Standard Procedures for Mitigation

Texas General Land Office
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Contents

Introduction **1**
Dune Protection Act 1
Dune Protection Permit 1
What are dunes? *1*
What is dune vegetation? *1*
Application Requirements *2*
Mitigation Plan **2**
Mitigation Sequence 2
Avoidance *2*
Minimization *3*
Mitigation and Compensation *3*
Pre-construction Meeting 4
Quantifying Impacts **4**
What are impacts? 5
Dune Volume 5
Quantifying Sand Volume Using ArcGIS *7*
Dune Vegetation 7
Vegetative Cover *8*
Estimating Vegetative Cover: Site Observation Method *9*
Estimating Vegetative Cover: Quadrat Sample Method (Plant Squares) *10*
Designing Mitigation and Compensation **10**
Dunes 10
Slope *12*
Sediment Content *12*
Dune Vegetation 13
Mitigation *14*
Compensation *14*
Planting Density *14*
Location of Mitigation or Compensation 15
Compensation *15*
Future Development *16*
Survivability *16*

Stabilization and Protection Techniques 16
Mitigation or Compensation Completion **17**
Assessing Completion 17
Pre-construction Site Visit *17*
Dune Volume *18*
Dune Vegetation *19*
Monitoring *20*
Deadlines 20
Certification of Completion 21
Permittee Inspection *21*
Local Government Inspection *21*
GLO Inspection *21*
Timeline 22
Local Government and GLO Tracking 22
APPENDIX A: Dune Protection Permit Application Checklist 23
APPENDIX B: Mitigation Plan Template 25

Introduction

The Texas General Land Office (GLO) is responsible for implementing and enforcing state statutes and regulations that protect critical sand dunes. Under the Dune Protection Act (Texas Natural Resources Code (TNRC) Chapter 63), the GLO shall identify critical dune areas and develop rules related to dune protection.

The state rules for dune protection are found in 31 Texas Administrative Code (TAC) Chapter 15, and in 2023 the rules were amended to change the dune mitigation and compensation deadlines, and authorize enforcement if a mitigation or compensation deadline is missed. To help implement this rule change, the GLO is publishing this guidance document to outline the requirements related to mitigation plans, assessing dune impacts, and the design and completion of mitigation/compensation projects.

Dune Protection Act

The Dune Protection Act requires local governments to establish and GLO to approve a **dune protection line** that preserves sand dunes within their jurisdiction. Dune protection lines may extend no farther than 1,000 feet landward of the mean high tide line of the Gulf of Mexico and must preserve, at a minimum, the dunes within the critical dune area. Dune protection lines are established in the local **dune protection plans**, which are available on the GLO's website here: https://www.glo.texas.gov/coast/coastal-management/open-beaches/index.html.

Dune Protection Permit

Any person proposing to damage, destroy, or remove a sand dune or portion of a sand dune seaward of a dune protection line or within a critical dune area or to kill, destroy, or remove in any manner any vegetation growing on a sand dune seaward of a dune protection line or within a critical dune area must submit a complete **dune protection permit** application to the appropriate local government. The local government forwards the complete application and any associated material to the GLO.

What are dunes?

A dune is an emergent mound, hill, or ridge of sand, either bare or vegetated, located on land bordering the waters of the Gulf of Mexico. Dunes can either be naturally formed by the windward transport of sediment or created via man-made vegetated mounds. Natural dunes are usually found adjacent to the uppermost limit of wave action and are usually marked by an abrupt change in slope landward of the dry beach. The term includes coppice mounds, foredunes, dunes comprising the foredune ridge, backdunes, and man-made vegetated mounds.

What is dune vegetation?

Dune vegetation is flora indigenous to natural dune complexes and growing on naturally-formed dunes or man-made vegetated mounds on the Texas coast, and can include coastal grasses and herbaceous and woody plants.

Application Requirements

The information that is required to be included in dune protection permit applications is outlined in 31 TAC § 15.3(s)(5), as well as in the local dune protection plans. **Appendix A** provides an overview of the information that is typically required to be included in permit applications for activities proposing adverse impacts to dunes and dune vegetation seaward of a dune protection line. Additional information may be required based on the scope and type of activity proposed.

Mitigation Plan

Applicants proposing to adversely impact dunes and dune vegetation seaward of a dune protection line must submit a mitigation plan demonstrating compliance with the **mitigation sequence** in 31 Texas Administrative Code § 15.4(f). After determining that no material weakening of dunes or material damage to dunes or dune vegetation will occur within critical dune areas or seaward of the dune protection line, the local government must use the **mitigation sequence** to determine whether to issue a permit. Each step in the mitigation sequence must be demonstrated in the mitigation plan.

> An optional template that outlines the information that should be included in the mitigation plan is available in **Appendix B**.

The mitigation sequence consists of the following steps, which are described in further detail below:

1. **Avoidance**: avoiding the negative effects on dunes and dune vegetation altogether by not taking a certain action or parts of an action.
2. **Minimization**: minimizing negative effects on dunes and dune vegetation by limiting the degree or magnitude of the action and its implementation.
3. **Mitigation**: repairing, rehabilitating, or restoring damaged dunes and dune vegetation in their pre-existing footprint.
4. **Compensation**: replacing or providing substitute dunes and dune vegetation, either on-site or off-site.

Mitigation Sequence

Avoidance

Avoidance means avoiding the effect on dunes and dune vegetation altogether by not taking a certain action or parts of an action. Applicants proposing adverse effects to critical dunes and dune vegetation seaward of a dune protection line must prove that there is no practicable alternative to the proposed activity, proposed site, or proposed methods conducting the activity, and the activity will not materially weaken the dunes or dune vegetation.

Applicants must include information regarding possible alternatives in the permit application and must use construction methods that will have no adverse effects on dunes and dune vegetation unless the applicant can demonstrate that the use of such methods is not feasible. Some examples of avoidance include:

- Locating construction activities as far landward of dunes as possible;

- Locating construction activities further landward or outside of the critical dune area, such as within a low-lying swale or upland area;
- Locating roads proposed parallel to beaches landward of critical dune areas and not within 200 feet landward of the line of vegetation; and
- Limiting the construction of new artificial runoff channels, including stormwater runoff channels, unless there is no alternative.

Minimization

Minimization means minimizing effects on dunes and dune vegetation by limiting the degree or magnitude of the action and its implementation. If an applicant demonstrates that proposed impacts to dunes and dune vegetation are unavoidable, they must demonstrate that the impacts have been minimized to the greatest extent practicable. Minimization techniques include:

- Minimizing construction and pedestrian traffic on or across dune areas, taking into account trends of dune movement and beach erosion;
- Routing private and public pedestrian beach access routes through washover areas, blowouts, areas where dune vegetation has already been disturbed, or low-lying areas;
- Promoting shared dune walkovers and beach access routes;
- Limiting the number and size of private access points to the public beach to the minimum extent needed to service the development;
- Posting signs in areas where pedestrian traffic is high explaining the functions of dunes and the importance of vegetation; and
- Prohibiting the construction or maintenance of a structure on previously mitigated or compensated dunes that are seaward of a dune protection line, where practicable, except for permitted dune walkover or similar access ways.

Mitigation and Compensation

If adverse impacts to dunes and dune vegetation have been avoided and 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 mitigation project or providing substitute dunes and dune vegetation in a compensation project.

Mitigation means repairing, rehabilitating, or restoring affected dunes and dune vegetation in their pre-existing footprint. Damages to dunes and dune vegetation must be mitigated for to provide, when compared to the pre-existing dunes and dune vegetation, an equal or greater area of vegetative cover and dune volume, an equal or greater degree of protection against damage to natural resources, and an equal or greater degree of protection against flood and erosion damage and other nuisance conditions to adjacent properties.

Compensation means compensating for effects on dunes and dune vegetation by replacing or providing substitute dunes and dune vegetation. Compensation projects must be located as closely as possible to the area where dunes and dune vegetation were adversely impacted to provide a similar level of protection. Compensation projects may only be conducted off-site (meaning on a different property than where the damaged occurred) if it is not possible to locate the compensation on the same site.

1:1 Mitigation or Compensation

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 will be adversely impacted, which is called 1:1 mitigation or compensation (**Figure 1**).

