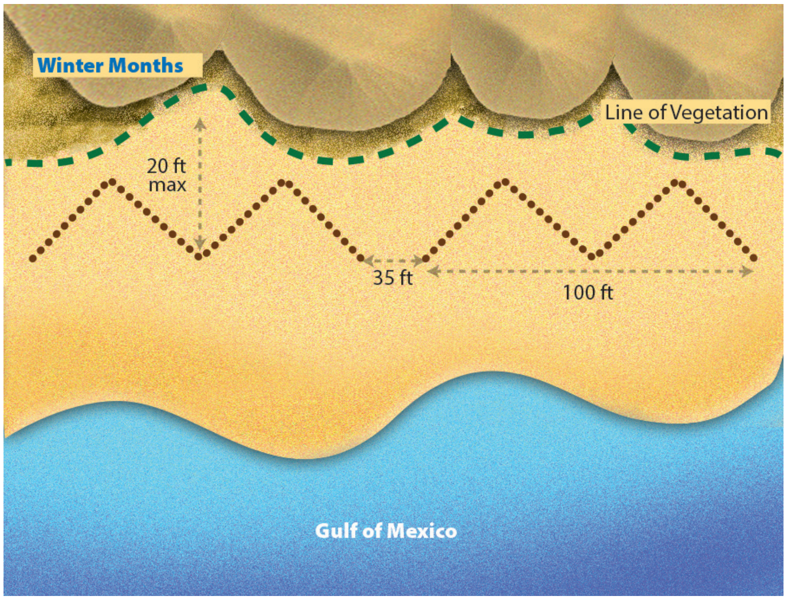


Figure 20. Optional placement of sand fencing outside of sea turtle nesting season.

During sea turtle nesting season in Texas, March 15th through October 1st, sand fences must be no more than 10 feet long and placed in segments spaced at a minimum of 10 feet apart **(Figure 19)**. The sand fencing should also be positioned to face the predominate wind direction and be at a 35-to-45-degree angle to the shoreline. This configuration is optimal to help protect nesting sea turtles, but sea turtle experts still recommend not using any sand fencing during the months of March through September since nesting sea turtles can easily become trapped or inhibited by fencing. The discontinuous sand fencing also creates wind and sand corridors for deposition between the fencing.

From October 1st through March 14th, sand fences may run parallel to the shore in a V-formation so long as they do not exceed 100 feet in length and are placed in segments at a minimum of 35 feet apart. **(Figure 20)**.

Alternative sand fence configurations may be used to repair breaches in the dune complex or washout areas with GLO approval.

Organic Brushy Material

Brush and seaweed can be also be used to build dunes as long as the piles are not too dense and air can flow within them. Piles of organic brushy material that are too dense or large may cause scouring or erosion of adjacent properties. Christmas trees can be an effective dune-building material as well if they are used in a region with a high amount of wind-blown sand and are placed at a high enough elevation to avoid wave action. Christmas trees, seaweed and brush can be held in place with stakes made of an organic, biodegradable material, such as wood.

Inorganic debris such as sandbags, rocks, bulkheads, riprap, asphalt rubble, concrete, or tires may not be used for dune building. These materials are not biodegradable and are safety hazards.

CONSTRUCTION WITH IMPORTED SAND

Some Texas beaches, particularly along the upper coast, are sand-starved. Natural sand accumulation occurs very slowly, and it may take as long as 20 years for a six-foot-high dune to form. Even with dune-building structures, the process is slow. In areas of limited sand supply, where the sand is saturated, or where it is restrained from blowing, dunes may be constructed of imported sand.

Sand for dune construction must not be taken from the beach. Doing so robs donor areas of the material necessary for maintenance of the beach and dunes, and may increase erosion. Removal of sand and other materials from barrier islands and peninsulas is strictly regulated by state laws (see "Beach Access and Dune Protection Laws"). Sand for dune construction can be obtained from construction-material suppliers or cement companies (see "Where to Get Help" for a list of potential beach quality sand suppliers in your area).

The salt content of sand used to construct dunes should not exceed four parts per thousand (ppt). Higher salt concentrations will inhibit plant growth. For this reason, freshly dredged spoil material is usually not a good source of sand for dune construction projects. If dredged material is to be used, its salinity can be lowered by allowing it to sit until rain has leached the salt. Depending on the material, this may take from six months to three years. A local soils testing laboratory can conduct salinity tests at a particular location (see "Where to Get Help").

Imported sand should be similar in color, grain size, and mineral content to the sand at the dune-building site. If native sand is topped with imported finer sediment, the finer sediment will quickly erode.

Man-made dunes should be of the same general height, slope, width, and shape as the natural dunes in the vicinity. Generally, they should be no less than four feet high with a slope of no more than 45

