GUIDELINES
for
CREATING and STABILIZING SAND DUNES
From Massachusetts to North Carolina

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DEFFINITION: Effective establishment and maintenance of physical (living or inert) barriers which manage the surface movement of shifting coastal beach sands.

PURPOSE: To develop a system of coastal sand dunes to protect human lives, personal property, and community infrastructures. A secondary benefit of such developments is the creation and protection of critical habitat of threatened and endangered bird species.

WHERE APPLICABLE: Along ocean and bay shorelines; where blowing sands and storm waters may cause damage to human and wildlife resources.

METHODS and MATERIALS: Sand dunes naturally form on barrier islands, shorelines exposed directly to the ocean, and inland sand deposits. The source of this wind born sand is the ocean or its bays. These parallel ridges of sand form perpendicular to prevailing winds and grow toward its source of sand. Periodic storm events and human activity continually alter their development and original configuration. Once developed the sand dunes provide adequate protection from moderate storms and tides. The existence and maintenance of vegetation on dunes provides a network of root and foliage which holds unconsolidated sand in place. American beachgrass is the dominant, naturally occurring, vegetation of the frontal dunes of the northern Mid-Atlantic and New England coasts. From Vriginia beach southward through the Carolinas, sea oats becomes the dominant foredune plant. When beachgrass or sea oats are established with structural resources and other dune species, a formidable well-anchored storm barrier is established, capable of saving major public and private assets. Establishing curvilinear foot paths or wooden crosswalks through or over the sand dunes, bordered by sand fencing, is necessary where foot or vehicular traffic is expected.

1.VEGETATION

A. **Plant Materials**: The foliage of most sand dune species filters sand from the wind. The reduction of wind velocity near the dune's surface by vegetation allows sand to be deposited. The root mass of these plant species adapted to the sand dune environment are typically deep and extensive, anchoring the dunes to their foundation. When possible only certified cultivars, which have been tested on similar sites, should be utilized for protecting valuable coastal resources.

1).Cultivar Releases recommended for stabilizing sand dunes; all cultivars listed were released by the USDA- Natural Resources Conservation Service's Plant Materials Program:

a.) **'Cape'** american beachgrass (*Ammophila breviligulata*)
b.) **'Atlantic'** coastal panicgrass (*Panicum amarum var. amarulum*)
c.) **'Avalon'** saltmeadow cordgrass (*Spartina patens*)
d.) **'Wildwood'** bayberry (*Myrica pensylvanica*)
e.) **'Ocean View'** beach plum (*Prunus maritima*)

2.) Additional plant materials suitable for adding plant diversity on sand dunes:

a.) Dune Crest 'Germplasm coastal little bluestem (*Schizachyrium scoparium* var. *littoralis*)
b.) 'Monarch' Germplasm seaside goldenrod (*Solidago sempervirens*)
c) partridge pea (*Chamaecrista fasiculata*)
d.) beach pea (*Lathyrus maritimus*)
e.) eastern red cedar (*Juniperus virginiana*)
f.) groundsel tree (*Baccharis halimifolia*)

NOTE: The cultivars listed were developed specifically for sand dune stabilization and should be specified and used when available. By using cultivars developed for such a harsh environment, the risk of plant failure is reduced.
In addition, when developing a planting plan for a dune system, it is imperative to plant species in their zone of adaptation.
The species best adapted to the frontal dune face are american beachgrass. As you move onto the back of the frontal dune or into the secondary dune system, the additional species listed above may be incorporated into the planting as available. By broading the plant diversity, the risk of plant failure is further minimized.

B. **Plant Establishment**

1.) 'Cape' american beachgrass (*Ammophila breveligulata*)- Beachgrass is successionally classified as a pioneering type species; it is about the only species capable of surviving the harsh environmental conditions of the frontal dunes. For initially stabilizing a dune system, this species is the most reliable and commercially available option. Once established it rapidly spreads by a rhizomatous root system, developing a soil binding network of inter-woven roots.