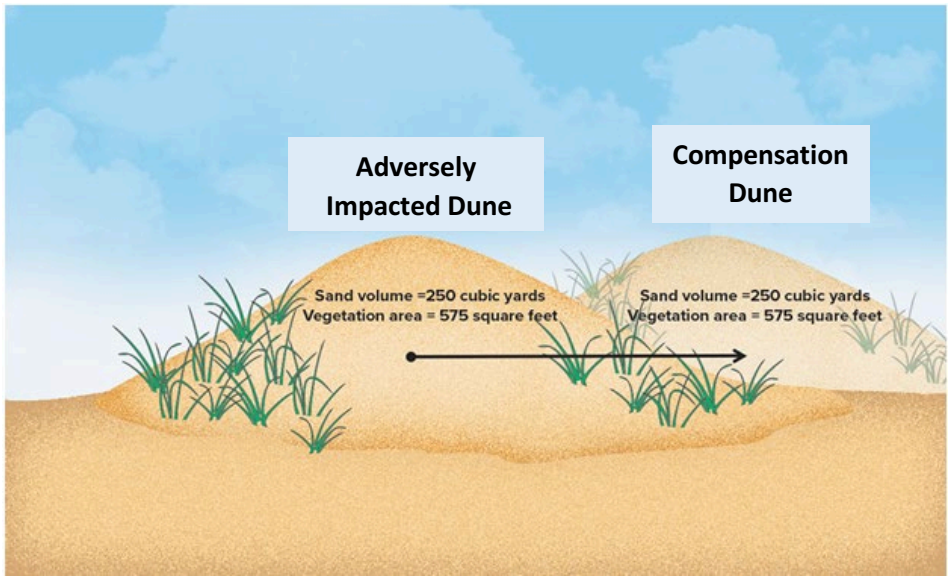


Figure 1. An example of 1:1 compensation.

Pre-construction Meeting

The GLO recommends a pre-construction site visit or meeting between the property owner or consultant, local government and GLO, especially for projects involving large-scale impacts to dunes and dune vegetation or a pre-existing violation. These site visits would allow for the local government or GLO to capture pre-construction photographs and GPS points that will later be used to determine project completeness.

The applicant may reach out to the GLO and local government to request a pre-construction site visit either prior to or after the submittal of the dune protection permit application. Requesting a pre-construction site visit prior to the application submittal would provide an opportunity for the applicant to receive preliminary feedback on the mitigation plan, which may help avoid delays in the permitting process. Feedback that may be able to be provided on the mitigation plan during a pre-construction meeting include suitable locations for mitigation or compensation, dune and dune vegetation impact calculations, restoration methods, and requirements for compliance with local and state rules.

GLO staff are available to participate in pre-construction meetings in-person with enough prior notice.

Quantifying Impacts

The entirety of the critical dunes and dune vegetation seaward of the dune protection line that will be adversely impacted by the proposed construction activities must be accounted for and included in the mitigation plan. Accurately identifying the volume of dunes and square footage of dune vegetation that will be adversely impacted is essential in verifying that mitigation or compensation is achieved on a 1:1 basis.

What are impacts?

The calculation of impacts to dunes and dune vegetation must account for all dunes that will be damaged, destroyed, or removed in the area seaward of the dune protection line or within the critical dune area and all dune vegetation that may be killed, destroyed, or removed in any manner that is growing on a sand dune seaward of a dune protection line or within a critical dune area. The impact calculations include not only the volume of dunes and square footage of dune vegetation that will need to be relocated due to proposed construction activities, but also any incidental impacts to dunes or dune vegetation during construction that will be mitigated for in-place, such as construction corridors or staging areas for equipment.

"Temporary" and "Permanent" Impacts
Applicants may refer to impacts that will be mitigated for in-place as "temporary" impacts and refer to impacts that will be compensated for as "permanent" impacts. These terms are not defined within the beach dune rules or local plans and should **not** be used to describe impacts to dunes or dune vegetation. All proposed impacts to dunes and dune vegetation, including the impacts that may be considered "temporary," must be identified and accounted for in the mitigation plan.

Unauthorized and unpermitted adverse impacts to dunes and dune vegetation seaward of a dune protection line are a violation of local and state rules and are subject to enforcement action. The GLO recommends applicants include all potential impacts to dunes and dune vegetation within their dune protection permit application to avoid the possibility of unpermitted impacts.

Dune Volume

Dune: A dune is an emergent mound, hill, or ridge of sand, either bare or vegetated, located on land bordering the waters of the Gulf of Mexico. Dunes can either be naturally formed by the windward transport of sediment or created via man-made vegetated mounds. Natural dunes are usually found adjacent to the uppermost limit of wave action and are usually marked by an abrupt change in slope landward of the dry beach. The term includes coppice mounds, foredunes, dunes comprising the foredune ridge, backdunes, and man-made vegetated mounds (**Figure 2**).

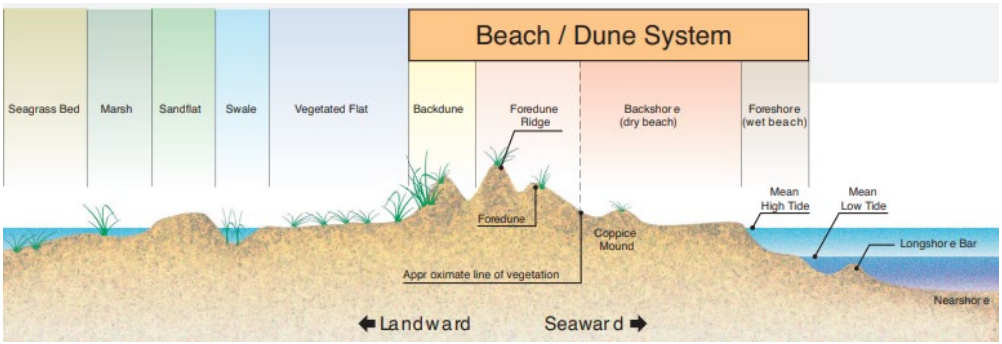


Figure 2. Typical cross-section of a Texas barrier island. Actual conditions may vary.

When quantifying impacts to dunes, the location and extent of the existing dunes should be identified by locating the toe of the dune feature based on the geomorphology of the beach dune system of the site. The toe of the dune represents the transition between the beach and the dune feature or between

an upland area or swale and the dune feature. The dune toe can be identified by the change in slope from the dune area to the upland or swale areas using contours on a topographic survey, cross-sections of the topography, digital elevation models, and/or photographs.

Figure 3 below shows aerial imagery and a cross-section derived from lidar data of a dune system. The on-the-ground photographs at Points 1, 2, and 3 show the landward or seaward toe(s) of backdunes. Point 3 shows the seaward-most dune toe, Point 2 shows the seaward dune toe of the back dune, and Point 1 shows the landward-most dune toe of the back dune. Note how the dune toes shown in the on-the-ground photographs correspond with a slope change in the cross-section view.