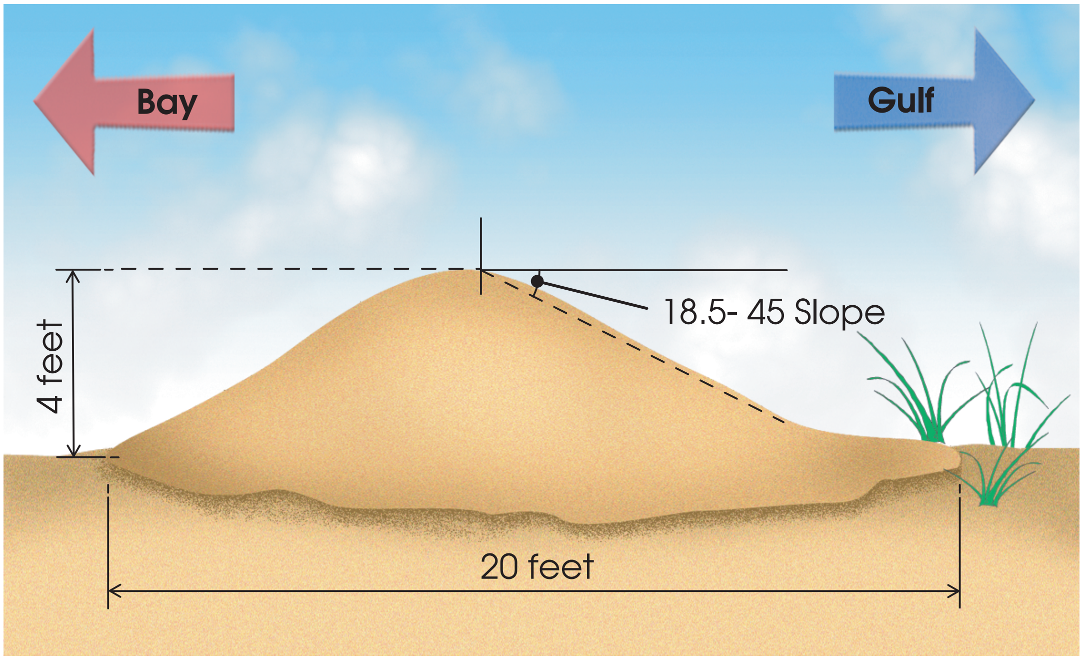


Figure 21. Minimum height, width, and slope of a dune constructed of imported sand.

degrees (a rise of one foot for every one horizontal foot). A slope of about 18.5 degrees (a rise of one foot for every three horizontal feet) is preferred. The initial width of the dune base should be at least 20 feet. A dune with a smaller base will not build to a height sufficient to provide storm protection **(Figure 21)**.

More specifically, in Nueces County and the City of Corpus Christi, a continuous foredune ridge of at least 14 feet in height with a minimum width of 350 feet and at least 50% vegetative cover is recommended. In the City of Port Aransas, a continuous foredune ridge with a minimum height of 10 feet, a minimum width of 100 feet and 85% vegetative cover is recommended. In the City of Galveston and Galveston County, restored dunes should be constructed at a 3:1 slope, at an average height of 75% of the island's base flood elevation, with more than 50% vegetative cover, and not extending further seaward than 4.1 feet elevation from mean sea level. In the City of South Padre Island, a dune system with a minimum 85% vegetative cover and with primary dune and inter-dune elevations of 10 feet, with some dunes reaching an optimum 12 feet in elevation or greater, is recommended. In Cameron County, a continuous dune ridge with a height of at least 16 feet and a minimum base width of 200 feet which contains 575 cubic feet of sand volume per linear feet above base flood elevation is recommended. These recommendations are found in each local government's Erosion Response Plan.

Where there is an ample supply of sand, construct dunes slightly landward of the location where foredunes would naturally occur to allow for natural seaward expansion. Generally, dunes may not be built more than 20 feet seaward of the line of vegetation, unless there is a demonstration that dunes would naturally form further seaward and will not interfere with the public's ability to use the beach during normal tide events. Dunes built too close to the Gulf can be destroyed by wave action during even minor storms and may interfere with public access along the beach.

Fine, clayey or silty sediments, hard or engineered structures, and materials such as bulkheads, riprap, concrete, asphalt, or other non-biodegradable items, may not be used to restore dunes.

Shoreline protection structures, such as seawalls and rock revetments, have been placed along portions of the coastline. While these structures protect public infrastructure and property landward of them, they are not considered dunes and should not be used as a method of, or core for, dune restoration. These structures do not provide the same habitat for flora and fauna that dunes do or store and supply sand to the beach system.

MITIGATION OR COMPENSATION FOR IMPACTS TO DUNES AND DUNE VEGETATION

When homes or other structures are constructed in the critical dune area, there will often be unavoidable adverse impacts to dunes and dune vegetation. If dunes and dune vegetation will be adversely affected by construction, the Dune Protection Act requires mitigation, or restoration, for those damages.

At the same time a beachfront construction certificate and dune protection permit is obtained, a mitigation plan must be submitted to the local government and the GLO that shows that the following steps, called the mitigation sequence, will be followed:

1. **Avoidance:** avoiding the negative effects on dunes and dune vegetation altogether by not taking a certain action or parts of an action. Example: locating the construction in an area where critical dunes and dune vegetation are not located.

2. **Minimization:** minimizing negative effects on dunes and dune vegetation by limiting the degree or magnitude of the action and its implementation. Example: reducing the size of the area that will be impacted.

3. **Mitigation:** repairing, rehabilitating, or restoring damaged dunes and dune vegetation.

4. **Compensation:** replacing or providing substitute dunes and dune vegetation, either on-site or off-site.

Each step in the mitigation sequence must be demonstrated in the mitigation plan. If adverse impacts to dunes and dune vegetation have been (1) avoided and (2) minimized as much as possible, then the impacts must be accounted for by either repairing or restoring the damaged dunes and dune vegetation in a (3) mitigation project or providing substitute dunes and dune vegetation in a (4) compensation project.