Date = November 1 to April 1; under non-frozen soil conditions
Planting Unit = a minimum of two stems (culms) per hole
Method = hand placement, or use of a vegetable or tree planter
Size = 16 to 18 inch long stems, ≥ ¼ inch in diameter
Depth = culms placed approximately 8-10 inches deep
Spacing: severe sites = 12" X 12"
normal sites = 18" X 18"
stable sites = 24" X 24"
Notes:

- Plant ≥ 100 feet of horizontal distance from the mean high tide water line to ensure success
- Plant a minimum of 10 parallel rows; stagger (off-set) rows to maximize protection
- Firm soil around plants to eliminate air pockets
- If utilizing dredged fill allow salts to leach out before planting and rains to compact sands

2.) 'Atlantic' coastal panicgrass (*Panicum amarum var.amarulum*)- This warm season bunch-like grass is a post stabilization species thriving from the crest of the frontal dune to inland sites. It is the only dune stabilization species which has been directly seeded on to the sand dunes successfully. Potted plants and stem divisions can also be successfully established on these severe sites. The annual foliage emerges from a deep fibrous perennial root system with short lateral rhizomes. This species can be successfully planted with or over seeded into stands of American beachgrass. The closely related switchgrass is not as well adapted to sand dune conditions due to its lower seedling vigor. However, it is a good alternative, especially north of Long Island where coastal panicgrass is not native.

Date: Seeding: over seeding = April 1 to May 1

Dormant seeding = November 1 to April 15
Planting = April 1 to May 15
Planting Unit = single bare-root or containerized seedling or division; 12 - 18 inches tall
Seeding rate = 8 to 12 Lbs. of Pure Live Seed (PLS) per acre
Depth: plants = 2 inches deeper than the nursery depth
seed = drilled 1½ to 2½ inches deep
Method: seed = hand broadcast/incorporated, garden seeder (single row, push) or mechanically operated drill or drop seeder
plants = hand placed, or use a vegetable or tree transplanter
Spacing: plants = place 2-4 feet apart within a row with rows spaced 6-8 feet apart
seed = 3' to 10' row spacing

3.) 'Avalon' saltmeadow cordgrass (*Spartina patens*)- Although typically associated with tidal salt marshes, saltmeadow cordgrass also naturally occurs in the secondary and back dune areas. Predominantly inhabiting inter-dune troughs and low blow-out areas. It is dominate in these micro-sites since most other sand dune species can not tolerate wet to saturated soil conditions. The trailing rhizomes of saltmeadow cordgrass are slender, but form dense mats near the surface. It is vegetatively established on normal sites using freshly harvested stems (culms) or containerized plants on severe locations.

Date = May 1 to May 15
Planting Unit = 3 to 5 live stems placed bare-root or containerized
Depth = 2 inches below the nursery grown depth
Method = hand placed, or vegetable planter
Size = ≥ 12 inches
Spacing = 18 to 36 inches depending on the severity of the planting site
Notes: Utilize this species in low elevation sites of sand dunes which are frequently moist or inundated.

3.) Seacoast bluestem (*Schizachyrium littorale*)**–** This native, warm-season grass is a coastal variation of the inland little bluestem. It differs visually with a more prostrate growth habit. Found in scattered open clumps in the back dunes, it rarely forms a solid stand, but is found mixed with other species such as beach heather, seaside goldenrod, beachgrass, bayberry, beach plum.

Date = March 1 to April 15

Planting Unit = one bare-root or potted plant
Depth = 2 inches below the nursery grown depth
Method = hand placed or vegetable planter
Size = ≥ 12-24 inch stem
Spacing = 24 to 36 inch row spacing with plants placed 24 inches apart within a row. Plant in the backdunes where sand is stable. May be interplanted with switchgrass, coastal panicgrass, saltmeadow cordgrass, seaside goldenrod, and beach or partridge pea.

