ATTACHMENT 15
SUBTASK I.A.2.b.

DUNE MANAGEMENT PLANNING

A Guide to Preparing a
Dune Management Plan as
provided for in
Statewide Planning Goal 18
(Beaches and Dunes)

July 1989

Department of Land Conservation and Development
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Introduction

Oceanfront dunes in developed areas are often viewed as a nuisance. In a few short years, grass-covered dunes can grow up until they block previously unobstructed views from oceanfront homes. Unvegetated dunes can in days or weeks either bury or scour homes along the shore.

Although dunes are often a source of frustration for oceanfront homeowners, they are also critical to protection of both the homes and the ocean beach. Dunes are immense reservoirs of sand which, in the worst of times, can save oceanfront homes from flooding and erosion. The dunes also protect the beach, for whether it happens slowly or suddenly, erosion of the dune adds sand to the beach.

State rules which limit alterations to foredunes are designed to strike a reasonable balance--to provide for enjoyment of oceanfront homes but, at the same time, recognize and protect the important values and functions that dunes provide.

This guide is designed to help property owners, local officials, planners and others prepare dune management plans. Such plans are required in order to allow grading to restore or establish views across a foredune or to prevent sand inundation of oceanfront buildings.

The recommendations provided here are based on the Department of Land Conservation and Development's experience in applying Goal 18. Much of this experience was gained in the preparation of a foredune grading plan for Nedonna Beach in Tillamook County. The Nedonna plan is a model for other areas. Copies of the Nedonna Beach Foredune Grading Plan are available from DLCD.

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Table of Contents

Background.....1

Oregon's Coastal Dunes.....1
Foredunes and Flood Protection.....1
State Land Use Policies.....3
Planning Requirements for Beaches and Dunes.....3
1984 Amendments to Allow Foredune Grading.....4

Deciding Whether a Dune Management Plan Is Needed.....7

Does the Area Qualify for Grading?.....7
Removal of Sand Inundation.....8

How to Prepare a Dune Management Plan.....11

Step 1: Determine if the Area Qualifies for Grading.....11
Step 2: Identify a Planning Area.....13
Step 3: Evaluate Dune Stability.....14
Step 4: Set Minimum Dune Height and Width.....16
Step 5: Prepare Management Plan Measures.....17
Step 6: Coordinate With Other Agencies.....20
Step 7: Plan Adoption, Implementation & Amendment.....21

Appendices

References.....23
Definitions.....24
Goal 18 (Beaches and Dunes).....26
Specifications for Dune Management Activities
(from the Nedonna Beach Dune Grading Plan).....28

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Background

Oregon's Coastal Dunes

Oregon's coast is a series of beaches separated by large basalt headlands. Headlands block the movement of sand and sediment alongshore. This separates beaches from one another into self-contained systems. Many of these systems have extensive sand deposits and well-developed beaches, dunes and nearshore sandbars.

Large vegetated foredunes are a relatively recent development on Oregon's coast. Growth of foredunes followed the introduction (and spread) of European beachgrass (Ammophilia arenaria) at the turn of the century. European beachgrass has caused a higher, more wind-stable dune to form further seaward than the dune formed by native American dune grass (Elymus mollis). This has resulted in some important changes to the shoreline. Areas that were previously part of the beach or ocean are now covered by tall vegetated sand dunes.

Since the turn of the century, foredunes on the Oregon Coast have also been the focus of resort and second home development. To date, a total of about 12 miles of foredune has been developed, with mostly second homes and motels.

Development has occurred on foredunes in spite of their obvious instability and potential for erosion. Erosion events over the last eighty years have uncovered sawed logs buried in the foredunes: evidence that major dune accretion has occurred in the last 100 years. Erosion of sand spit foredunes has been notable. The resort community of Bayocean on the spit at Tillamook Bay was destroyed by erosion between 1939 and 1952. Erosion at Siletz Spit (1972) and Alsea Spit (1984) has destroyed and damaged oceanfront homes at those locations. Lesser erosion events in other areas have prompted homeowners to place riprap to protect their homes from erosion.

Foredunes and Flood Protection

As noted above, foredunes play a key role in protecting the shoreline from flooding. The importance of the foredune has been well established by scientific studies:

> As the dune is attacked by storm waves, eroded material is carried out and deposited offshore, where it alters the underwater configuration of the beach. Accumulating sand decreases the offshore beach slope (makes it more nearly horizontal), thereby presenting a broader bottom surface to storm wave action. This surface absorbs or dissipates through friction an increasingly large amount of destructive wave energy that would otherwise be focused on the shoreline behind the barrier (Clark, 1977).

> While the sloping beach and beach berm are the outer line of defense to absorb most of the wave energy, dunes are the last zone of defense in absorbing the energy of storm waves that overtop the berm. Although the dunes erode during severe storms, they are often substantial enough to afford complete protection to the land behind them. Even when breached by waves of a severe storm, dunes may gradually rebuild naturally to provide protection to the land behind them (Corps of Engineers, 1975).

Flooding and shoreline erosion on the Oregon Coast are attributable to several factors. Catastrophic flooding is projected by the Federal Emergency Management Agency (FEMA) as the 100-year flood. A 100-year ocean flood combines high tides with a storm surge and/or a tsunami. The projected elevation of such a flood along the Oregon Coast varies depending on shoreline characteristics, and ranges from 19 to 29 feet above mean sea level.

Erosion usually occurs as part of major flooding events but is also attributable to several other factors. Jetties, like those at Bayocean Spit (at Tillamook Bay), block littoral drift and cause erosion of down-drift beaches.

Erosion on sand spits can also occur when jetties are not present. El Niño events on the Pacific Coast change Oregon's normal pattern of no net littoral drift to a net northerly littoral drift. The 1982-83 El Niño event was followed by major accretion at the northern ends of pocket beaches and erosion at the southern ends all along the Oregon Coast. At the mouth of Alsea Bay, an uncontrolled outlet, the northward movement of sand built a bar across the usual inlet position, deflecting it northward. As a result, most of the spit was eroded away, tripling the size of the inlet opening (Rosenfeld, 1985).

Nearshore currents can also combine to cause or exacerbate shoreline erosion. Rip currents, caused by waves approaching parallel to the shoreline forming a cell circulation, cut a trough in the offshore bar as they move away from the beach. Rip currents hollow out embayments which can provide an opening for direct wave erosion of the shoreline (Komar, 1979). Rip currents have been most clearly associated with erosion at Siletz Spit in 1972-73, and probably contributed to erosion at Nedonna Beach in 1977-78.

The extent of erosion and flooding varies depending on the combination of these and other factors. 100-year flooding would inundate most of Rockaway Beach west of the Coast Highway, and would cause substantial erosion. Erosion is usually centered in the lee of rip currents and can be very rapid, removing up to 100 feet of property in two or three weeks (Komar, 1979).