The volume of dunes and square footage of dune vegetation in a mitigation or compensation project must be the same as or more than the volume of dunes and square footage of dune vegetation that were damaged or adversely impacted. This is called 1: 1 mitigation. **(Figure 22)**

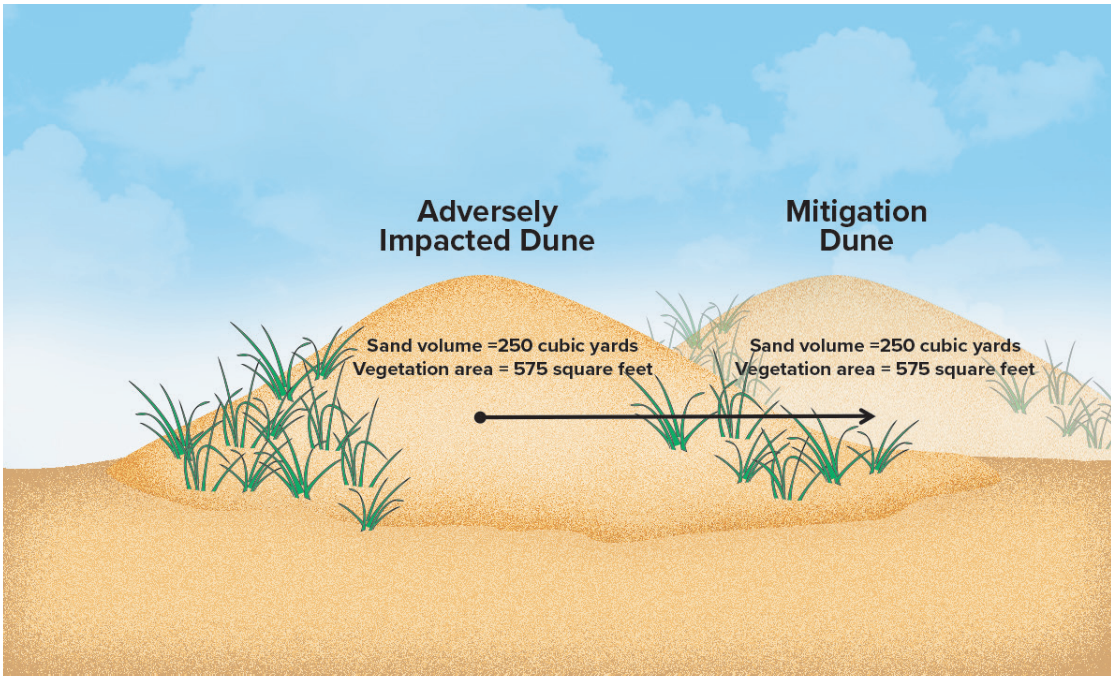


Figure 22. An example of 1:1 mitigation.

Mitigation and compensation projects must be located as closely as possible to the area where dunes and dune vegetation were adversely impacted, in order to provide a similar level of protection from the Gulf. Compensation projects may only be conducted off-site (meaning on a different property than where the damages occurred) if it is not possible to locate the compensation on the same site.

When developing a mitigation plan, the process of dune construction and restoration should follow the same methods outlined in this guidance document. The location, contour, volume, elevation, vegetative cover, and sediment content of the dunes in mitigation and compensation projects must be similar to the naturally formed dunes in the area.

Mitigation or compensation for adverse effects to dunes and dune vegetation must begin before or at the same time as construction and must continue until the restored dunes and dune vegetation are equal or superior to the pre-existing dunes and dune vegetation. Mitigation or compensation dunes and dune vegetation must be preserved and maintained until the local government determines that the mitigation or compensation project is complete, meaning the shape, size and vegetative cover of the dune restoration project matches or is greater than the surrounding naturally formed dunes.

The time necessary to restore dunes and dune vegetation may change depending on climate, time of year, soil moisture, plant stability, and storm activity. For this reason, permit holders have three years to complete mitigation or compensation after beginning restoration efforts.

DUNE WALKOVERS

Damage to dunes from pedestrian traffic can be avoided by the use of elevated walkovers for access to the beach. If walkovers are conveniently placed near access roads, parking areas, beachfront subdivisions, and public facilities, pedestrians will be less likely to cut footpaths through the dunes. Also, providing walkovers may increase public awareness of the importance of dunes and promote an appreciation of the sensitivity of the dune environment **(Figure 23)**. Dune walkovers should be shared between multiple property owners and subdivisions when possible in order to reduce impacts to the dune system by the proliferation of walkovers.

A walkover should begin behind the critical dune area and end just seaward of the dunes or line of vegetation where it will not interfere with public use of the beach at normal high tide. The structure should be oriented at an angle to the prevailing wind direction. Otherwise, wind blowing directly up the path of the walkover may impede the growth of vegetation beneath it, erode sand from the seaward end, and increase the possibility of washout or blowout occurrences.

CONSTRUCTION STANDARDS

Wood is the preferred construction material for walkovers because it is less expensive than metal, does not collect and retain heat as metal does, and is readily adapted to a number of designs. Although there are a few walkovers made from polyvinyl plastic, treated lumber and galvanized nuts and bolts may be used. The use of lumber treated with hazardous or toxic treatments, such as creosote, is discouraged. Basic structural guidelines for walkovers are detailed in **Figure 24**.

The width of a dune walkover or similar structure should be limited to four feet wide. An increased width of up to six feet, excluding limited passing areas, should only be permitted for public access walkovers, shared walkovers for three or more residences, or for wheelchair or golf-cart use. Dune walkovers greater in width than six feet should be limited to public dune walkovers. If a walkover will be infrequently used, a width of two feet is recommended.

Figure 23. Dune walkover.