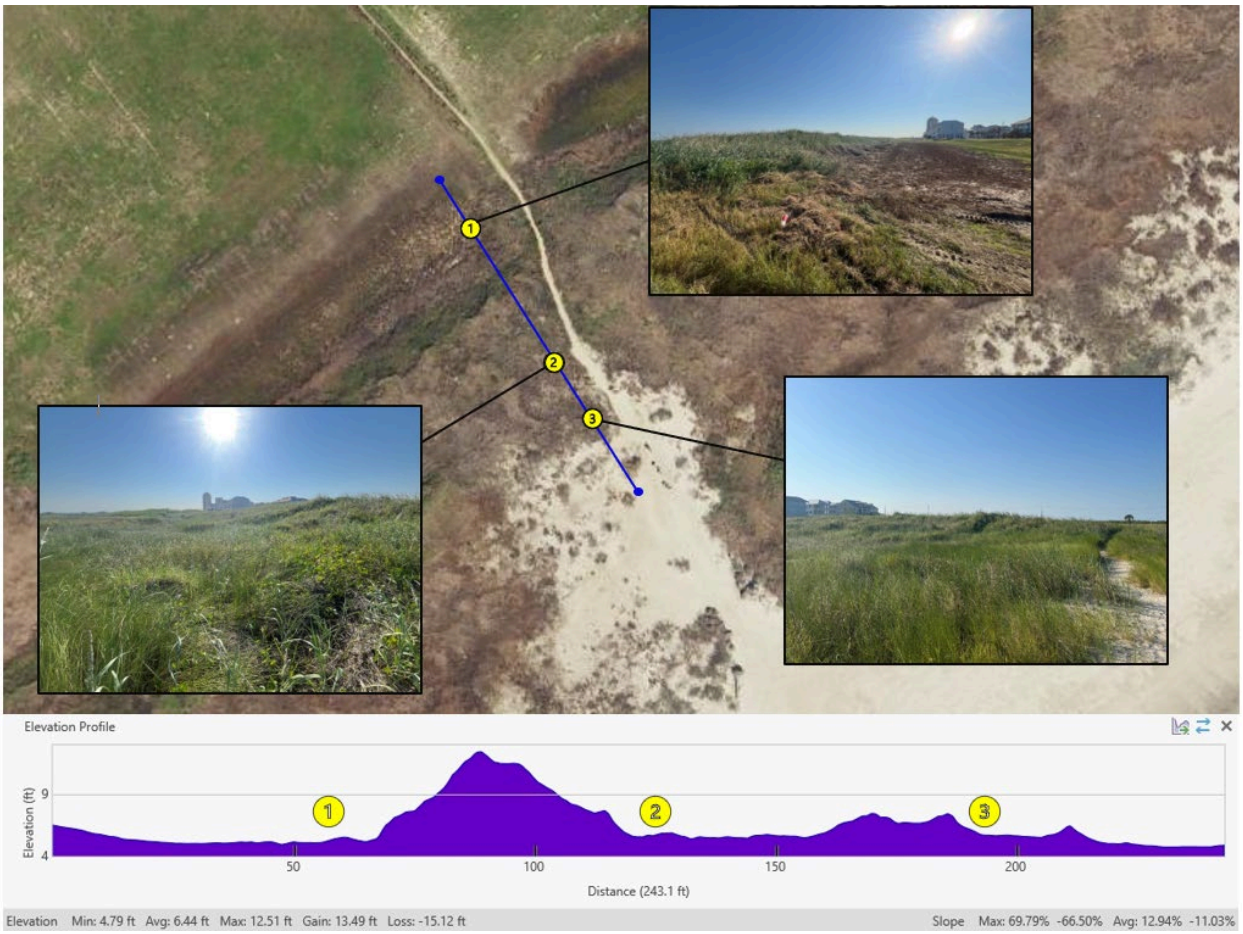


Figure 3. Dune system cross-section elevation profile and on-the-ground photographs of the dune toes.

For areas where structures or other construction activities are proposed and the existing dunes will no longer be part of the dune system, the entirety of the volume of sand above the dune toe should be included in dune volume impact calculations. Using **Figure 3** as an example in a hypothetical situation, if a parking lot was proposed on the back dune between Point 1 and Point 2, the entirety of the dune volume above the toe of the dune in the area where the parking lot is proposed must be accounted for. Dune impact calculations should also include any dunes that will be impacted by regrading or sloping activities to stabilize the site.

All the sand from impacted dunes must remain within the dune system and must be placed within the mitigation or compensation area. **Sand from critical dune areas may not be used to raise the elevation of the site or as fill material for construction.**

Quantifying Sand Volume Using ArcGIS

One tool that can be used to quantify the volume of dunes to which adverse impacts are proposed is ArcGIS Desktop, which requires a paid subscription. After determining the toe of the dune feature, dune volume impacts can be estimated using the Surface Volume tool in the 3-D Analyst toolbox. The Surface Volume tool calculates the 3-D surface area and volume of the region between a surface and/or reference plane. To determine dune volume, the reference plane should be set as the elevation of the toe of the dune. Then, selecting ABOVE the reference plane will assess the volume and surface area of the region above the specified reference plane (or toe of the dune) (**Figure 4**).

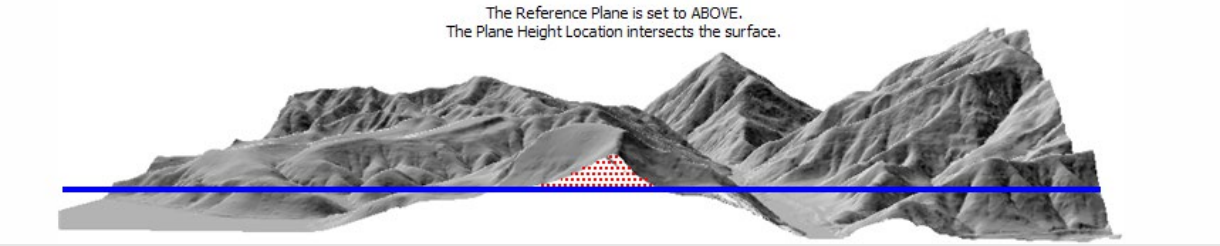


Figure 4. Illustration from ESRI showing the reference plane is set to ABOVE. Source: https://desktop.arcgis.com/en/arcmap/latest/tools/3d-analyst-toolbox/surface-volume.htm

Dune Vegetation

Dune vegetation: Flora indigenous to natural dune complexes and growing on naturally-formed dunes or man-made vegetated mounds on the Texas coast and can include coastal grasses and herbaceous woody plants.

Dune vegetation species that are growing on a critical dune seaward of the dune protection line are protected and must be included in the calculation of dune vegetation impacts. Non-native or invasive species or vegetation that is not growing on a dune seaward of the dune protection line are not protected and do not require mitigation or compensation. While not a comprehensive list, examples of nonnative or invasive species include Brazilian peppertree, common sunflower (*Helianthus annus*), Chinese tallow, palm trees, salt cedar, sod, bermudagrass, and St. Augustine grass.

The quantification of dune vegetation impacts should be based on the **3-D surface area** of the dune that will be adversely impacted and should take into consideration vegetative cover of the impact area. Since dunes are not flat surfaces and have elevation changes and slopes, the square footage of dune vegetation should take into account those elevation changes, rather than assuming that the dune is a flat surface (**Figure 5**). The steps described in "Quantifying Sand Volume Using ArcGIS" above can also be used to calculate the 3-D surface area of a dune.

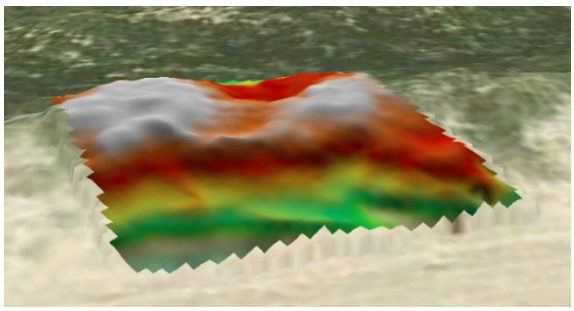


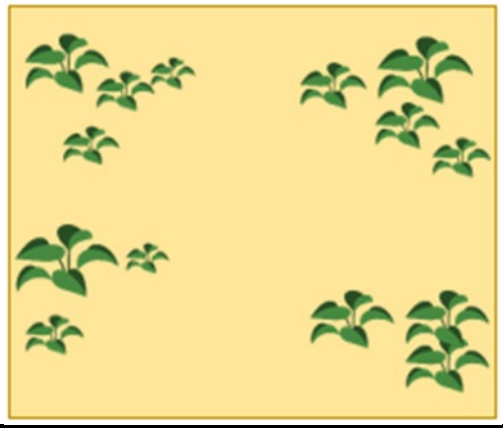
Figure 5. An example of the 3-D surface of a dune system.

Vegetative Cover

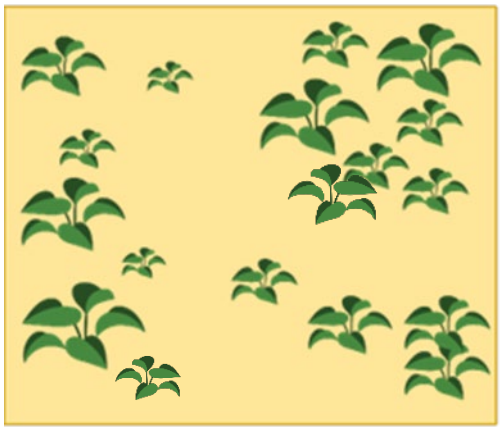
Vegetative cover generally refers to the percentage of ground surface covered by vegetation. There are several different methods that can be used to estimate vegetative percent coverage, from visual site observation to the plant quadrat method. Below are visual representations of various ranges of percent vegetative cover and photo examples from dune systems on the Texas Gulf coast.

0-10% Vegetative Cover

11 – 25% Vegetative Cover



26 – 50% Vegetative Cover



51 – 75% Vegetative Cover

76 – 100% Vegetative Cover

Estimating Vegetative Cover: Site Observation Method

Objective: To evaluate extent of vegetative cover in a specific site through visual observation.

Materials Needed:

- Camera/Phone (for documentation)

Steps:

1. Site selection
    - Choose the site where the mitigation/compensation project is proposed.
2. Visual Assessment
    - For the selected area, assess the vegetative cover by estimating the percentage of ground covered by indigenous dune vegetation.
    - Use the following categories for estimation:
        - 0 - 10% cover
        - 11 - 25% cover
        - 26 - 50% cover
        - 51 - 75% cover
        - 76 - 100% cover
3. Documentation
    - Take photographs of current site conditions to visually document the vegetative cover.

Estimating Vegetative Cover: Quadrat Sample Method (Plant Squares)

Objective: To quantitatively assess vegetative cover in a specified site using a quadrat sampling method.