State Land Use Policies

In the late 1960's and early 1970's, the State of Oregon adopted several laws to limit inappropriate development of coastal resources. In 1967, Oregon legislators enacted a state Beach Bill, establishing a public easement over Pacific Ocean beaches up to the vegetation line on sandy beaches. The state's easement is based on the historic use of the beaches as highways. While many beaches are still privately owned, the state's recreational easement both assures uninterrupted recreational use of the beach and prohibits any alteration by landowners without state approval. Permits are only allowed when they will not interfere with public use of the beach.

In 1971, the state began developing detailed policies for the entire coastal zone. This culminated in 1976 with the adoption of four Statewide Planning Goals for coastal resources. The Goals are the state's coastal regulations adopted by the state's land use planning agency: the Land Conservation and Development Commission (LCDC). Cities and counties are required to adopt comprehensive plans and land use ordinances which implement the Goals. LCDC then reviews and approves plans for compliance with the Goals. (By 1986, all of the state's coastal cities and counties had acknowledged comprehensive plans.)

Planning Requirements for Beaches and Dunes

Statewide Planning Goal 18 (Beaches and Dunes) sets specific standards for regulating new development in beach and dune areas. The Goal prohibits building on undeveloped foredunes that are subject to ocean flooding or erosion. The Goal includes other standards to protect development from flooding and erosion and to avoid interference with the natural sand system:

- Findings are required for any new development in beach or dune areas. These findings must assess the effects of the proposed development on the beach and dunes and on surrounding development, and demonstrate how the development will avoid or minimize impacts on the dune and adjacent areas.

- Breaching of foredunes is prohibited, except for temporary breaching in emergencies, such as to drain floodwater from upland areas.

- Riprap and other structural means of erosion control are only allowed on shorelines that were developed by January 1, 1977.

Local governments typically implement Goal 18 portions of their plans through special zoning districts or overlay zones which require that any proposed development or dune alteration be reviewed and approved by the local government. Ordinances also usually require minimum setbacks from the beach zone line. Local

zoning ordinances also implement the federal floodplain management requirements. Regulations adopted to implement these requirements prohibit development in velocity flooding areas. Essentially, new development on vacant lots must be set back at least as far as existing homes on adjacent lots.

In-fill development is allowed on foredunes that were developed when the Goals were adopted. Groups of lots in areas that had existing homes, or a combination of public facilities and services (roads, sewer, water, etc.) on January 1, 1977, are considered "committed to development" and thus exempt from the prohibition on new development in foredunes. New homes in such areas generally must be located in line with existing homes.

1984 Amendments to Allow Foredune Grading

In 1984, the Oregon Legislature directed LCDC to evaluate the coastal goals to determine how well they were working and to suggest appropriate changes. Property owners from Nedonna Beach and elsewhere convinced the Commission to reassess its prohibition on grading. Property owners contended that grading could be done in a way that would not harm the foredune. Several experts suggested that grading, along with other measures, might actually be a means of improving the foredune's resistance to flooding and erosion.

The Department of Land Conservation and Development (DLCD) formed an advisory committee of scientists, planners and citizens to determine if grading could be done in a way that would not harm the foredune. The committee was asked to address two questions:

1. Is it possible to alter foredunes by grading and not compromise their flood and erosion protection qualities; and

2. How should grading or similar activities be regulated to assure that these benefits are not significantly reduced or destroyed?

The committee assessed the effect of grading by reviewing how foredunes affect and are affected by flooding. The committee concluded that the foredune's major asset is its bulk: more sand means more capacity to absorb ocean wave energy. Foredune height and vegetative cover were also considered important. Height is important because of the potential for large waves to overtop the foredune completely and thereby directly attack back areas. Beachgrass captures windblown sand on the dune, helping build up the dune, and its extensive root system helps bind the sand together in the face of ocean flooding.

The committee's major conclusion was that the potential for flooding would typically not be increased by grading because grading would not reduce the amount of sand in the foredune. Rather, grading would simply rearrange the sand, moving some of

the sand from the top of the dune, the crest, to the forward part of the dune, the foreslope. If the sand were properly stabilized, the foredune would retain the same mass of sand to withstand ocean flooding. Other standards in a plan for grading would prescribe sloping and a minimum height to assure that the dune slope is preserved, and so that grading does not make the dune more subject to ocean flooding.

If the grading did not lower the foredune below the flood level, and if graded areas were revegetated, the committee reasoned that the foredune's ability to withstand flooding would not be reduced. The committee recommended that Goal 18 be amended to allow grading based on the following principles:

1. Grading should be done based on plans for an entire area because geologic processes affect entire stretches of shoreline.

2. Plans should be based on clear information about the long-term stability of the particular stretch of shoreline, with special emphasis on factors which affect sand supply to the beach including patterns of ocean flooding, erosion and accretion and the effects of shoreline structures.

3. Grading should not increase the area subject to 100-year flooding.

4. Grading should be done as part of a plan to build up a dune to some minimum height and width to provide a uniform barrier to ocean flooding and erosion.

5. Graded areas should be promptly stabilized.

6. Sand should not be removed from the beach-dune system.

The Commission adopted the advisory committee's recommendations that limited grading be allowed for view maintenance where a management plan had been prepared. Specifically, the Goal amendment adopted by the Commission provided that:

> Grading or sand movement necessary to maintain views or to prevent sand inundation may be allowed for structures in foredune areas only if the area is committed to development and only as part of an overall plan for managing foredune grading. A foredune grading plan shall include the following elements based on consideration of factors affecting the stability of the shoreline to be managed including sources of sand, ocean flooding, patterns of accretion and erosion (including wind erosion) and the effects of beachfront protective structures and jetties. The plan shall:

a. Cover an entire beach and foredune area subject to an accretion problem including adjacent areas potentially affected by changes in flooding, erosion or accretion as a result of dune grading;

b. Specify minimum dune height and width requirements to be maintained for protection from flooding and erosion. The minimum height for flood protection is four feet above the 100-year flood elevation;

c. Identify and set priorities for low and narrow dune areas which need to be built up;

d. Prescribe standards for redistribution of sand and temporary and permanent stabilization measures including the timing of these activities; and

e. Prohibit removal of sand from the beach-foredune system.

Deciding Whether a Dune Management Plan is Needed

Dune management is usually needed in developed areas. This is because dunes have been altered by past events, such as erosion and grading, which have reduced the dunes' ability to withstand erosion and flooding. Cooperative action by the affected property owners (through a plan) is usually the best way to improve the condition of the dune.

What kinds of alterations are permitted without a plan?

Generally, actions which improve the condition of the dune are encouraged and can be permitted without a plan. These include:

- Planting or fertilizing beachgrass;
- Placement of sand fences to build up low areas; and,
- Removal of sand accumulations around an existing dwelling. (Any removal which lowers the height of the foredune requires a plan amendment--see discussion below.)

Some of these actions require permits or approval from the affected city or county. Alterations to dunes seaward of the beach zone line require approval from the State Parks and Recreation Department.

Even though plans are generally desirable, grading and planning don't necessarily go together. Many developed dune areas will <u>not</u> qualify for view grading because the dunes are too low (i.e., they are less than four feet above the 100-year flood elevation). Even in these cases, though, a plan may be desirable to help deal with some other dune-related problems, such as blowing sand, public access, fire hazards or habitat enhancement.