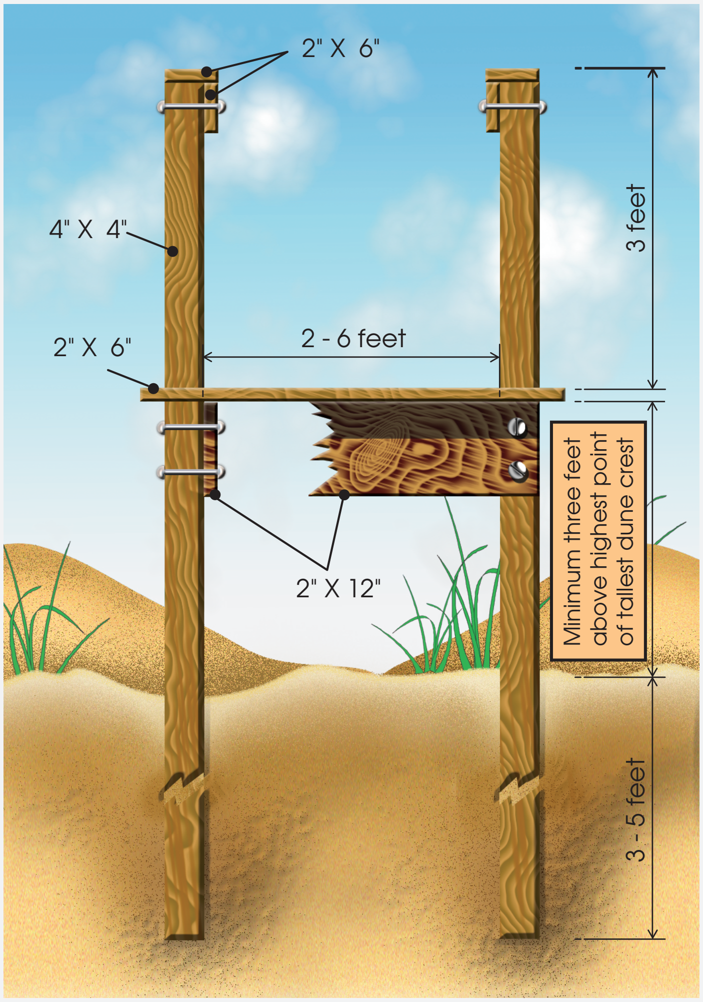


Figure 24. Construction details for a dune walkover.

The lowest level of the walkover must be of sufficient elevation to accommodate the expected increases in dune height. At a minimum, the lowest level of a dune walkover with a width of four feet or less should be constructed at a height of at least three feet above the highest point of the tallest dune crest beneath and immediately adjacent to the dune walkover. The lowest level of a dune walkover with a width greater than four feet should be constructed at a height of at least four feet above the highest point of the tallest dune crest.

Space the slats forming the deck of the walkover 1/2 inch apart so that sunlight and rainfall can penetrate to vegetation below and so that sand will not accumulate on the deck.

Place the supporting piers as far apart as possible along the length of the structure. A distance of at least six feet between pairs of piers is recommended. Implant the piers at least three feet in the ground to ensure stability. A depth of five feet or more is advisable to allow for erosion around the piers during storms. Install the piers with a hand auger or posthole digger rather than with a tractor.

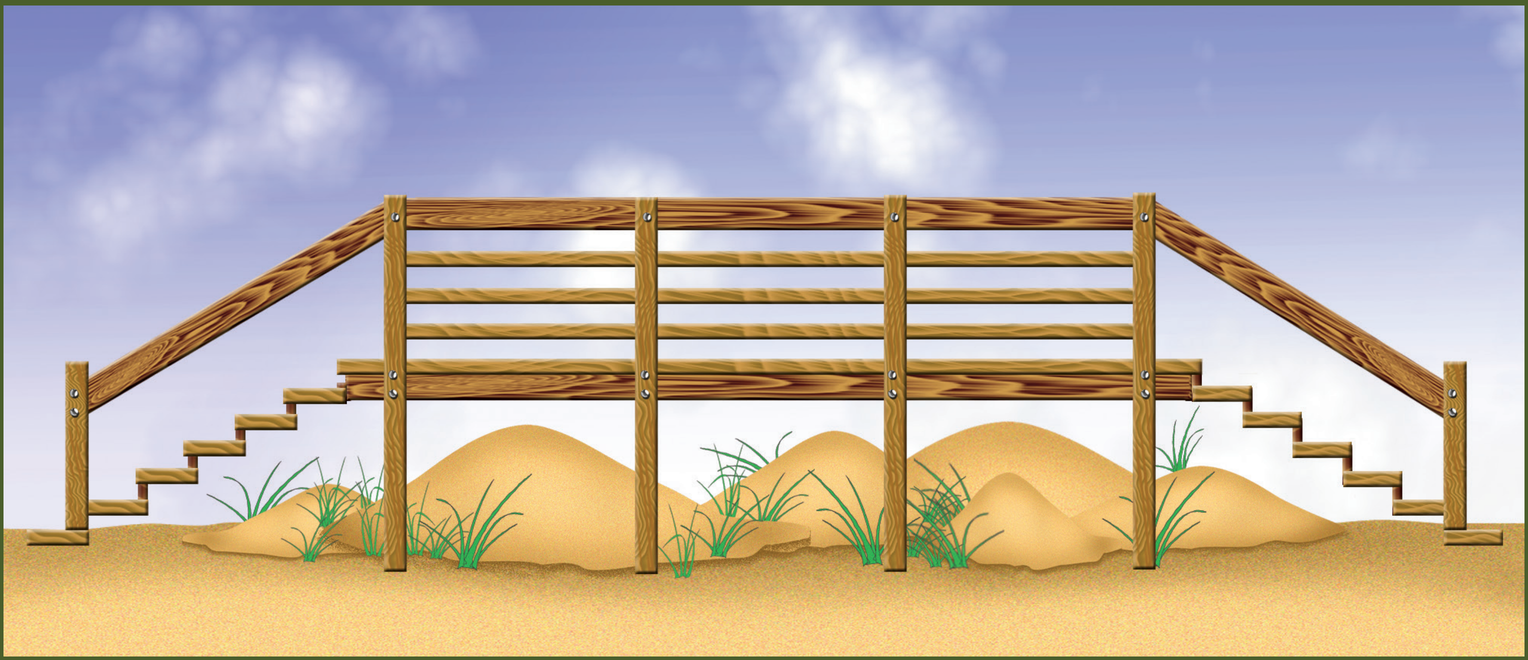
Walkover piers should not be set with cement, since the use of concrete to stabilize dune walkover pilings is prohibited. Any damages to the dune area must be authorized by the local government and repaired as soon as possible.