Materials Needed:

- Quadrat frame
- Camera/Phone (for documentation)

Quadrat Size Recommendations:

- 1m x 1m or 3ft x 3ft

Sampling locations:

- Select multiple sample locations randomly within the project area

Number of Assessments:

- Minimum of 10 quadrats (recommended)

Steps:

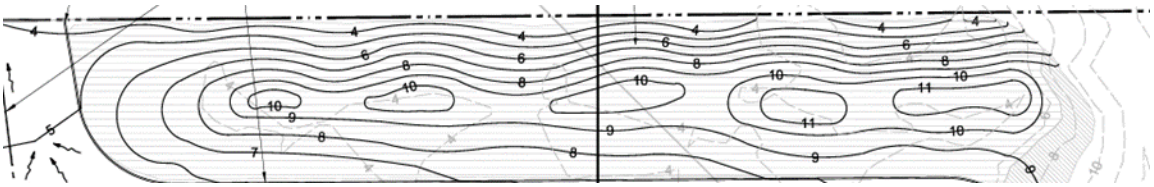
1. Site selection
    - Select multiple sites within the project area.
2. Quadrat Placement
    - Lay the quadrat frame on the ground at each of the selected locations.
3. Documentation
    - Take photographs of the quadrat showing current site conditions of vegetative cover.
4. Repeat assessment
    - Continue to next selected location and repeat assessment until desired number of quadrats have been assessed.
5. Vegetative Cover Assessment (using ImageJ – free software)
    - Use ImageJ, a tool for measuring percentage cover, by following guidance from: https://virtue.gmbl.se/sites/default/files/english/3_cover_manual.pdf

Designing Mitigation and Compensation

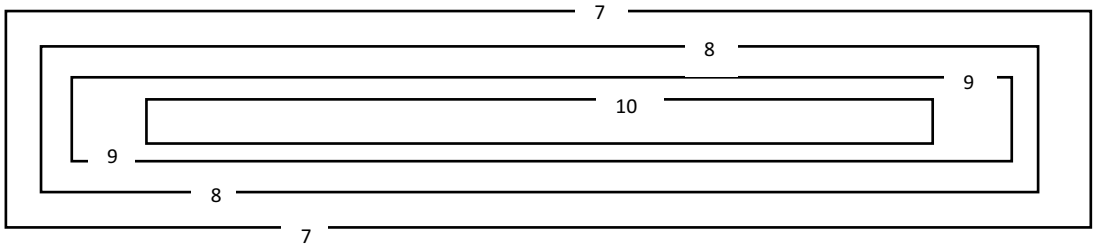
The volume of dunes and square footage of dune vegetation in a mitigation or compensation project must be the same as or more than the volume of dunes and square footage of dune vegetation to which adverse impacts are proposed. When designing a mitigation and/or compensation project, various considerations need to be made regarding the shape and sediment content of mitigated and/or compensated dunes, the type of dune vegetation and planting density, the location of the project, and potential stabilization and protection techniques. Mitigation and compensation areas must adhere to the dune restoration requirements in 31 TAC § 15.7(e), as follows.

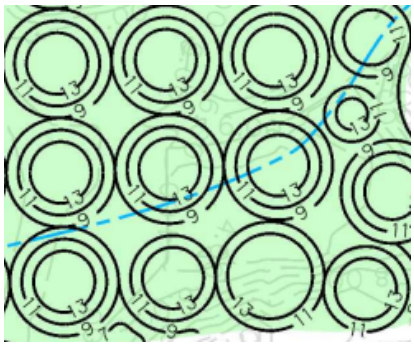
Dunes

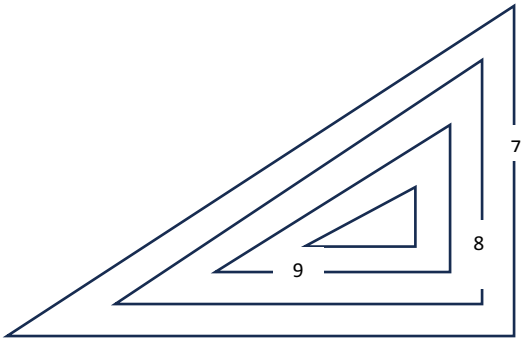
The restored dunes in a mitigation or compensation project must approximate the natural position, contour, volume, elevation, and sediment content of naturally formed dunes. The shape of restored dunes should be rounded, have a contour profile similar to natural dunes, and be continuous with any surrounding natural dunes. Example A shows contours of dune features that **would mimic** natural dunes because they are rounded and continuous.

A. 

Below are example contours of features that **would not** mimic natural dunes. Example B shows contours with 90-degree angles and rectangular features, Example C shows contours forming perfect circles, and Example D shows contours with sharp angles. These shapes do not occur in naturally formed dunes and should not be used when designing restored dunes.

B. 

C. 

D. 

Slope

Restored dunes should be designed with a slope of no more than 45 degrees (a rise of one foot for every one horizontal foot), but a slope of 18.5 degrees (a rise of one foot for every three horizontal feet) is preferred (**Figure 6**). However, the design of the restored dunes should be based on the shape, contours, and slope of any existing natural dunes within the restoration area.

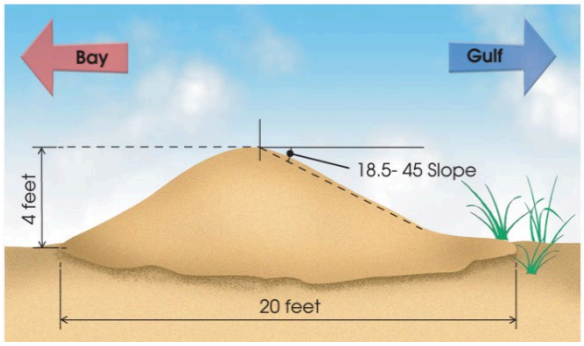


Figure 6. Recommend slope of restored dunes.

Sediment Content

Sand for dune construction should be sourced from the impacted dunes. If additional sand is needed, only beach-quality sand that is of a similar grain size and mineralogy as the existing sediment on site may be used. The source and characteristics of any sand from off-site to be used in the mitigation or compensation area should be included in the dune protection permit application for review by the local government and GLO. **Fine, clayey, and silty sediments may not be used.**

A sediment analysis can be used to determine if the grain size and mineralogy of the sand to be used in mitigation or compensation is similar to the sediments found on site. **Figure 7** below is an example sediment analysis showing grain size. The report should provide information on grain size, color, toxicity levels, and percentage of fines. A couple of grab samples should be tested for every pile of sand to be used in a project and additional tests should be obtained for any new material that will be added.

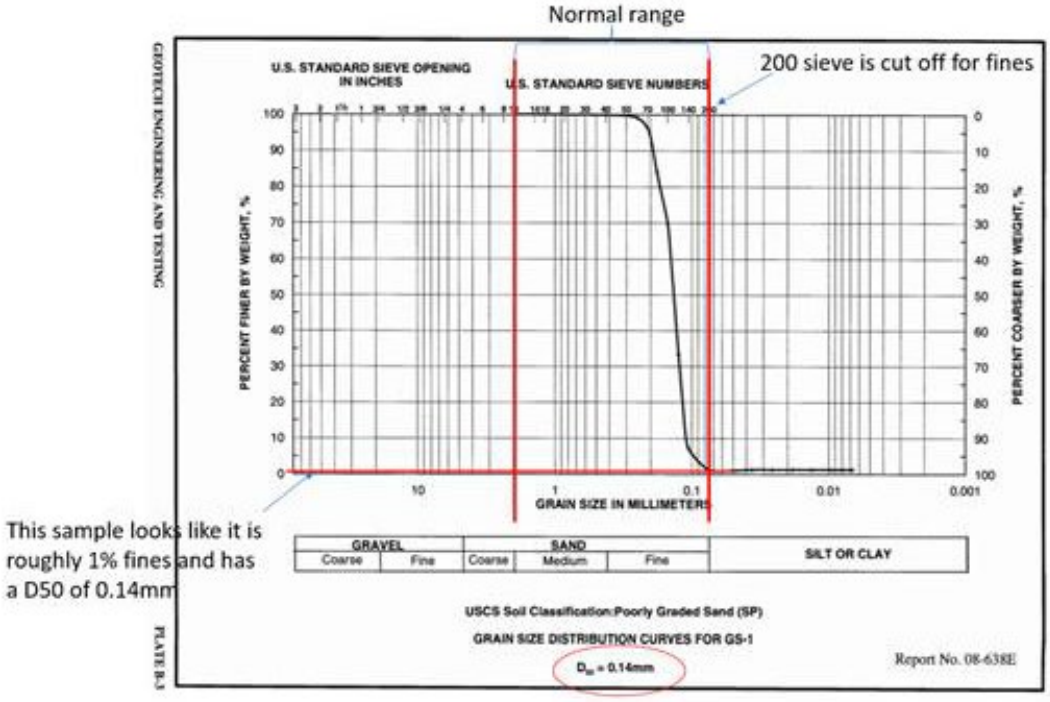


Figure 7. Example sediment analysis showing grain size.