In some very limited situations (described below), grading can be permitted without a foredune grading plan. Basically, this is when grading does not involve a breach in the foredune.

Does the Area Qualify for Grading?

The first step in applying Goal 18 is to determine whether or not the area proposed for grading qualifies for grading. The basic requirements to qualify for dune grading are these:

- The area to be graded must be presently "developed" or within an acknowledged urban growth boundary (UGB).
- Areas to be lowered must be more than 4 feet above the 100-year flood level.

- A management plan must be prepared and adopted by the affected city and county.

- The plan must cover a complete area, not just one or a few lots.

Removal of Sand Inundation

Goal 18 requires a plan to grade sand in order to "prevent" sand inundation. The Goal does not require a plan to remove sand which is actually inundating a structure. The following discussion is provided to help distinguish between "preventative" grading (which requires a plan) and "remedial" removal (which does not).

The distinction between grading which is "preventative" and that which is "remedial" is subtle but important. Remedial grading is by its nature maintenance: it is necessary to keep the building functional. Sand which is physically piled up against exterior walls, doors or windows can damage the structure (by rot or breakage) or prevent access into and out of the structure. Consequently, removal of sand which is physically piled up against a building and which prevents normal access to the building is remedial and permissible without a plan.

Allowing very limited removal also recognizes that removal of sand which is actually against a house is a temporary, stopgap solution. More extensive removal is typically done as a longer-term solution with the hope that it will prevent sand from building up. Both because it is intended as a long-term solution and because it constitutes a more major alteration of the foredune, preventative grading is prohibited without a full-fledged dune management plan.

The Goal requires a management plan for preventative grading because of its potential harmful effects--more extensive grading can increase potential flood damage, increase sand inundation of neighboring properties or damage dune integrity. In the interim, other measures, such as sand fencing or vegetative plantings, can help minimize the need for periodic removal.

Defining Remedial Grading

The character of piled sand and the technology for moving sand determine what a minimal amount of removal is. Accumulations of dry sand typically collapse when excavated. Sand is typically graded with a front end loader, bulldozer or small, rubber-tired grader, such as a "bobcat." Removal is accomplished by pushing or carrying sand seaward onto or over the crest of the dune. This requires some slight reverse slope to allow sand-moving equipment to traverse the dune.

Guidelines for Removal of Sand Inundations

The following guidelines are intended to help counties determine how much removal is the minimum amount necessary to make a building functional. While these are only guidelines, more extensive removal is arguably for the purpose of preventing inundation and would, under Goal 18, require a dune management plan.

Remedial sand removal may include:

- Clearing of sand which is actually inundating houses or commercial or industrial buildings. Clearing should only remove sand within 15 feet of the building to a level not more than 6" below the sill of the closest part of the building's foundation.

- Foundation excavation that is necessary for constructing a new structure.

- Excavation necessary for the purpose of placing a beachfront protective structure.

- Minor reshaping of the forward portion necessary to provide an even slope for planting stabilizing vegetation.

All of these activities will typically require a development permit from the county. And, the county will need to apply the requirements in its plan for review of development in beach and dune areas.

Recommended Conditions on Remedial Grading

The following conditions are suggestions for cities and counties to use in regulating grading around existing houses and buildings. Although these are only recommendations, they are designed to limit grading consistent with the requirements in Goal 18.

Rear yard: (Rear yard is the yard seaward of the structure) Sand may be removed to the level of the top sill of the foundation within 10 feet of the building. From the 10-foot line, all grading shall slope upward to the crest of the dune at a ratio of 2:1 (horizontal:vertical).

Side yards: Sand may be removed to the level of the top sill of the foundation within 5 feet of the building. From the 5-foot line, sand grading shall slope upward at a ratio of 2:1.

Front yard: All sand that is landward of the building may be removed down to the sill level of the foundation, provided removal does not create slopes of more than 2:1 with adjacent

properties. Grading may not lower the front yard below the level of adjacent streets or roads except to clear sidewalks or driveways.

General Conditions:

- All grading should be done so that it does not lower the height of the foredune below that specified. Any removal which exceeds standards must be promptly restored.

- A 48-hour prior notice of date and time for grading is required to allow onsite inspection by the city or county or to provide for flagging by the city or county.

- All graded sand should be placed on the foredune seaward of the building.

- Temporary and permanent stabilization to prevent or minimize new sand buildup is required. Temporary stabilization usually includes covering graded sand with ryegrass straw and punching straw into the sand. Permanent stabilization should be accomplished through planting of beachgrass and fertilization.

How to Prepare a Dune Management Plan

If measures other than remedial grading aren't adequate to handle the sand inundation problem you're dealing with, a dune management plan may be necessary. The following discussion provides a step-by-step guide to preparing a dune management plan.

Each section includes a discussion of the key Goal requirements and provides some practical direction in assembling the information needed to put together a plan. Answers to common questions are provided at the end of each section.

This discussion will help explain how the Nedonna Beach Foredune Grading Plan and Technical Report were prepared.

Step 1: Determine if the Area Qualifies for Grading.

Not all areas can qualify for dune grading. Grading is only permitted in the following circumstances:

- The area to be graded is presently developed;
- Grading is to restore ocean views or prevent sand inundation; and,
- A plan for the area is prepared in compliance with Goal 18.

"Developed" Areas

Areas that were developed on January 1, 1977, and all areas within acknowledged urban growth boundaries are potentially eligible for grading. "Development" means houses, commercial and industrial buildings, and vacant subdivision lots which are physically improved through construction of streets and provision of utilities to the lot.

Areas that do not qualify as developed may be included within a dune management plan but are not eligible for grading.

The Goal limits foredune grading to areas developed before 1977, because these areas had a reasonable expectation of maintaining ocean views. Areas developed since 1977 have been developed with knowledge of the restrictive requirements of Goal 18, and should have accounted for potential dune accretion or erosion in the siting process.

Goal 18 prohibits residential, industrial and commercial development on foredunes subject to ocean flooding or wave overtopping or undercutting. Areas that were built upon prior to the effective date of the Goal (January 1, 1977) have generally been exempted from this ban through the adoption of Goal exceptions. (Also, 1984 amendments required local governments to

identify "developed areas" at the time of periodic review.) The acknowledged city or county comprehensive plan should indicate what areas are "developed" and are thus eligible for foredune grading.

Eligibility for Grading vs. Dune Management Planning

There has been some confusion about what areas may be included within a dune management plan because of the restriction on dune grading. Areas that are not eligible for grading (i.e., undeveloped areas) can and usually should be included within a management plan. Management actions other than grading may be necessary or appropriate in these areas.

Preparation of a Plan in Compliance With Goal 18

A plan must be for an area, not just a few lots. Processes that shape dunes cover larger areas. Effective management requires dealing with larger areas. This requires that an expert in beach and dune processes assess the condition of the dune and potential erosion problems, and prescribe areawide solutions. The following discussion suggests how a plan can be prepared.