Providing handrails on both sides of the walkover is recommended as a safety measure and to discourage people from jumping off into the dunes. Railings are particularly advisable on public walkovers and those that are high above the ground. Railings should be at least three feet high.

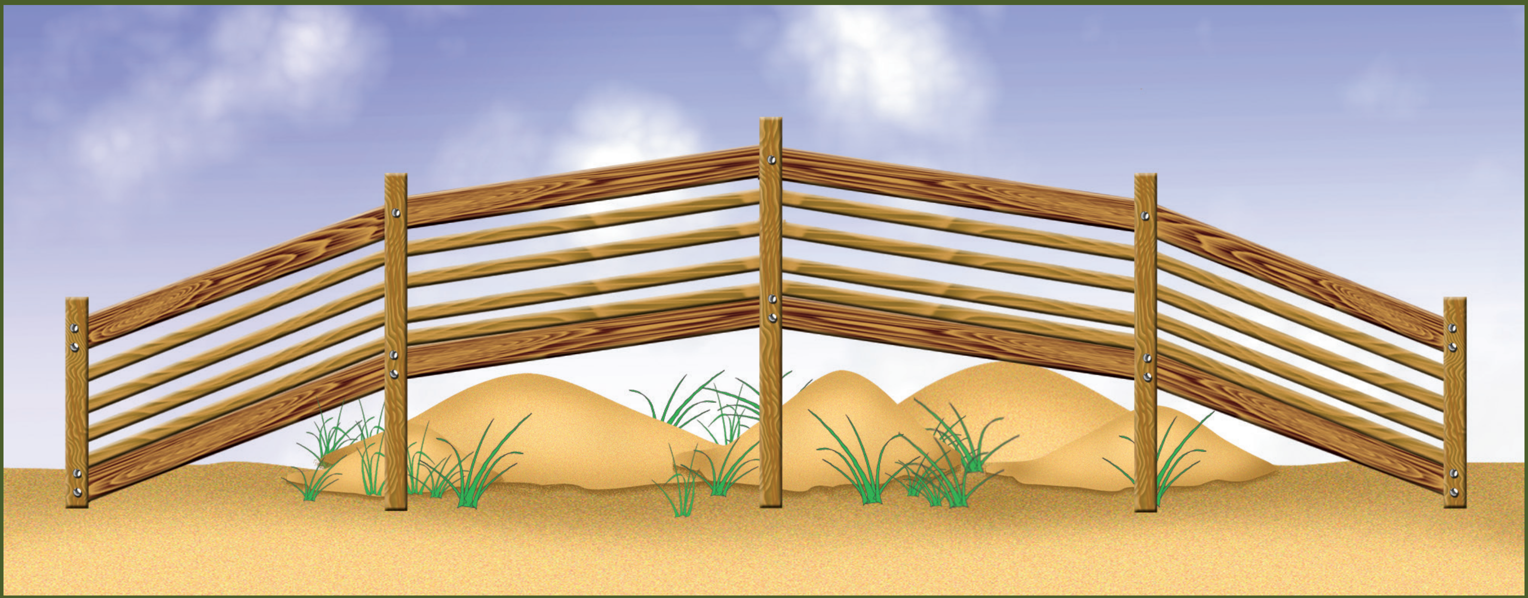
For all new construction of public dune walkovers in areas where vehicles are prohibited from driving on and along the public beach, local governments should construct walkovers in a manner that is accessible for persons with disabilities, where practicable. Guidelines for constructing a dune walkover to be accessible for persons with disabilities are located in the GLO’s Texas Beach Accessibility Guide.

Walkovers should be inspected on a regular basis and promptly repaired as needed. To avoid damage to dunes, workers should enter the dune area on foot rather than by vehicle.

Figure 25 A and B show two of the most common designs for dune walkovers in Texas and are variations of the common pier-supported structure employing telephone pole or fence post piers. Design A has a flat deck with steps at each end. Design B has ramps instead of steps, and the deck is arched where dune formations are highest. Prior to construction, check with the local building inspector for preferred specifications for dune walkovers.



(A) Pier-supported with steps



(B) Pier-supported with ramps

Figure 25. Dune walkover designs.

BEACH ACCESS AND DRAINAGE

ACCESS ROADS

The need for public roads to provide access to beaches often conflicts with the need to protect dunes; however, damage to dune areas by access roads can be minimized if the roads are properly designed.

Roads constructed parallel to the shoreline should be located as far landward of the dunes as possible. Beach access roads built perpendicular to the beach should be located in washover or blowout areas whenever possible, following natural land contours.

Beach access roads should be oriented at an angle to the prevailing wind direction. This will reduce the chance that water and wind will be channeled along them and erode the dunes at the sides of the road cuts **(Figure 26)**. Access roads near beaches should be elevated (similar to a speed bump) near the foredune ridge near the foredune ridge to reduce channelization of water during high tides **(Figure 27)**.

To minimize dune destruction, access roads should be as narrow as practicable. Any dune area damaged during road construction should be revegetated. Sand fencing can be used to retard erosion along the sides of the roads.