5.) **Monarch Germplasm seaside goldenrod** (*Solidago sempervirens*) – This perennial forb adds color and variety to a dune planting. It is a major food source on the fall migration of the Monarch butterfly. From it's inconspicuous green basal leaves in winter into early summer arises a brilliant yellow flower cluster in early fall. Although often blamed for causing allergies, it is actually an insect pollinated plant. (Ragweed is the real culprit).

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Planting Unit = one bare-root or potted plant
Depth = 2 inches below the nursery grown depth
Method = hand placed or vegetable planter
Size = ≥ 12-18 inch stem
Spacing = 24 to 36 inch row spacing with plants placed 24 inches apart within a row. Plant in the backdunes where sand is stable. May be interplanted with switchgrass, coastal panicgrass, saltmeadow cordgrass, and beach or partridge pea.

6.) **Beach pea and partridge pea** (*Lathyrus maritimus/Chamaecrista fasciculata*) Beach pea is adapted from New Jersey- north and partridge pea, an annual reseeding legume, from Massachusetts to the Carolinas. These native legumes have good wildlife value as edible seed for both upland game and shore birds.

Partridge pea (seed only)
Date: Seeding: over seeding = April 1 to May 15
dormant seeding = November 1 to April 15

Seeding rate = 2-4 pounds of Pure Live Seed (PLS) per acre.

Depth: = seed drilled 1½ to 2½ inches deep in stilled sand

Method: seed = hand broadcast/incorporated, single row garden seeder, or mechanically operated drill or drop seeder

Beach pea (plants only)
Planting Unit = single bare-root or containerized seedling or division; 12 - 18 inches tall
planting = April 1 to May 15

Depth: plants = 2 inches deeper than the nursery depth
Method: plants = hand placed, or use a vegetable or tree planter
Spacing: plants = 4' X 4'
seed = 3' to 10' row spacing

7.) Shrubs and Trees (bayberry, beachplum, rugosa rose, groundsel)- Medium sized shrubs and small trees naturally dominate the back dune zone of New Jersey's barrier islands. The shrubs begin to co-inhabit the mid secondary dunes. Once extensive stands of bayberry, beach plum, pitch pine and other woody species covered these islands where houses now stand. The shrub species which are well adapted to the dune ecosystem are capable of either layering or root suckering. The trees and shrubs of the sand dunes have deep tap root systems for supplying adequate moisture and nutrients. Each species utilized for back dune stabilization has its own unique attributes Beach plum has a colorful bloom in spring which yields a tasty succulent cherry like fruit. Bayberry roots have nodules which enable it to fix atmospheric nitrogen similar to legumes; it also produces aromatic fruit and leaves. The thorny stems of rugosa rose are useful in directing pedestrian traffic along established access trails. This rose species also blooms from late spring to early fall, then gives rise to a bright red fruit. The pines and junipers which are adapted to sand dunes provide the visual appeal of evergreens in the back dunes. The major function of tree and shrub vegetation on sand dunes is still the permanent solid structural stabilization. All of trees and shrubs of the sand dunes produce viable seed, but intentional establishment occurs using bare-rooted or potted seedlings.

Date = March 15 to April 15; unless soil is frozen

Planting Unit = 1/0 or 2/0 bare-root seedlings or containerized transplants
Depth = 2 inches below the nursery grown depth
Method = hand placement or using a tree planter
Size = ≥ 12 inches tall
Spacing = 4 to 6 feet apart; off-set (stagger) rows for maximum protection
Notes: to ensure establishment (first 2 years) all competing vegetation must be removed from within 2 feet of each plant; it is important not fertilize the surrounding vegetation which will potentially out-compete the tree or shrub

C. **Maintenance**

Fertilizer

Date = May through July; no sooner than 30 days after planting
Rate = ≤ 50 lbs. of nitrogen (N) per acre, ≤ 25 lbs. of phosphorus (P) and potassium (K) per acre
Frequency :

- Apply N for the first two years after planting, then as needed to maintain stem density and plant health.
- Single or split applications are acceptable if not applied before May 1 or after July 30. Split applications must be at least 30 days apart.
- It is only necessary to apply P and K bi-annually

Recommended Formulations:

- 10-10-10, 20-10-10, 15-10-10, etc. are acceptable as long as the maximum rates per nutrient are not exceeded
- Time release fertilizers are encouraged that will provide the target amounts of the primary nutrients per acre.