Who is Qualified to Do a Dune Management Plan?

State rules do not set formal qualifications for persons to do dune management plans or any other kind of plan. Preparing a dune management plan does, however, require some knowledge of dune and shore processes and knowledge about sand stabilization. Usually this requires a combination of expertise. For the Nedonna Beach plan, the state employed two "experts." One was a state-registered engineering geologist with specific training and experience with shore processes. The second was a person with long experience with sand stabilization.

These experts do not have to write every step of the plan. Typically, a city or county planner working with these experts can prepare an acceptable plan. Experts need to be involved in making the key technical judgements about the nature of problems in the area and making specific recommendations about appropriate corrective measures. Many of the specifications in the Nedonna plan can be applied in other areas with little or no change. However, relevant experts should be consulted first to confirm that these practices are appropriate for the particular situation.

Who Prepares and Adopts the Plan?

A dune management plan needs to be adopted by the city or county that has planning and zoning responsibility for the area covered by the plan. The plan itself may be prepared by any qualified group or individual. For example, a plan could be sponsored by a property owner's association or a special district.

Plans should be prepared with the involvement of all the affected property owners as well as affected agencies and groups. This assures that a range of interests and concerns are reflected in the final product. Broad involvement and review is also a good means to check the technical assessment provided by the experts involved in preparing the plan.

Step 2: Identify a Planning Area

Goal 18 Implementation Requirement 7(a) requires that dune management plans cover an entire beach and foredune area subject to an accretion problem, including adjacent areas potentially affected by changes in flooding, erosion, or accretion as a result of dune grading.

Identification of a planning area should be based on a technical evaluation of an entire littoral cell. A littoral cell includes a stretch of shoreline bordered on either end by headlands, jetties or other obstructions which block the longshore movement of sand by waves and currents.

The evaluation should be conducted by a person with expertise in nearshore coastal processes and should be based on a review of available information about the study area. This would include:

- Studies on historic rates of erosion and accretion; and

- Floodplain studies prepared by FEMA.

The technical evaluation should also identify what adjacent areas are likely to be affected by dune grading activities. These areas must be included in the plan. At a minimum, these areas must include:

- Areas that may be affected by ocean flooding; and

- Areas subject to erosion or accretion as a result of dune grading.

Can a Planning Area Be Less Than an Entire Littoral Cell?

Yes. Based on the technical evaluation, local government may choose to focus its planning effort on a particular portion of a littoral cell, provided that the entire area subject to an accretion problem is included. In order to select a short area of shoreline (i.e., an area of less than 2000') for management, the plan should show that nearby areas:

- Are not experiencing sand accretion problems;

- Are adequately stabilized; and

- Are unlikely to be adversely affected by dune management on the subject property.

Plans must address sand management on an areawide basis rather than for individual lots or small groups of lots. This is critical because the processes that shape beaches and dunes occur over larger areas. Effective management requires dealing with sand movement over a large area. Management plans for individual lots or small stretches of shoreline are generally inappropriate. Lot-by-lot management is not workable because actions in one part of an area will directly or indirectly affect the rest of the area.

Dune management plans for very short stretches of shoreline are only appropriate when an accretion problem is clearly limited to a small area.

Step 3. Evaluate Dune Stability

Goal 18 Implementation Requirement 7 requires that plans be based on consideration of factors affecting the stability of the shoreline to be managed including sources of sand, ocean flooding, patterns of accretion and erosion (including wind erosion), and effects of beachfront protective structures and jetties.

Plans must identify and assess the effect of the range of natural and human factors that may affect beach and dune stability. The purpose of this requirement is to assure that management plans are prepared with a complete understanding of the factors that might affect plan implementation. Complete knowledge about the processes at work may alter the steps taken to maintain and enhance the beach and foredune. At a minimum, confirming the range of potential hazards should serve as a notice and disclaimer to property owners about the potential hazards to development located on or near foredunes.

Sources of sand need to be studied to determine whether accretion is a long-term problem for the area or simply a freak occurrence. For example, recent erosion and accretion events appear to be linked to the very intense El Niño experienced in 1982-83. The short-term results of El Niño may be offset by long-term changes to the area. Information on ocean flooding is available by consulting the Federal Emergency Management Agency's floodplain maps for the area. Plans should also consider FEMA's recent regulations regarding re-mapping of velocity flood zones, also called V-zones. The new regulations, which have not yet been applied to the Oregon Coast, will probably extend V-zones landward. The regulations require that dunes have a cross-sectional area of 540 square feet or more above the stillwater flood elevation level in order to be considered adequate to withstand ocean flooding. Dunes that are of less volume will be considered to be ineffective in preventing ocean flooding. In addition, V-zones will extend to the landward side of the oceanfront dune.

The effects of beachfront protective structures are relatively well established (see Komar, 1979 and Komar and McDougall 1988). Onsite investigation should be able to confirm the importance of specific structures in a study area. At Nedonna Beach, for example, restoration of the Nehalem River jetties was found to be critical to maintaining the foredune in that stretch of shoreline.

One conclusion of this analysis might be that catastrophic dune erosion and serious damage to development is unavoidable. Even if this is the conclusion, dune management may still be advisable to delay or lessen this unavoidable damage. If the analysis produces this kind of conclusion, local governments should clearly notify property owners. They should also consider enacting other restrictions on new development to avoid or minimize these hazards. Appropriate responses might include a plan for landward relocation of development, notice and disclaimer to property owner's about risks, etc.

Sources of Information

This evaluation should compile information from a variety of sources:

- General coastwide information about coastal processes and problems. Several studies provide good background information about coastal processes and hazards. These provide general information that should provide a baseline for technical recommendations about dune management.

- Historical aerial photography. Aerial photographs of the entire ocean shoreline are available back to 1939. Comparing photos over the last 50 years provides an excellent basis for evaluating hazards and processes for a specific area. This historical information can be used to apply the general coastwide studies.

- Past site-specific studies. Much of the Oregon coast has been studied for one reason or another in the past. These other studies can provide specific information about processes at work in the area. For example, a key element to any dune management plan is the FEMA floodplain maps for the area.

- Onsite investigation. Experts should walk the area to confirm existing conditions and to assess specific problems and potential solutions. Onsite surveys of existing conditions are also very helpful.

Step 4: Set Minimum Dune Height and Width

Implementation Requirement 7(b) requires that foredune grading plans "specify a minimum dune height and width to be maintained for protection from flooding and erosion. The minimum height for flood protection is 4 feet above the 100-year flood elevation."

The purpose of the minimum requirement is to maintain the foredune's ability to survive a major erosion or flooding event. The foredune protects landward development by absorbing and reflecting wave erosion that would otherwise damage or destroy landward structures. As a general rule, the dune should be as wide as possible--the wider, the better. For purposes of the Goal requirement, the dune should be wide enough to withstand reasonably predictable erosion. Foredunes along the Oregon coast have been known to erode 150 feet or more in a single erosion event.

Setting the minimum foredune width should be based on consideration of several factors:

- The horizontal extent of shoreline retreat likely to occur as a result of long-term shoreline retreat (i.e., 50 years).