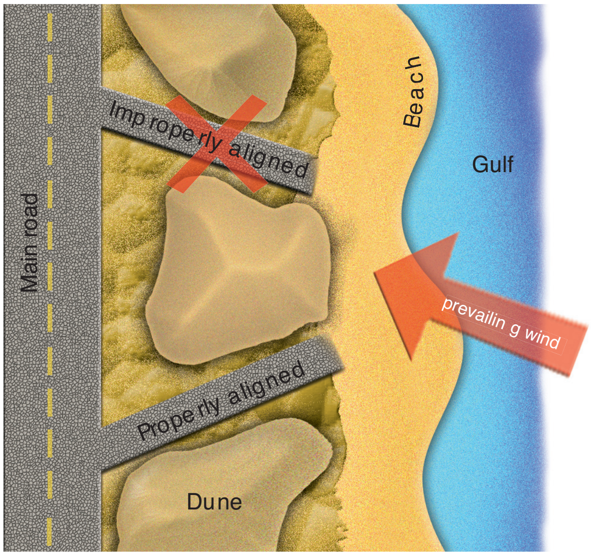


Figure 26. Alignment of beach access roads.

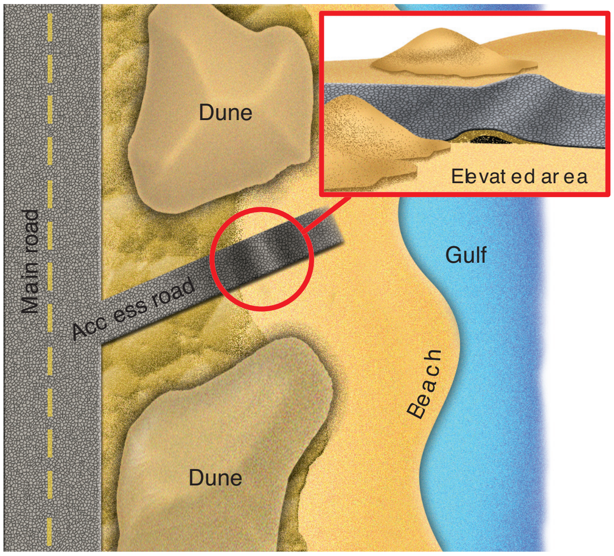


Figure 27. Elevating beach access roads at beach juncture.

DRAINAGE

On an undeveloped barrier island, rainwater generally seeps into the ground or drains toward open water. As an island is developed and land is covered with buildings and pavement, the amount of permeable land surface exposed to absorb rainfall is reduced, and runoff increases. On barrier islands with dense urban development or areas where the contour of the land has been altered, storm runoff does not follow the natural course to the Gulf and can create a washout, resulting in flooding of shorefront property. In addition, the washout exposes land and buildings behind the dunes to further flooding by storm surge.

Drainage patterns resulting from construction must not erode dunes, the public beach, or adjacent properties. General Land Office rules require that new channels be directed inland instead of through critical dunes toward the gulf. Damage to dunes and to property behind them can be prevented or halted by the installation of a retention pond to collect and contain rainwater until it can seep into the ground. Either man-made or natural swales will serve this purpose. The retention pond should be large enough to contain the anticipated volume of runoff and located where it will receive the maximum amount of drainage **(Figure 28)**. A qualified professional should design the system and oversee its construction.

More information regarding managing stormwater and coastal nonpoint source pollution can be found on the GLO's Clean Coast website: cleancoast.texas.gov.

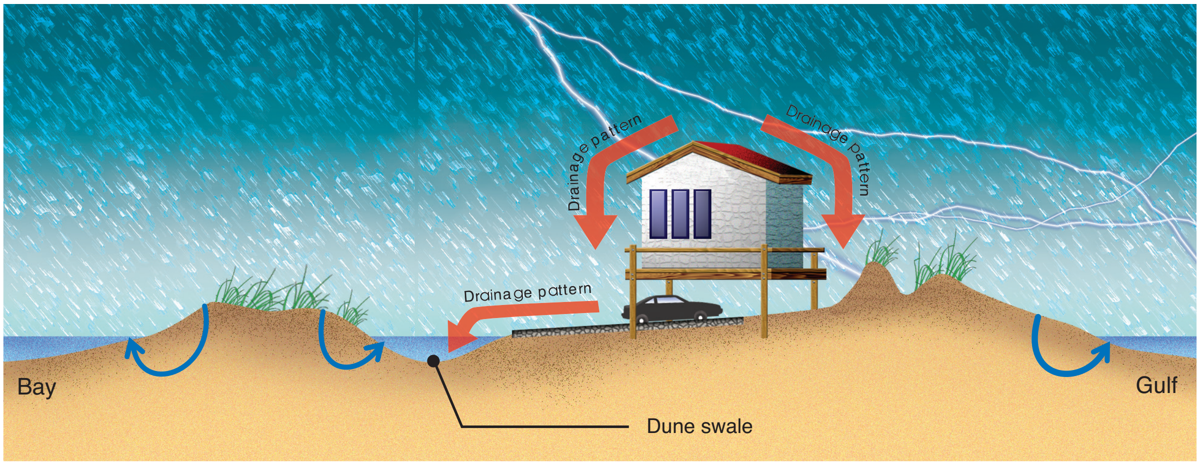


Figure 28. Utilizing a retention pond for drainage.

BEACH MAINTENANCE

Beach maintenance is defined as the cleaning or removal of debris from the beach or redistribution of seaweed on the beachfront by handpicking, raking, or mechanical means. Local governments may conduct or authorize beach maintenance activities for the purpose of providing access to the beach, as long as these activities do not materially weaken dunes or dune vegetation and will not result in the significant redistribution of sand or significantly alter the beach profile or line of vegetation.