In general, any sand that will be placed seaward of the dune protection line should meet the following parameters:

- At least 75% quartz
- No more than approximately 10% fines
- Grain size of medium to very fine sand
- Median grain size between 0.10 – 0.30 mm
- No more than 5% fine gravel

The Texas Coastal Sediments Geodatabase (TxSed)contains sediment-related geospatial and geotechnical data and can be found on the GLO website here: https://www.txsed.com/. TxSed can be used to assist in identifying existing sediment characteristics of a site by selecting the nearest grab sample point on the beach adjacent the project site. Once clicking on the point, a window will pop up that shows the date and source of the sample and the percent sand, silt, clay, and gravel. The percent sand, silt, clay and gravel of the material to be used in the dune restoration project should be as close as possible to the percents of the existing sediment on site.

Dune Vegetation

Mitigation and compensation projects should be designed to use or repair the existing dune vegetation in the proposed impact area, where possible.

Only indigenous dune vegetation that will achieve the same protective capability as the surrounding natural dunes may be used in mitigation or compensation projects. While not a comprehensive list, three common dune vegetation species are recommended for dune restoration projects anywhere along the Texas coast (**Figure 8**):

- Bitter panicum (*Panicum amarum*)
- Sea oats (*Uniola paniculata*)
- Marshhay cordgrass (*Spartina patens*)

Figure 8. Bitter panicum (left), sea oats (middle), and marshhay cordgrass (right).

The dune vegetation in the mitigation or compensation area should incorporate indigenous species found on any nearby natural dunes, which may include species not listed here. Nonnative or invasive species, such as Brazilian peppertree, common sunflower (*Helianthus annus*), Chinese tallow, palm trees, salt cedar, sod, bermudagrass, and St. Augustine grass, may not be replanted or used in mitigation and compensation projects.

Additional information on native dune species on the Texas coast is available in the GLO's Dune Protection and Improvement Manual for the Texas Gulf Coast. The Dune Manual does not include a comprehensive list of all native dune vegetation species in Texas, but the GLO is available to provide assistance with a determination on protected and native dune vegetation species.

Mitigation

Incidental impacts to dunes or dune vegetation that may occur during construction, such as within construction corridors or staging areas for equipment, should be mitigated for in-place, where possible. Mitigation projects may attempt to repair or restore impacted dune vegetation in its original footprint by watering the impacted area. Spreading new seeds and transplanting live root dune vegetation will be necessary if the existing dune vegetation is cleared or removed. If dune vegetation will be harvested and transplanted to the mitigation area, the applicant must harvest the vegetation in a manner that will not damage the existing dunes in the harvest locations. Plants may only be taken from dense stands in areas that are not subject to erosion and should not be taken from coppice mounds or foredunes that are sparsely vegetated. Individual plants should be removed in a scattered pattern at intervals of no less than two feet, and the root structure should remain intact. Property owner permission is required to harvest vegetation from outside the boundaries of the property.

Compensation

For compensation projects, the entirety of the dune vegetation in the proposed impact area should be harvested, stored and quickly relocated to the compensation site prior to the construction of any structures and within one year of the initiation of construction. Topsoil material or native hay containing seeds of indigenous dune vegetation may also be placed in the compensation area to supplement the transplanted vegetation and help achieve the required vegetative cover. The topsoil material or native hay should only contain the seeds of indigenous dune vegetation species.

Planting Density

The planting density of the vegetation in the mitigation or compensation area should be designed with the goal of meeting or exceeding the square footage and density of the dune vegetation that will be adversely impacted. Vegetation should be planted on a minimum of 2-3-foot centers (**Figure 9**) and at an adequate square footage to be equal to or greater than the square footage that was adversely impacted.

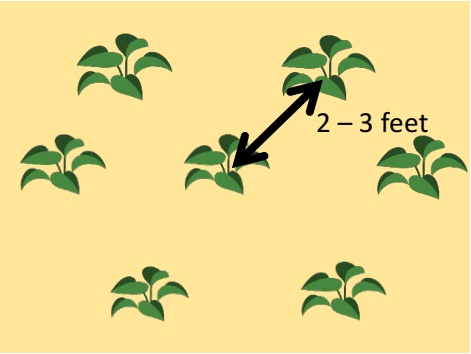


Figure 9. Example of 2 – 3 foot planting centers.

Planting vegetation closer together or at a greater square footage than what is required may help complete the mitigation or compensation on a faster timeline. Implementing a watering schedule when rainfall is limited may also help with vegetation survival and achieving completion.

Additional recommendations regarding dune vegetation plantings are available in the GLO's Dune Protection and Improvement Manual for the Texas Gulf Coast: glo.texas.gov/sites/default/files/resources/glo/coast/coastal-management/forms/files/dune-protection-manual-gpb.pdf.

Location of Mitigation or Compensation

Restored dunes may be located no more than 20 feet seaward of the line of vegetation and must follow the natural migration of the vegetation line. Local governments may not allow any person to restore dunes, even within the 20-foot corridor, if the dunes would restrict or interfere with the public use of the beach at normal high tide. Restored dunes may not be located in areas subject to regular wave action or in areas where they would prevent beach use under normal conditions. Restored dunes may not interfere with vehicular traffic or be located within the driving lane on vehicular beaches and may not interfere with or obstruct public pedestrian pathways to the beach.

In some instances, restored dunes may be allowed to be located farther seaward than the 20-foot restoration area only upon a demonstration by the applicant that substantial dunes would likely form further seaward naturally and would not restrict or interfere with public access to the beach at normal high tide.

Compensation

The GLO recommends locating compensation dunes within low spots or swales in the dune system and avoiding locating compensation in areas where it may bury existing dune vegetation growing on dunes. Compensation dunes must be continuous with any surrounding naturally formed dunes and be located as close to the impacted dunes as possible. Compensation must be located seaward of the dune protection line and should not be further landward than the dunes and dune vegetation that were adversely impacted.

Future Development

Restored dunes are protected under the same requirements as natural dunes. In most cases, structures are prohibited from being constructed or maintained on previously mitigated or compensated dunes seaward of a dune protection line, except for permitted dune walkovers or similar access ways. Applicants should take any future proposed development activities into consideration when selecting the location of mitigation or compensation areas.

Survivability

Mitigation and compensation should not be located in areas where it is likely the dunes and dune vegetation will not survive, since the permittee is required to preserve and maintain the mitigation or compensation areas until the GLO has determined mitigation is complete. Some factors that may impact the survivability of dunes and dune vegetation in a mitigation or compensation area include frequency of inundation, availability of sunlight and rainfall, and presence of vehicular and pedestrian traffic.

For example, if an applicant is proposing to construct a dune walkover and will adversely impact dune vegetation beneath and adjacent to the dune walkover during construction, in-place mitigation would not be viable beneath the dune walkover in areas where there is an inadequate height above the dunes for vegetation to survive (**Figure 10**).

Figure 10. Example of the area beneath a dune walkover where vegetation is struggling to survive.

Similarly, compensation seaward of the line of vegetation may not always be viable if the proposed compensation area is frequently inundated by high tide events or is located near vehicular driving lanes or parking areas. Compensation projects seaward of the line of vegetation should also take into consideration any ongoing beach maintenance activities that may overlap with the project.

Stabilization and Protection Techniques

Various techniques can be used to protect and stabilize sand in dune restoration projects, such as sand fencing, coconut coir fiber matting, and native hay. Any proposed stabilization or protection techniques, including fencing, must be authorized under a dune protection permit from the local government.

The planting of native vegetation to trap and stabilize sand is always preferable to the use of man-made structures, but sand fences may be used to trap sand and protect restoration projects when site conditions are appropriate. Sand fencing must be temporary and discontinuous and conform with the guidelines in the latest edition of the GLO's Dune Protection and Improvement Manual for the Texas Gulf Coast (**Figure 11**). Post-and-rope fencing may also be used to protect dune restoration sites from vehicular or pedestrian foot traffic.

Figure 11. Discontinuous sand fencing should be no more than 10 feet long placed in segments approximately 10 feet apart, facing the predominant wind direction at a 35-to-45-degree angle to the shoreline.