- The horizontal extent of shoreline erosion induced by a 100-year flood event.

- The minimum width necessary to comply with FEMA's requirement for a cross-sectional area of 540 square feet above the stillwater flood level forward of the crest of the foredune.

- Some additional distance (20-30 feet) to provide a buffer area between oceanfront buildings and the projected line of erosion.

For planning purposes, foredune width should be measured from the oceanfront building setback line or existing shoreline protection structures (whichever is further seaward) to the seaward edge of the foredune.

What Steps Are Required to Meet the Minimum Foredune Width Requirements?

The management plan should include steps which are sufficient to establish or maintain a foredune in compliance with the minimum width described above. This should include establishing a setback line for new residential development and commercial and industrial buildings.

The setback line should apply to all structures or improvements which are essential to the existence or operation of the use and that would require protection from erosion by structural

shoreline protection. This would include accessory structures, parking areas, utilities, drainfields, etc.

The setback would not need to apply to minor structures, such as freestanding decks or fences, that are of minor value and that would not require shoreline protective structures. Goal 18's prohibition on development in active foredunes allows "other development" (i.e., other than residential, commercial or industrial development) if it is demonstrated that the development:

a. Is adequately protected from any geologic hazards, wind erosion, undercutting, ocean flooding and storm waves; or is of minimal value; and,

b. Is designed to minimize adverse environmental effects. (Goal 18, Implementation Requirement 2)

Developments of minimal value suitable in foredune areas include beach and dune boardwalks, fences which do not affect sand erosion or migration and temporary open-sided shelters.

Step 5: Prepare Management Plan Measures

Subsections (c), (d) and (e) of Implementation Requirement 7 list specific measures which must be included in a dune management plan. These steps should be adequate to establish and maintain a foredune which meets the minimum width and height requirements specified in the plan.

Plans should include a step-by-step plan of action for establishing and maintaining a foredune adequate to comply with the requirements of this Goal. This action plan should specify the timing, by calendar year and season, of the recommended management measures to be taken, such as movement of sand, placement of structures, vegetative plantings or other temporary and permanent stabilization measures.

Decisions about what measures or combination of measures are appropriate requires a site-specific analysis of the area to be managed and the desired results. This part of the plan should be prepared by a qualified expert in dune management. At Nedonna Beach, a series of subareas were identified. Each subarea included a dune with relatively consistent characteristics--dune height and width and vegetative cover were relatively constant and development was similar throughout the area. By dealing with small areas, the plan can be tailored to fit the needs and problems in each area.

Usually the plan will be implemented in two parts. The first part should specify a number of steps that are necessary to establish an optimal dune. For example, areawide grading, shaping, planting and fertilizing will be done to initially implement the plan over a broad area. Implementation of these

measures might take place over a two or three-year period, depending on the condition of the dune.

The second part of the plan will be the specifications on how each of these individual activities is done. These are intended to regulate management of the dune after the first couple of years but should be applied when the plan is initially implemented. Appropriate implementing measures may include placement of graded sand, planting, fertilization, propagation or suppression of stabilizing vegetation, and placement of temporary stabilization devices, such as sand fences. Specifications for each of these activities as developed for Nedonna Beach are included in the appendix.

Dunes are changing features. Erosion, unanticipated accretion or other alterations to the dune will require remedial action to repair or rebuild the dune. Providing the specifications anticipates the need for ongoing management of the dune. It should also help give property owners guidance on how and where to manage the dune.

Setting Priorities for Building Up Low and Narrow Areas

Most developed dune areas have breaches, or low or narrow spots. These are typically the result of past alterations or flood or erosion events. Since the dune effectively functions as an erodible dike, any low or narrow spot is a weakness in the dune which reduces the dune's ability to withstand a major flooding event.

Subsection (c) requires that dune management plans identify and set priorities for low and narrow dune areas which need to be built up. The overall objective is to make the dune a more effective and uniform barrier for flood protection.

The general priorities for placement of graded sand should be in the following order:

- Filling of foredune areas which are below the 100-year flood elevation up to the 100-year flood elevation.

- Filling of foredune areas which are lower or narrower than the minimum dune height and width specified in the management plan. Generally, the lowest and narrowest areas should be filled first.

- Filling of other foredune areas that have been identified as having special management needs or problems.

- Filling of other areas to establish a more uniform dune profile throughout the area subject to the management plan.

- Placement on the beach below the high water line.

It is usually not feasible to move graded sand more than 200 or 300 feet. (It's expensive and can damage the dune by disturbing a large area.) Consequently, meeting these priorities will depend on how close graded areas are to those that need more sand.

Standards for Sand Redistribution and Temporary and Permanent Stabilization

Incorrectly done, sand grading can destabilize the dune and cause sand to inundate landward areas. Grading must be carefully done in order to avoid these problems. The Nedonna Plan includes a number of standards which regulate how grading should occur. The Nedonna specifications are generally applicable to most foredune areas in Oregon. However, each dune area should be reviewed individually to determine if some special or additional precautions are necessary to properly protect the dune from damage.

Some key considerations are:

- Avoid deep excavation or fills of vegetated areas. European beachgrass, for example, can recover (with fertilization) where the dune is graded two to four feet. Deeper cuts appear to reduce the ability of the grass to recover, which makes some planting necessary. The same is generally true for fills.

- Provide temporary stabilization. Grading destroys beachgrass's ability to hold sand, at least until the grass can grow back. Until this happens, the dune is very vulnerable to wind erosion. Ryegrass straw punched into the sand is an effective means of providing temporary wind stabilization.

- Fertilize. The need to plant or replant beachgrass can be reduced or avoided if graded or sparsely vegetated areas are properly fertilized.

- Encourage foreslope vegetation. Plants deflect winds upward, causing sands to drop. Dunes generally grow in height because there is little or no vegetation on the front face of the dune to stop the sand. Consequently, sand is blown upslope to the top of the dune where it hits a mass of vegetation and drops, causing the dune to grow taller. Planting or fertilizing grass on the foreslope can catch this sand on the front of the dune and cause the dune to grow in width rather than height. This can avoid or reduce the need for subsequent grading.

- Plant beachgrass in bare areas.

- Sign and fence where appropriate. Dunes are sensitive to human use. This is especially true for graded areas sprouting new beachgrass. Signs and sand fences should inform the public about the stabilization project and channel foot traffic so that it doesn't harm the dune.

To meet this requirement, plans should include specific requirements regulating the placement and stabilization of graded sand.

Prohibition on Removal of Sand

Dune management plans are required to prohibit the removal of sand from the beach-foredune system. The reason for this requirement is simple. Foredune management is an attempt to maintain and enhance the protection that the beach and dune provide from ocean flooding. This protection is determined in large part by the amount of sand in the system. On Oregon's coast, there does not appear to be any new sources of sand to the beach-dune system. This means that removal reduces the amount of sand in the system. While any individual removal is likely to have a negligible effect, removing modest amounts over a long period of time will cumulatively reduce the supply of sand in the beach-dune system. This in turn will reduce the size of the beach and dune and reduce protection provided by the dune.