Notes:

- Only apply fertilizer to within the drip line of shrubs and trees. Not following this rule will result in excessive herbaceous growth, which will out compete newly established trees and shrubs.
- Apply using broadcasting machinery

2.) Replant:

- Like a chain, a dune system is no stronger than its weakest link. Uniform, unbroken dune lines are essential to the protection a system can provide.

- Uncontrollable events (i.e. storms, construction, etc.) may damage sand dunes. If such damage occurs between October and April replant within a month. If the damage is experienced from May to September, utilize the outlined sand fencing or excavation procedures listed below, then plant during the recommended establishment period .

2. SAND FENCING: A quick and effective way to build temporary sand dunes is with the use of sand fencing (standard snow fence). Utilizing lines of fencing and wooden posts, orientated parallel to the beach. A source of sand is necessary for this technique to be effective, but it is not limited by time of establishment.

A. **Materials**

1) Fencing:
   - Standard 4 ft. slatted wood snow fencing; wood must be decay free
   - Four wire ties ($\geq$ 12 ga.) must be used to secure fencing to each post.
2) Posts:
   - Wooden posts must be $\geq$ 6½ ft. long, with a minimum diameter of 3 inches; typical length ranges from 7 to 8 ft.
   - The posts should be made from black locust, eastern red cedar, Atlantic white cedar, or other species of similar durability and strength.
   - Space posts 10 ft. apart, and set them $\geq$ 3 feet deep

B. **Technique**

1) Position - orientate fence lines parallel to waterline of the beach, at least 140 feet from mean high tide (see figure 2)
2) Height - with adequate sand sources, dune elevations can be increased annually by at least four foot increments. (approximately the maximum height of the fencing, this can be increased with vegetation); The maximum dune height which is attainable will range from 12 to 15 feet, but is greatly influenced by prevailing wind velocities and sand grain size
3) Installation - weave fencing in front of and behind alternating posts to attain maximum strength
4) Number of Rows - 2 parallel rows spaced 30 to 40 feet apart, are ideal; but single rows with 30 ft. perpendicular spurs, spaced 40 ft. apart are also acceptable if space is a major limiting factor

5) Replacement - sand will typically fill fencing to ¾ of its total height at a maximum; upon reaching maximum fence capacity, additional lines of fence can be added until maximum planned dune height is reached; replace damaged fencing and posts within one month of storm damage to maintain a contiguous dune line

C. **Comments**

- This method is more expensive per linear foot than building dunes with vegetation alone, but less expensive than using earth moving machinery to construct dunes.
- Although dune height can be increased faster, it is limited by the fence height and ability to continually add more lines of fencing.
- Planting parallel rows of vegetation on either side of fences is usually more effective than either vegetation or fencing techniques alone.
- When complementing fencing with vegetation, do not plant closer than ten feet and no further than 15 feet from the fence lines. Vegetative strips should be about 20 ft. wide

3. **MECHANICAL EXCAVATION**

- With the use of various earth moving machines temporary, excavated sand dunes are quickly created.
- Since time is required for settling and cohesion to occur, such dunes are often short lived and only provide minimal protection to the public and private resources behind them.
- This method is often useful in the repair of storm damaged sand dunes during the fall and winter months. Any blow-out areas can be quickly filled.
- Front-end loaders of all sizes can be used. Various grading machines are also useful.
- Pumped sand from off shore dredging can be shaped and positioned with machinery