The GLO encourages the use of temporary fencing, such as silt fencing, flags, or other similar markers to protect existing dune areas during construction and prevent construction equipment from entering areas where impacts are not permitted.

Organic, brushy materials and other biodegradable materials, such as coconut coir fiber matting or native hay, may also be placed on top of restored dunes to try to help stabilize the sand and dune vegetation. The hay material should be sourced from indigenous dune vegetation species and should not contain any non-native seeds. Materials that are not biodegradable may not be used in dune restoration projects.

Mitigation or Compensation Completion

Permittees are required to complete the sand placement and dune vegetation relocation or planting portions of a mitigation plan within one year of the initiation of construction. Mitigation or compensation efforts must be conducted continuously until the repaired, rehabilitated, and restored dunes and dune vegetation are equal to or superior to the pre-existing dunes and dune vegetation. These efforts shall include preservation and maintenance pending completion of mitigation or compensation, which is required within three years of initiation of construction. This means that if a pending mitigation or compensation project is damaged before it is certified as complete, the permittee is responsible for conducting additional mitigation or compensation activities, including sand placement and vegetation plantings, as needed until completion is achieved.

A mitigation or compensation project is considered **complete** when the dune restoration project's position, contour, volume, elevation, and vegetative cover matches or exceeds the surrounding naturally formed dunes.

Assessing Completion

Pre-construction Site Visit

As mentioned in an above section, the GLO recommends a pre-construction site visit or meeting between the property owner or contractor, local government, and GLO to assist with the mitigation or

compensation completion assessments. These site visits would allow for pre-construction photographs and GPS points to be captured by local government or GLO staff to compare to completed projects.

If an applicant does not request or wish to participate in a pre-construction site visit, local government and GLO staff should still visit the site prior to construction to take pre-construction photographs of both the proposed impact sites and mitigation and compensation project areas. Pre-construction photographs of the impact site can be used to verify that the density of the vegetation within the mitigation or compensation area matches or exceeds the impacted vegetation.

Local government and GLO staff can also use handheld GPS units or cell phones with the appropriate software, or other similar equipment, to capture the pre-construction elevations of the proposed mitigation or compensation sites. These elevation measurements can then be compared to post-construction elevation measurements and the grading and layout plan to confirm project completeness.

Dune Volume

The dune volume portion of a mitigation or compensation project is **complete** once the volume of dunes in the mitigation or compensation area is equal to or greater than the volume of dunes that were adversely impacted, and the position, contour, and elevation of the mitigation or compensation area matches or exceeds the surrounding naturally formed dunes.

To be able to assess if the dune volume in the mitigation or compensation area is at the required size, local government and GLO staff must refer to the grading and layout plan included in the dune protection permit application. The grading and layout plan should include both the pre-existing contours and elevations of the project site and the proposed contours and elevations for final grade.

During a field inspection, local government and GLO staff can use handheld GPS units or cell phones with the appropriate software to take elevation (altitude) measurements in the mitigation or compensation area to confirm if the elevations on the ground match the proposed contours and elevations for final grade from the grading and layout plan. If the grading and layout plan included dimensions (width, length, height) of the dunes in the proposed mitigation or compensation area, measurements of the dunes can be taken using a measuring tape as an alternative to a GPS unit or cell phone. Depending on the size of the dunes in the mitigation or compensation areas, current color photographs may also be able to be used to verify completion.

Local governments may also elect to use drones, if available, to capture images of a mitigation or compensation area before and after mitigation/compensation occurs and use available software, such as Drone Deploy, to calculate elevation differences.

If a dune protection permit authorized significant large-scale impacts to dune volume or if unauthorized impacts to dunes occurred, the local government or GLO may also request a post-construction topographic survey showing the final topography of the site.

Dune Vegetation

The dune vegetation portion of a mitigation or compensation project is **complete** once the square footage of dune vegetation in the mitigation or compensation area is equal to or greater than the square footage of dune vegetation that was adversely impacted and the vegetative cover within the mitigation or compensation area matches or exceeds the surrounding naturally formed dunes.

Newly planted vegetation within the mitigation or compensation area is not considered complete immediately after the initial planting. The vegetation needs to become established and grow to reach the same vegetative cover and density as the surrounding naturally formed dunes. For additional information on assessing vegetative cover, refer to Page 9. **Figure 12** shows vegetation recently planted that would not yet be considered complete mitigation or compensation as the vegetative cover is sparse and not as dense as the surrounding dunes.

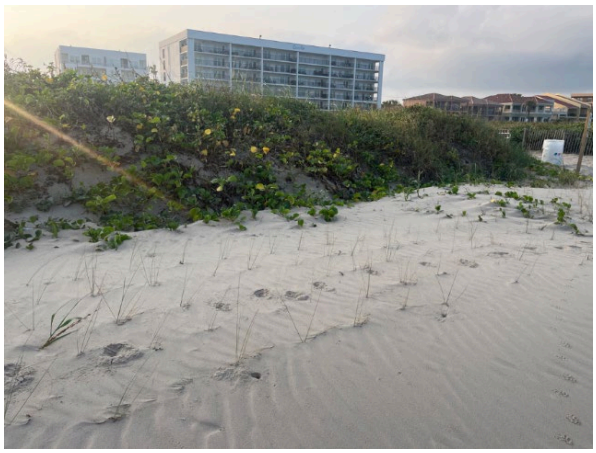


Figure 12. Recently planted dune vegetation.

Figures 13 and 14 below show a restoration site immediately after vegetation was planted compared to after the vegetative cover has filled in. Mitigation/compensation would not be considered complete until the vegetative cover matches existing surrounding natural dunes, as seen in B of both figures.

A. B.

Figure 13. The image on the left (A) shows a mitigation site immediately after planting, and the image on the right (B) shows the same site a year later after the vegetation cover has expanded to match the surrounding dunes.

A. B.

Figure 14. The image on the left (A) shows a restoration site immediately after planting, and the image on the right (B) shows the same site later that year after the vegetation cover has become established. Photographs provided by Steve Mercer.

Monitoring

The GLO encourages permittees to assess the survivability of newly planted vegetation 60 to 90 days following planting. If a significant number of plants do not survive, permittees should consider replanting to be able to achieve the required square footage and vegetative cover.

Following the initial survivability assessment, the GLO recommends permittees reassess mitigation and compensation sites on a quarterly basis for the first year and on a biannual basis following the first year until the vegetative cover matches the surrounding natural dunes.

If any dune sand or dune vegetation within the mitigation/compensation area becomes damaged or washes away pending completion, the permittee is responsible for maintaining the mitigation/compensation area by placing additional dune sand and planting additional vegetation as needed.

Permittees should include a **monitoring plan** within their mitigation plan that outlines the frequency of monitoring events and the maintenance activities that may be undertaken based on the findings of the monitoring events.

Deadlines

Permittees must begin mitigation or compensation for any adverse effects to dunes and dune vegetation prior to or concurrent with the commencement of construction. If mitigation or compensation is not completed in accordance with the mitigation plan prior to the commencement of construction, the permittee must provide the local government with proof of financial responsibility in the amount equal to that necessary to complete the mitigation or compensation.

Permittees must complete the sand placement and, if applicable, the dune vegetation relocation or planting portions of the mitigation or compensation plan within one year of initiation of construction. The GLO recognizes that the time necessary to restore dunes and dune vegetation varies with factors such as climate, time of year, soil moisture, plant stability, and storm activity. Therefore, permittees are required to complete mitigation or compensation and achieve a 1:1 ratio within three years of initiation of construction.

A summary of the deadlines related to mitigation or compensation is as follows:

- **Initiation of mitigation or compensation**: prior to or concurrent with construction, or proof of financial responsibility is required.
- **Sand placement and dune vegetation relocation or plantings**: within 1 year of initiation of construction.
- **Completion of mitigation/compensation at a 1:1 ratio**: within 3 years of initiation of construction.

If a permittee fails to meet any of the above-mentioned deadlines or other deadlines included as a special condition of the dune protection permit issued by the local government, the GLO and the local government may initiate enforcement as provided in 31 TAC § 15.9.

Certification of Completion

Permittee Inspection

Permittees should notify local governments of the following:

- Date of the initiation of construction,
- Date of sand placement and dune vegetation relocation or planting activities, and
- The completion of mitigation and compensation activities at a 1:1 ratio.

Local Government Inspection

The local government will use the mitigation plan included in the permit application to verify that the mitigation or compensation is complete, as defined in the above sections, during a site visit. After the local government determines that mitigation or compensation is complete, the local government must provide written notification to the GLO. Written notifications to the GLO of complete mitigation or compensation should include photographs or other evidence supporting the local government's preliminary determination.