Where sand grading is allowed, sand must be retained in the beach and dune system. For practical purposes, the "beach-foredune system" includes the beach and the foredune landward to either the line of existing oceanfront buildings or shorefront protective structures, whichever is further seaward.

Step 6: Coordinate With Other Agencies

Several agencies have responsibility for development or regulation of development of beach and dune areas. They should be notified of and involved in the preparation of dune management plans under this section:

- Oregon Division of State Lands

- Oregon Department of Parks and Recreation

- Federal Emergency Management Agency

- Local sewer or water district, if any

- Local utilities which provide underground service or connections.

Plans which provide for management of beach or dune areas seaward of the beach zone line should be submitted to the Department of Parks and Recreation for their review and approval. Plans which provide for fill or removal in areas seaward of the vegetation line should be submitted to the Division of State Lands for their review and approval.

How Does a Dune Management Plan Affect the Permitting or Regulatory Authority of Other Agencies?

The Goal is not intended to diminish or avoid compliance with applicable requirements of other state, local or federal laws which regulate development or alterations to beaches and dunes. Permits or other approvals may be necessary from the following agencies for alterations to dune areas:

Agency	Area Regulated
Department of Parks and Recreation	Areas seaward of the beach zone line
Division of State Lands	Areas seaward of the line of vegetation
City or County Flood Ordinances	Movement of sand in areas subject to velocity flooding.

Step 7: Plan Adoption, Implementation and Amendment

Adoption

Grading plans need to be adopted by the city and/or county with planning authority over the area covered by the plan. The amendment must include implementing zoning regulations which are adequate to assure compliance with the approved plan.

Plans and implementing ordinances will need to regulate a variety of activities that may not presently be regulated by land use ordinance. Ordinances should regulate any alteration to sand dunes including removal or destruction of vegetation, fires, vehicle access, application of herbicides, etc.

While plans need to be adopted as land use amendments, some aspects of plan implementation may be addressed by other groups. Ideally, counties may want to consider establishing a local special district with special responsibilities and enforcement powers to maintain and enhance the dune. An interim step could be to have a homeowner's association adopt bylaws which help implement the plan.

While plans must be adopted by a city or county, they can be prepared on behalf of any qualified group or individual.

Implementation

Dune management plans may be implemented by any qualified group or individual. Dune modifications require permission from the affected property owner. Where lands oceanward of the beach zone line or vegetation line are involved, permission (and possibly permits) will be needed from the Department of Parks and Recreation and the Division of State Lands.

Plans will usually require that grading or planting or other measures be done over a larger area (i.e., several lots). This is usually more economical because it allows for economies of scale for the operator.

Plans should also require periodic monitoring of the condition of the dune. Monitoring is necessary to assure that the prescribed management measures are working and to respond to unforeseen changes in the foredune. This can usually be done through short onsite visits to assess the general condition of the foredune. Usually walking the area will disclose any important changes in the dune, including the condition of stabilizing vegetation. More frequent monitoring may be needed initially to assure that grading or planting is having the desired effect.

Amendment

Plan amendments will need to comply with requirements of Goal 18. During periodic review, the local government should reevaluate the condition of the dune and the success of dune management efforts. The results of this review may suggest needed changes to the plan.

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Definitions

Dune management is an unavoidably technical subject. Clarification of some of the key terms used is helpful in applying the Goal. (Note: The definitions used here may be different than those in the applicable local plan or ordinance.)

Beach: Gently sloping areas of loose material (e.g., sand, gravel, and cobbles) that extend landward from the low-water line to a point where there is a definite change in the material type or landforms, or to the line of vegetation (Statewide Planning Goals). For the purposes of dune management planning, the landward extent of the beach is to the foreslope of the foredune.

Crest: The top portion of a foredune, typically a relatively flat portion of the dune between points where the dune slopes noticeably toward the beach or landward.

Development: The act, process or result of developing. (Develop is defined as: to bring about growth or availability; to construct or alter a structure, to conduct a mining operation, to make a physical change in the use or appearance of land, to divide land into parcels, or to create or terminate rights of access.) (Statewide Planning Goals.) Oceanfront areas are considered developed where there are houses, commercial and industrial buildings and vacant subdivision lots which are physically improved through construction of streets and provision of utilities to the lot (Goal 18, Implementation Requirement 5).

Dune: A hill or ridge of sand built up by the wind along sandy coasts (Statewide Planning Goals).

Foredune, active: An unstable barrier ridge of sand paralleling the beach and subject to wind erosion, water erosion and growth from new sand deposits. Active foredunes may include areas with beach grass and occur in sand spits and at river mouths as well as elsewhere (Statewide Planning Goals).

Foreslope: The forward or beach-facing slope of a foredune, from the point where sand is beginning to accumulate around driftwood or scattered vegetation landward to a point where the slope of the dune flattens out or the crest of the dune, whichever is further seaward.

Grading or sand movement: Any excavating or filling or combination thereof (Uniform Building Code), or redistribution of sand by mechanical means.

Littoral cell: A stretch of shoreline bordered on either end by headlands, jetties or other obstructions which block the longshore movement of sand by waves and currents.

Foredune breaching: A foredune may be breached when the exception demonstrates an existing dwelling located on the foredune is experiencing sand inundation and the grading or removal of sand is:

(a) Only to the grade of the dwelling;
(b) Limited to the immediate area in which the dwelling is

(c) Sand is retained in the dune system by placement on the beach in front of the dwelling; and,
(d) the provisions of Goal 18 Implementation Requirement 1 are met. (Exceptions Rule, OAR 660-04-022(8))

18. BEACHES AND DUNES

GOAL

To conserve, protect, where appropriate develop, and where appropriate restore the resources and benefits of coastal beach and dune areas; and

To reduce the hazard to human life and property from natural or man-induced actions associated with these areas.

Coastal comprehensive plans and implementing actions shall provide for diverse and appropriate use of beach and dune areas consistent with their ecological, recreational, aesthetic, water resource, and economic values, and consistent with the natural limitations of beaches, dunes, and dune vegetation for development.

INVENTORY REQUIREMENTS

Inventories shall be conducted to provide information necessary for identifying and designating beach and dune uses and policies. Inventories shall describe the stability, movement, groundwater resource, hazards and values of the beach and dune areas in sufficient detail to establish a sound basis for planning and management. For beach and dune areas adjacent to coastal waters, inventories shall also address the inventory requirements of the Coastal Shorelands Goal.

COMPREHENSIVE PLAN REQUIREMENTS

Based upon the inventory, comprehensive plans for coastal areas shall:

1. Identify beach and dune areas; and
2. Establish policies and uses for these areas consistent with the provisions of this goal.

IDENTIFICATION OF BEACHES AND DUNES

Coastal areas subject to this goal shall include beaches, active dune forms, recently stabilized dune forms, older stabilized dune forms and interdune forms.