The GLO encourages the removal of litter and other debris by handpicking or raking and strongly discourages the use of machines which disturb the natural balance of gains and losses in the sand budget and natural cycle of nutrients.

Sargassum

One of the most common beach maintenance activities is the redistribution of Gulf Seaweed or *Sargassum*, often by mechanical means. The seaweed is removed from the wrack line and placed in low areas or breaches within the primary dune complex or at the toe of the dunes immediately adjacent to the line of vegetation.

Sargassum acts as a home for many animals, including sea turtles, while it is floating on the water and can serve as both protection and a food source on the beach. *Sargassum* also helps protect the sand from wind- and wave-driven erosion and promotes the development of embryo dunes, or coppice mounds. *Sargassum* can be beneficial if left on the beachfront, but it can also help protect and build dune systems if placed at the toe of the dunes.

BEACH ACCESS AND DUNE PROTECTION LAWS

Any group or individual planning to undertake a dune protection or improvement project on the Texas coast must be aware of federal, state, and local laws and regulations that apply to the proposed action.

FEDERAL GUIDELINES

In 1987, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, and the U.S. Department of Agriculture Natural Resources Conservation Service (then the Soil Conservation Service) drafted the Federal Manual for Identifying and Delineating Jurisdictional Wetlands. Federal permits must be obtained from the Corps of Engineers for activities in these areas. Jurisdictional wetlands are identified on the basis of plant type, soils, and local hydrology.

In many cases, activities in coastal sand dunes will not affect jurisdictional wetlands and no federal permit will be required; however, seasonally wet swales between dunes may be considered wetlands. Questions regarding jurisdictional wetlands in Texas and procedures for obtaining proper permits can be directed to the local county commissioners court or to the U.S. Army Corps of Engineers, Galveston District (see “Where to Get Help”).

The Federal Emergency Management Agency (FEMA) classifies all foredunes as “coastal high-hazard areas,” or “high-velocity zones” (V-zones). A “V-zone” is defined as “a special flood hazard area extending from offshore to the inland limit of a foredune along the open coast, and any other area subject to high velocity wave action from storms or seismic sources.”

Foredunes are included in V-zones because they absorb the brunt of storm attack. FEMA requires more rigorous construction standards within V-zones and also prohibits “any human-caused alterations of sand dunes which could increase potential flood damage.” For more information concerning V-zones, and to obtain flood maps, contact a FEMA representative or your local floodplain coordinator. The Texas Water Development Board is the State Coordinating Office for the National Flood Insurance Program (see “Where to Get Help”).

STATE LAWS

The Open Beaches Act (Chapter 61 of the Texas Natural Resources Code), passed by the Texas Legislature in 1959, codified the public's common law right of free and unrestricted access to the "public beach," which extends from the line of mean low tide to the line of vegetation on the shoreline bordering the Gulf of Mexico. The act makes it unlawful to prevent or impede access to or use of the public beach by erecting barriers or by posting signs declaring a beach closed to the public. The act also required local governments to create beach access and use plans to preserve and enhance access to and the use of public beaches within their jurisdiction.

The Dune Protection Act (Chapter 63 of the Texas Natural Resources Code), enacted in 1973 and amended by the Texas Legislature in 1991, requires the commissioners court of any county with public beaches bordering on the Gulf of Mexico to establish a dune protection line on the Gulf shoreline. This requirement applies to mainland shoreline fronting the open Gulf as well as to the Gulf shoreline of islands and peninsulas. The county may allow the governing body of a municipality to assume this responsibility within its corporate limits and extraterritorial jurisdiction. The dune protection line can be established up to 1,000 feet landward of the mean high tide line. A dune protection permit from the county commissioners court or city is required for most activities seaward of the line.

Beachfront Construction Certificate and Dune Protection Permit

All construction activities within 1,000 feet of mean high tide or seaward of the first public road, whichever is greater, must be authorized by a beachfront construction certificate and all activities seaward of the local dune protection line must be authorized by a dune protection permit. Construction involves building, bulkheading, filling, clearing, excavation, or substantial improvement to or alteration of land or any structure and includes any impacts to sand dunes or dune vegetation.

To obtain a beachfront construction certificate and dune protection permit, an application must be submitted to the local government, the permitting entity. Once the local government receives a complete application that contains all necessary documentation, the application is sent to the Land Office to review and provide comments. After the local government has received comments from the Land Office, they may approve the proposed construction and issue a beachfront construction certificate and dune protection permit if they determine that the proposed activities are consistent with their dune protection and beach access plan.

Questions about the beach dune regulations or the permitting process should be directed to the county commissioners court, city, or the Land Office, (see "Where to Get Help").

Texas Coastal Management Plan

The Texas Coastal Management Program (CMP) is a federally approved, networked program that works to improve the management of Texas coastal natural resources. The CMP links the knowledge and expertise of eight (8) state agencies and four (4) Commissioner appointed representatives, collectively known as the Coastal Coordination Advisory Committee (CCAC), to provide advice and make decisions to ensure the long-term ecological and economic productivity of the Texas coast. The CMP receives funding from the National Oceanic and Atmospheric Administration that allows the Land Office to administer grant money for coastal projects. Additionally, the CMP reviews federal actions, activities, licenses, permits and applications for federal assistance issued under other federal programs for consistency with the goals and policies of the CMP. The CCAC may review applications for beachfront construction certificates and dune protection permits issued by local governments, funds for dune restoration and walkovers, and local government dune protection and beach access plan certifications.

Coastal Erosion Planning and Response Act

In 1999, the Texas Legislature passed the Coastal Erosion Planning and Response Act (CEPRA) to provide funding to coastal communities for projects that slow the effects of coastal and shoreline erosion. Dune restoration and beach nourishment projects may be funded through this program. Communities may submit proposals for the Land Office for such projects.