GLO Inspection

The GLO may conduct a field inspection to verify compliance with 31 TAC § 15.4(g). The GLO will reference the mitigation plan included in the permit application to confirm that the volume of dunes and square footage and density of dune vegetation in the mitigation or compensation area matches or exceeds the impacted dunes and dune vegetation.

If the local government does not receive an objection from the GLO regarding the completion of mitigation or compensation within 30 working days after the GLO is notified in writing, the local government may certify that the mitigation or compensation is complete.

Timeline

Below is a timeline summarizing the mitigation and compensation deadlines and completion steps.

1. Optional pre-construction meeting with local government and/or GLO staff where pre-construction photographs and measurements can be taken.
2. Property owner, contractor, or developer obtains dune protection permit from local government prior to beginning any construction activities on-site, including any grading, clearing, filling, excavating, or placing materials on site.
3. Permittee notifies the local government of the date of the initiation of construction, and the local government notes the date in the tracking spreadsheet.
4. Permittee notifies the local government of the completion of the sand placement and vegetation planting activities within the mitigation or compensation area (required to be completed within 1 year of initiation of construction). Local government verifies completion and notes date in the tracking spreadsheet.
5. Permittee monitors the mitigation or compensation area regularly to assess if there has been any damage and if any maintenance activities (i.e., placing additional sand, planting additional vegetation) are needed.
6. Permittee notifies the local government of the completion of mitigation or compensation when a 1:1 ratio has been achieved (required within 3 years of the initiation of construction).
    - Dune vegetation: square footage equal to or greater than impacted area identified in permit, and vegetative cover matches or exceeds surrounding natural dunes
    - Dunes: volume equal to or greater than impacted area identified in permit
7. Local government performs a site inspection to verify if mitigation is compensation is complete and may request a preliminary consultation from the GLO on completeness.
8. After a local government determines that mitigation or compensation is complete, the local government provides written notification to the GLO, which should include supporting documentation demonstrating completeness.
9. If the local government does not receive an objection from the GLO within 30 days after the GLO is notified in writing, the local government may certify that the mitigation or compensation is complete. GLO may conduct a field inspection to verify completeness.

Local Government and GLO Tracking

Local governments and the GLO will coordinate to track and monitor permitted mitigation and compensation projects through a shared spreadsheet. The GLO has created spreadsheets for each jurisdiction that have been shared with the local governments. Once the permittee has notified the local government of the initiation of construction and the completion of the sand placement and vegetation planting activities, the local government should add these dates to the shared tracking spreadsheet. The spreadsheet should also be updated with field inspection dates and comments by the local government and GLO and with the completion date of mitigation or compensation.

The GLO and local government will meet twice a year or more to review the pending mitigation and compensation projects and discuss any upcoming field inspections.

APPENDIX A: Dune Protection Permit Application Checklist

General Application Requirements

Dune protection permit applications must include the following, at a minimum:

- ☐ A comprehensive mitigation plan that conforms with the requirements in 31 TAC §§ 15.4 and 15.7 which includes a detailed description of the methods which will be used to avoid, minimize, mitigate, and/or compensate for any adverse effects on dunes or dune vegetation. The mitigation plan should include the following information:
    - Narrative describing how the proposed impacts to dunes and dune vegetation are unavoidable and have been minimized to the greatest extent practicable.
    - Detailed description of the methods which will be used to mitigate and/or compensate for any adverse impacts to dunes and dune vegetation, including the source of any sand and vegetation to be used in the mitigation or compensation project.
        - If any fill or off-site sand will be used, a sediment analysis that accurately reflects the characteristics of the fill material to be placed on site needs to be provided to demonstrate that the grain size and mineralogy of the proposed fill material will be similar to native beach sand.
        - Planting and revegetation procedures, including information regarding the species of vegetation or seeds to be used. If vegetation will be harvested on or off site, a description of the methods which will be used to harvest dune vegetation in a manner that will not damage dunes in the proposed harvest location should be provided.
        - If dune vegetation will be harvested from off site, written permission from the property owner for vegetation removal is required.
    - A timeline that demonstrates compliance with required deadlines and a monitoring plan to ensure completion of required mitigation or compensation.

- ☐ An accurate map, site plan, survey, or plat identifying the following:
    - Location and quantity of proposed adverse impacts to dunes and dune vegetation, which clearly identifies the square footage of dune vegetation and volume of dunes to be adversely impacted;
    - Location and quantity of the proposed mitigation or compensation, which clearly identifies the square footage of dune vegetation and volume of dunes to be located in the proposed mitigation or compensation area; and
    - Distance from the seaward extent of the project area to the line of vegetation.

- ☐ A grading and layout plan identifying all existing and proposed elevations (in reference to the National Oceanic and Atmospheric Administration data), existing contours of the project area (including the location of dunes and swales), and proposed contours for final grade. If the proposed contours for final grade will be identical to the existing contours on site, an additional final grading and layout plan is not required.

- ☐ Current color photographs of the site which clearly show the current location of the vegetation line and the existing dunes on and immediately adjacent to the tract. The photographs should be dated and must clearly show both the area where dune and/or dune vegetation impacts are proposed and the proposed compensation areas.

- ☐ Where a mitigation plan is required, the contact information for all landowners immediately adjacent to the tract and affirmation by the applicant that the adjacent landowners will be provided with notice of the hearing at least 10 days prior to the hearing on the application.

- ☐ Proof of the applicant's financial capability acceptable to the local government to mitigate or compensate for adverse effects on dunes and dune vegetation.

Dune Walkover Application

Applications proposing the construction of a **dune walkover** must also include the following:

- ☐ Accurate cross-section and elevation view designs of the proposed dune walkover, which shows the proposed height of the walkover over the dunes and proposed width of the dune walkover.

- ☐ If any work is being done on the ground for the construction of the dune walkover, the adverse impacts that may occur within a construction corridor must be included in the mitigation plan.

Off-Site Compensation

Applications proposing **off-site compensation** for adverse impacts to dunes and dune vegetation must provide the following additional application materials:

- ☐ The name, address, contact information, and legal description of the property intended to be used for off-site compensation.

- ☐ Information demonstrating that off-site compensation will be located as close to the construction site as practicable.

- ☐ Information demonstrating that FEMA Region 6 has been notified of the proposed off-site compensation.

- ☐ All relevant information regarding the success, current status, and stabilization of the dune restoration efforts on the compensation site.

- ☐ Any increase in potential flood damage to the site where the adverse effects on dunes and dune vegetation will occur and to the public and private property adjacent to that site.

- ☐ The proposed date of initiation of the compensation. Local governments shall include a condition in each permit authorizing off-site compensation, which requires permittees to notify local governments in writing of the actual date of initiation within 10 working days after compensation is initiated.

APPENDIX B: Mitigation Plan Template

Below is a template of the information that should be included in a mitigation plan, at a minimum. Note that the below is specific to the mitigation plan and may not identify all application requirements for a dune protection permit application.

Site address: _____

Legal description: _____

Applicant: _____

Property owner (if different from applicant): _____

Proposed activities causing adverse impacts *(example: dune walkover)*: _____

_____

Proposed adverse impacts to dunes and/or dune vegetation seaward of the dune protection line:

_____ cubic yards of dunes

_____ square feet of dune vegetation

Proposed mitigation and/or compensation:

Mitigation (in-place)

_____ cubic yards of dunes

_____ square feet of dune vegetation

Compensation (in alternate location)

_____ cubic yards of dunes

_____ square feet of dune vegetation

Compensation will occur (circle answer): On-site and/or Off-site

If off-site compensation is proposed, provide the name, address, contact information, and legal description of the property used for off-stie compensation. Information demonstrating that on-site compensation is not possible and that the off-site compensation will be located as close to the construction site as practicable must be provided.

Description of how the proposed impacts to dunes and dune vegetation are unavoidable and have been minimized to the greatest extent practicable:

- *Has the applicant located the construction as far landward as practicable?*
- *Can the applicant locate the construction activities outside of the critical dune area?*

- *How has construction been minimized to the greatest extent practicable?*

Detailed description of methods which will be used to mitigate and/or compensate for any adverse effects on dunes or dune vegetation:

- *Information regarding any adverse impacts that may occur within a construction corridor or for staging areas for equipment.*
- *Information regarding the source of the sand to be used within the mitigation or compensation areas. If sand from off-site will be used, a sediment analysis needs to be provided to demonstrate that the grain size and mineralogy of the proposed material will be similar to the material on site.*
- *Planting and revegetation procedures, including information regarding the source and species of vegetation to be used.*
- *If vegetation will be harvested off site, written permission from the property owner for vegetation removal is required. If vegetation will be harvested from an area seaward of the dune protection line, the proposed harvest location and a description of the methods which will be used to harvest the dune vegetation in a manner that will not damage critical dunes should be provided.*

A timeline that demonstrates compliance with required deadlines and a monitoring plan to ensure completion of required mitigation and/or compensation.