USES

Uses shall be based on the capabilities and limitations of beach and dune areas to sustain different levels of use or development, and the need to protect areas of critical environmental concern, areas having scenic, scientific, or biological importance, and significant wildlife habitat as identified through application of Goals 5 and 17.

IMPLEMENTATION REQUIREMENTS

1. Local governments and state and federal agencies shall base decisions on plans, ordinances and land use actions in beach and dune areas, other than older stabilized dunes, on specific findings that shall include at least:
   a. The type of use proposed and the adverse effects it might have on the site and adjacent areas;
   b. Temporary and permanent stabilization programs and the planned maintenance of new and existing vegetation;
   c. Methods for protecting the surrounding area from any adverse effects of the development; and
   d. Hazards to life, public and private property, and the natural environment which may be caused by the proposed use.
2. Local governments and state and federal agencies shall prohibit residential developments and commercial and industrial buildings on beaches, active foredunes, on other foredunes which are conditionally stable and that are subject to ocean undercutting or wave overtopping, and on interdune areas (deflation plains) that are subject to ocean flooding. Other development in these areas shall be permitted only if the findings required in (1) above are presented and it is demonstrated that the proposed development:
   a. Is adequately protected from any geologic hazards, wind erosion, undercutting, ocean flooding and storm waves; or is of minimal value; and
   b. Is designed to minimize adverse environmental effects.
3. Local governments and state and federal agencies shall regulate actions in beach and dune areas to minimize the resulting erosion. Such actions include, but are not limited to, the destruction of desirable vegetation (including inadvertent destruction by moisture loss or root damage), the exposure of stable and conditionally stable areas to erosion, and construction of shore structures which modify current or wave patterns leading to beach erosion.
4. Local, state and federal plans, implementing actions and permit reviews shall protect the groundwater from drawdown which would lead to loss of stabilizing vegetation, loss of water quality, or intrusion of salt water into water supplies. Building permits for single family dwellings are exempt from this requirement if appropriate findings are provided in the comprehensive plan or at the time of subdivision approval.

(Continued on next page)

18. BEACHES AND DUNES (Continued)

5. Permits for beachfront protective structures shall be issued only where development existed on January 1, 1977. Local comprehensive plans shall identify areas where development existed on January 1, 1977. For the purposes of this requirement and implementation Requirement 7 "development" means houses, commercial and industrial buildings, and vacant subdivision lots which are physically improved through construction of streets and provision of utilities to the lot and includes areas where an exception to (2) above has been approved.

   The criteria for review of all shore and beachfront protective structures shall provide that:

   a. visual impacts are minimized;
   b. necessary access to the beach is maintained;
   c. negative impacts on adjacent property are minimized; and
   d. long-term or recurring costs to the public are avoided.

6. Foredunes shall be breached only to replenish sand supply in interdune areas, or on a temporary basis in an emergency (e.g., fire control, cleaning up oil spills, draining farm lands, and alleviating flood hazards), and only if the breaching and restoration after breaching is consistent with sound principles of conservation.

7. Grading or sand movement necessary to maintain views or to prevent sand inundation may be allowed for structures in foredune areas only if the area is committed to development and only as part of an overall plan for managing foredune grading. A foredune grading plan shall include the following elements based on consideration of factors affecting the stability of the shoreline to be managed including sources of sand, ocean flooding, and patterns of accretion and erosion (including wind erosion), and effects of beachfront protective structures and jetties. The plan shall:

   a. Cover an entire beach and foredune area subject to an accretion problem, including adjacent areas potentially affected by changes in flooding, erosion, or accretion as a result of dune grading;

   b. Specify minimum dune height and width requirements to be maintained for protection from flooding and erosion. The minimum height for flood protection is 4 feet above the 100 year flood elevation;

   c. Identify and set priorities for low and narrow dune areas which need to be built up;

   d. Prescribe standards for redistribution of sand and temporary and permanent stabilization measures including the timing of these activities; and

   e. Prohibit removal of sand from the beach-foredune system.

The Commission shall, by January 1, 1987, evaluate plans and actions which implement this requirement and determine whether or not they have interfered with maintaining the integrity of beach and dune areas and minimize flooding and erosion problems. If the Commission determines that these measures have interfered it shall initiate Goal amendment proceedings to revise or repeal these requirements.

GUIDELINES

The requirements of the Beaches and Dunes Goal should be addressed with the same consideration applied to previously adopted goals and guidelines. The planning process described in the Land Use Planning Goal (Goal 2), including the exceptions provisions described in Goal 2, applies to beaches and dune areas and implementation of the Beaches and Dunes Goal.

Beaches and dunes, especially interdune areas (deflation plains) provide many unique or exceptional resources which should be addressed in the inventories and planning requirements of other goals, especially the Goals for Open Spaces, Scenic and Historic Areas and Natural Resources; and Recreational Needs. Habitat provided by these areas for coastal and migratory species is of special importance.

A. INVENTORIES

Local government should begin the beach and dune inventory with a review of Beaches and Dunes of the Oregon Coast, USDA Soil Conservation Service and OCCDC, March 1975, and determine what additional information is necessary to identify and describe:

1. The geologic nature and stability of the beach and dune landforms;
2. Patterns of erosion, accretion, and migration;
3. Storm and ocean flood hazards;
4. Existing and projected use, development and economic activity on the beach and dune landforms; and
5. Areas of significant biological importance.

B. EXAMPLES OF MINIMAL DEVELOPMENT

Examples of development activity which are of minimal value and suitable for development of conditionally stable dunes and deflation plains include beach and dune boardwalks, fences which do not affect sand erosion or migration, and temporary open-sided shelters.

C. EVALUATING BEACH AND DUNE PLANS AND ACTIONS

Local government should adopt strict controls for carrying out the Implementation Requirements of this goal. The controls could include:

1. requirement of a site investigation report financed by the developer;
2. posting of performance bonds to assure that adverse effects can be corrected; and
3. requirement of re-establishing vegetation within a specific time.

D. SAND BY-PASS

In developing structures that might excessively reduce the sand supply or interrupt the longshore transport or littoral drift, the developer should investigate, and where possible, provide methods of sand by-pass.

E. PUBLIC ACCESS

Where appropriate, local government should require new developments to dedicate easements for public access to public beaches, dunes and associated waters. Access into or through dune areas, particularly conditionally stable dunes and dune complexes, should be controlled or designed to maintain the stability of the area, protect scenic values and avoid fire hazards.

F. DUNE STABILIZATION

Dune stabilization programs should be allowed only when in conformance with the comprehensive plan, and only after assessment of their potential impact.

G. OFF-ROAD VEHICLES

Appropriate levels of government should designate specific areas for the recreational use of off-road vehicles (ORVs). This use should be restricted to limit damage to natural resources and avoid conflict with other activities, including other recreational use.

H. FOREDUNE GRADING PLANS

Plans which allow foredune grading should be based on clear consideration of the fragility and ever-changing nature of the foredune and its importance for protection from flooding and erosion. Foredune grading needs to be planned for on an areawide basis because the geologic processes of flooding, erosion, sand movement, wind patterns, and littoral drift affect entire stretches of shoreline. Dune grading cannot be carried out effectively on a lot-by-lot basis because of these areawide processes and the off-site effects of changes to the dunes.