Removal of Sediments

Sections 61.211 through 61.227 of the Texas Natural Resources Code regulate the removal of sand, marl, gravel, and shell from islands, peninsulas, and land within 1,500 feet of mainland public beaches outside corporate limits. A permit must be obtained from the relevant county commissioners court for the excavation of any of these materials unless the material is to be moved by a landowner, or with a landowner's consent, from one location to another on the same piece of property. No permit is required if the removal is officially undertaken by a federal, state, or local government entity. An incorporated city, town, or village may not authorize the removal of sand, marl, gravel, or shell from a public beach within its boundaries for any purpose other than the construction of a public-sponsored recreational facility or a shoreline protection structure.

The Texas Parks and Wildlife Department, under Chapter 86 of the Parks and Wildlife Code, regulates the disturbance and removal of marl, sand, gravel, shell, or mudshell located within tidewater areas for any purpose other than that necessary or incidental to navigation or dredging under state or federal authority. Questions may be direct to this department (see "Where to Get Help").

WHERE TO GET HELP

FEDERAL

For construction standards in floodplains and coastal high-velocity zones:

Federal Emergency Management Agency, Region VI
(940) 898-5399
www.fema.gov

For information on permitting in jurisdictional wetlands:

U.S. Army Corps of Engineers Galveston District
(409) 766-3004
www.swg.usace.army.mil

Corps of Engineers – Corpus Christi
(361) 814-5847

For information related to endangered species:

U.S. Fish & Wildlife Service Texas Coastal Ecological Services
Houston Field Office
(281) 286-8282
Corpus Christi Field Office
(361) 994-9005

STATE

For information on permitting coastal construction:

Texas General Land Office Coastal Resources
(800) 998-4456
www.glo.texas.gov

For information on Environmental permits for activities within the Texas Coastal Management and Joint Permit application boundaries or on state-owned submerged land:

Texas General Land Office Corpus Christi Permit Service Center
602 N. Staples St., Suite 240
Corpus Christi, TX 78401
(361) 886-1630

Texas General Land Office Galveston Permit Service Center
Texas A&M University Galveston Campus
1001 Texas Clipper Road, Building 3026, Room 912
Galveston, TX 77533
(409) 741-4057

For information on sand, marl and gravel removal from tidal waters:

Texas Parks and Wildlife Department
(512) 389-4864
www.tpwd.texas.gov

For general flood-related questions:

Texas Water Development Board
(512) 463-7847
www.twdb.texas.gov

COASTAL COUNTIES

Coastal counties that administer dune protection and beachfront construction programs:

Jefferson County
1149 Pearl Street, 5th floor
Beaumont, TX 77701-3619
(409) 835-8584

Chambers County
P.O. Box 1180
201 Airport Road
Anahuac, Texas 77514-1708
(409) 267-3623

Galveston County
722 Moody, Suite 200
Galveston, Texas 77550
(409) 766-2244

Brazoria County
451 North Velasco, Suite #210
Angleton, Texas 77515
(979) 864-1295

Matagorda County
2200 7th Street
Bay City, Texas 77414-0571
(979) 244-2717

Nueces County
P.O. Box 18608
Corpus Christi, TX 78480
(361) 949-8121

Cameron County
P.O. Box 2106
South Padre Island, TX 78597-2106
(956) 761-5493

COASTAL MUNICIPALITIES

Coastal municipalities that administer dune protection and beachfront construction programs:

City of Galveston
3015 Market St.
Galveston, TX 77550
(409) 797-3660
coastalresources@galvestontx.gov

City of Jamaica Beach
5264 Jamaica Beach Road
Jamaica Beach, TX 77554-8674
(409) 737-1142

Village of Surfside Beach
1304 Monument Dr.
Surfside, TX 77541
(979) 233-1531

Town of Quintana
814 N. Lamar
Quintana, TX 77541
(979) 233-0848

City of Port Aransas
710 W Ave A
Port Aransas, TX 78373
(361) 749-4111

City of Corpus Christi
2406 Leopard Street
Corpus Christi, TX 78408
(361) 826-3240

City of South Padre Island
4601 Padre Blvd
South Padre Island, TX 78597
(956) 761-3044

City of Freeport
200 W 2nd Street
Freeport, TX 77541
(979) 233-3526

SOURCES OF VEGETATION INFORMATION

U.S. Department of Agriculture Natural Resources Conservation Service
(817) 774-1261
www.tx.nrcs.usda.gov

Kika de la Garza Plant Materials Center
3409 N. FM 1355
Kingsville, TX 78363
(361) 595-1313

Lady Bird Johnson National Wildflower Center
4801 La Crosse Avenue
Austin, TX 78739-1702
(512) 292-4200
www.wildflower.org

Texas A&M University – Galveston
Marine Biology Department
(409) 740-4528
www.tamug.tamu.edu/mars/

Apache Ecological Service
27426 Dobbin Hufsmith Road
Magnolia, TX 77354
(281) 356-3135

BEACH-QUALITY SAND INFORMATION

Potential local suppliers of beach-quality sand:*

Texas International Terminals
4800 Old Port Industrial Road
Galveston, TX 77554

Sorrell Construction, Equipment & Materials LLC
P.O. Box 2049
Freeport, TX 77542

Olmito Sand Pit
5926 Maverick Rd
Brownsville, TX 78521

Sediment analysis testing facilities:*

Terracon Consultants Inc.
11555 Clay Road
Houston, TX 77043
(713) 690-8989

1740 W 4th St., Ste 101
Freeport, TX 77541-5051
(979) 705-4942

**This list may not be exhaustive and does not constitute endorsement by the GLO.*

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