- *Summary of deadlines for completion of mitigation and/or compensation:*
    - *Initiation of mitigation or compensation must be prior to or concurrent with construction or proof of financial responsibility is required.*
    - *Sand placement and dune vegetation relocation or plantings must be conducted within 1 year of initiation of construction.*
    - *Completion of mitigation/compensation at a 1:1 ratio must be completed within 3 years of initiation of construction.*

Attachments:

Has an accurate map provided (Y/N)? _____

Note: The map must identify: (1) the location and square footage of dune vegetation and volume of dunes to be adversely impacted, (2) the location and square footage of dune vegetation and volume of dunes to be located in a mitigation and/or compensation area, and (3) distance from the seaward extent of the project area to the line of vegetation. Providing dimensions of these areas is helpful.

Has a grading and layout plan been provided (Y/N)? _____

> *Note: The grading and layout plan must identify all existing and proposed elevations, existing contours of the project area, and proposed contours for final grade. If proposed contours for final grade will be identical to the existing contours on site, an additional final grading and layout plan is not required.*

Has contact information for all landowners immediately adjacent to the tract been provided (Y/N)?

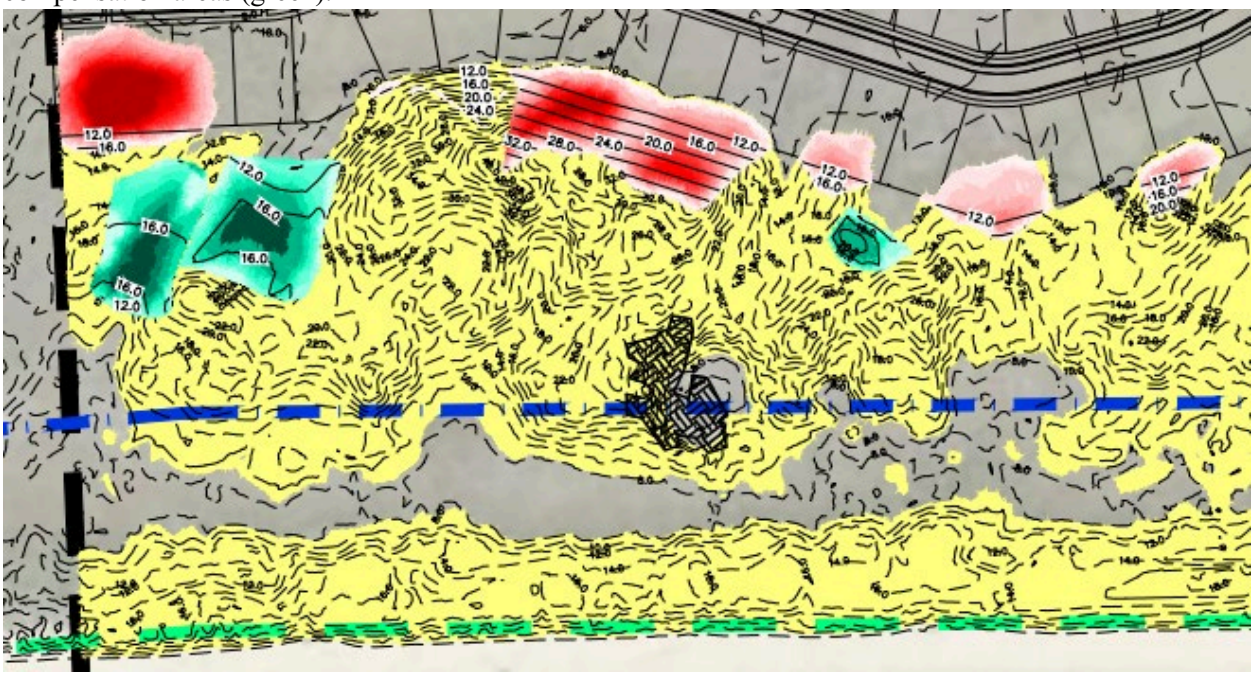
_____

Has affirmation by the applicant that the adjacent landowners will be provided with notice of the hearing at least 10 days prior to the hearing on the application been provided (Y/N)? _____

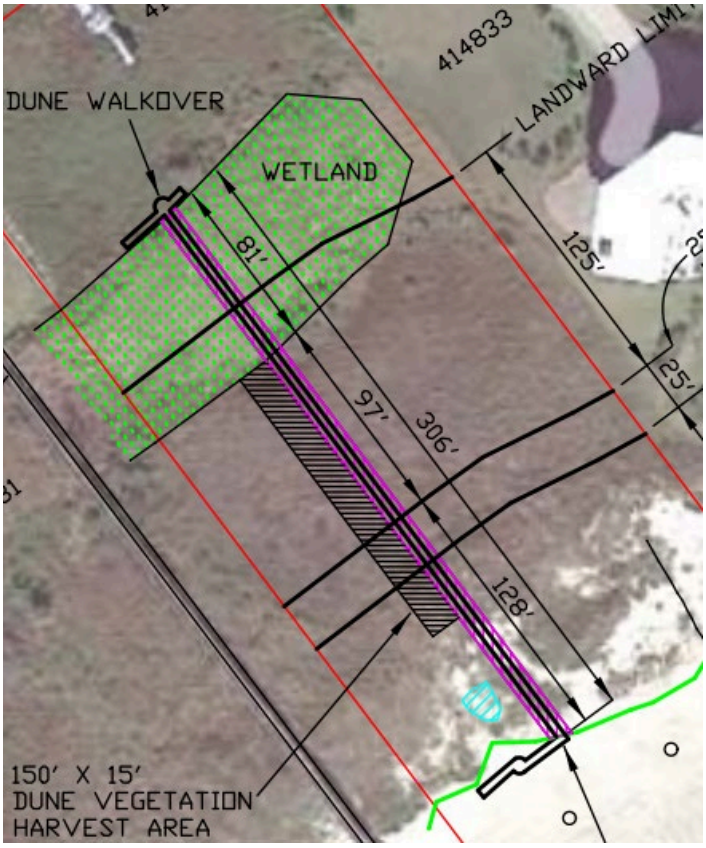
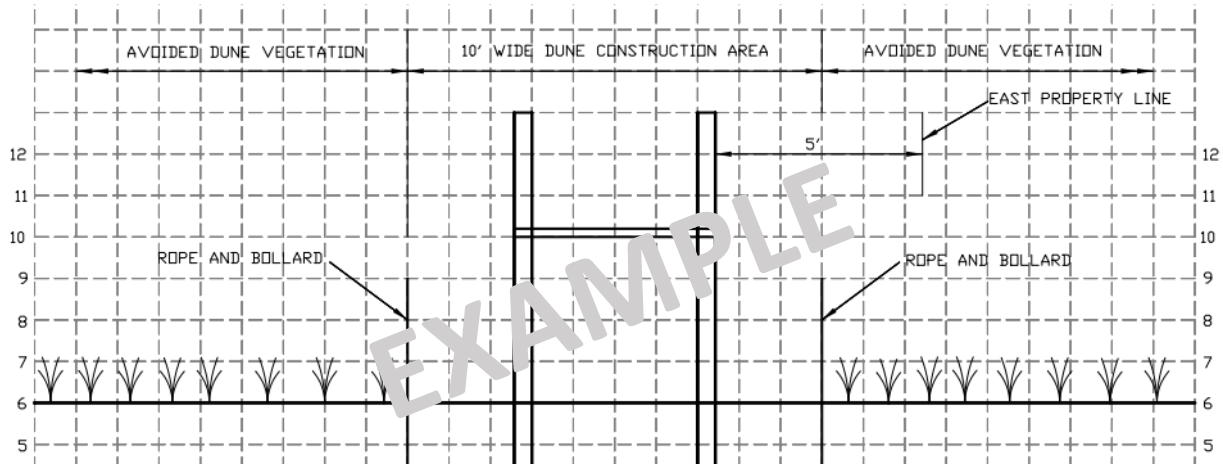
Have current color photographs of the site which clearly show the dunes to be adverse impacted and the area where mitigation or compensation is proposed been provided (Y/N)? _____

EXAMPLES

Example grading and layout plan identifying the critical dune area (yellow), the location of the impacted dunes and dune vegetation (red), and the location and proposed contours for final grade of the compensation areas (green).



Example map for a dune walkover identifying in-place dune vegetation mitigation for a construction corridor (pink) and the dune vegetation harvest area (black).



Example construction plans for a dune walkover showing a construction corridor where in-place mitigation will occur.