Plans should also address in detail the findings specified in Implementation Requirement (1) of this Goal with special emphasis placed on the following:

- Identification of appropriate measures for stabilization of graded areas and areas of deposition, including use of fire-resistant vegetation;
- Avoiding or minimizing grading or deposition which could adversely affect surrounding properties by changing wind, ocean erosion, or flooding patterns;
- Identifying appropriate sites for public and emergency access to the beach.

SPECIFICATIONS

Planting European Beachgrass 1/

Planting Stock:

The stock to be planted is European Beachgrass (Ammophilia arenaria). The source and quality of the planting stock should be approved by the contracting officer or the authorized representative.

Digging, Stripping and Trimming:

The plants should be thoroughly cleaned by shaking sand and silt from the roots. Dead stalks and trash should be removed from the culms by stripping. The underground stems should be broken back so that one or two nodes remain. The grass culms should be sorted and tied into bundles weighing approximately 10 pounds; tops should be cut back so that the overall length of the planting stock measures about 20 inches.

Storage:

The planting stock should be planted within eight hours of removal from the nursery areas or heeling-in beds. The heeling-inbeds should be a well-drained damp trench with the roots (nodes) covered to a depth of at least 8 inches. Stock should not be held in heeling-in beds for a period exceeding two weeks. The supply of stock at the planting site must be kept in a cool shady place or otherwise protected against damage from excessive drying. Cold storage at 34-38 degrees farenheit for periods of up to 2 months is also acceptable.

The planting stock should be handled and transported by any method that does not damage the planting stock or area.

Planting:

1. The grass is planted in hills with an average of three live culms per hill but no fewer than two in up to 10% of the hills.

2. The spacing between hills should average 12 inches on the foreslope and 18 inches on the crest. (See Table 1)

3. The grass should be planted to a depth of 12 inches, with sand or silt for cover compacted to exclude air from the roots (nodes). The top of the plant should be upright and extend approximately eight inches above the ground.

4. No planting should be done on any area until the moisture is within three inches of the ground surface. Nor should any planting be done when the temperature exceeds 60 degrees F. or when freezing conditions prevail.

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1. Adapted from Ternyik, 1979. Specifications are also applicable to American beachgrass (Ammophila breviligulata) and Sea Lyme-grass (Elymus mollis).

5. All areas planted should be fertilized with coarse particle ammonium sulfate commercial fertilizer (21-0-0), applied at a rate of 42 pounds of available nitrogen per acre (one pound per 1000 square feet). (Elephant Brand or its equivalent is recommended because grains are large enough to avoid being blown by wind.) Fertilizer should be applied when the wind is calm and the rain is steady; irrigation may be substituted for rain. The fertilizer should be applied at the time directed by the contracting officer or the authorized representative.

TABLE 1: Transplants Needed With Varied Spacing Requirements

Transplant Type	Spacing	1,000 sq. ft.	one acre
Beachgrass - 3 culms per hill	12"x12"	3,004	130,680
Beachgrass - 3 culms per hill	18"x18"	1,335	58,080
Beachgrass - 3 culms per hill	24"x24"	751	32,670
Beachgrass - 3 culms per hill	30"x30"	480	20,880
Beachgrass - 5 culms per hill	12"x12"	5,006	217,800
Woody species - 1 transparent per hill	3'x3'	111	5,840
Woody species - 1 transparent per hill	6'x6'	28	1,210
Woody species - 1 transparent per hill	8'x8'	16	680
Woody species - 1 transparent per hill	12"x12"	7	302

Note - A word of caution: Always order 3% more to offset heavy planting.

Inspection:

1. Inspections should be made by the contracting officer or his authorized representative. A representative cross section of not less than 5% of the planted areas should be inspected to ensure compliance with the contract requirements.

2. Nonconformance with any specifications classifies a plant hill as unsatisfactorily planted. A tolerance of 5% or 5 unsatisfactory plant hills per 100 is satisfactory. However, any amount over 5% should be applied as an equal percentage reduction of the acreage planted (payments being made on the basis of net acreage). When the deficiencies are 10% or over, the contractor should be expected to take steps to correct them.

Timing:

Planting is recommended between November 15 and April 10. Plantings occurring this time of the year will be most successful because of the abundant rainfall and natural growth pattern of european beachgrass. Beachgrass can be planted at other times of the year, however, additional measures are necessary to assure planting success such as irrigation and fertilization. Usually, it is preferable to delay planting to the November to April season noted above and temporarily stabilize the area by placing rye grass straw (1 inches-2 inches) covered loosely with sand to prevent blow-outs.

Storage:

Plants should be kept in water immediately prior to planting to maintain moisture and proper temperature.

Planting:

Should be done at night or when temperature is below 60 degrees farenheit. Plants should be watered after planting and fertilizing.

Secondary Stabilization:

Plantings of secondary stabilizing vegetation are appropriate in well-vegetated backslope and back areas but not in the crest or foreslope.

Species:

The following plants are appropriate for secondary stabilization:

Salal (Gaultheria shallon)
Evergreen Huckleberry (Vaccinium ovatum)
Shore Pine (Pinus contorta)
Purple Beach Pea (Lathyrus japonicus)
Seashore Lupine (Lupinus littoralis)
Tree Lupine (Lupinus arboreas)

Planting Requirements:

Secondary stabilization should be done in conformance with the recommendations provided in Table 2.

Conditions:

1. Secondary stabilization should only be done when initial stabilizing vegetation (i.e., european beachgrass) is well established.

2. Secondary plantings should occur directly in existing stands of beachgrass. Beachgrass should not be destroyed or removed prior to planting, so that it can continue to stabilize the area as secondary plants are establishing themselves. Succession should occur without destruction since beachgrass tends to thin out and die where it is cut off from sand accretion.

TABLE 2: SECONDARY STABILIZATION

Recommended Native Plants for Dune Stablization

Species	C	S	BR	B&B	Seed	1-0	2-0	Size	CA	FC	SP	Season
European Beachgrass	X		X				X	20"	X		18"x18"	11/15 - 3/15
American Beachgrass	X		X				X	20"		X	18"x18"	11/15 - 4/15
Sea Lyme grass	X		X				X	20"		X	18"x18"	11/15 - 2/15
Seashore Bluegrass		X			X			15 lb.		X	cc	9 or 4 - 6
Seashore Lupine		X			X			7 lb.		X	cc	9 or 4 - 6
Purple Beach Pea		X			X			15 lb.		X	cc	4 - 6
Tree Lupine		X			X			30 lb.		X	cc	4 - 6
Salal		X		X			X	1 gal.	X		3'x3'	12 - 2
Evergreen Huckleberry		X		X			X	1 gal.	X		3'x3'	12 - 2
Scotch Broom		X	X			X		14"		X	8'x8'	12 - 3
Shore Pine		X	X	X			X	12"-20"	X		8'x8'	12 - 2

C - Colonizer-initial stabilizer Adapted from: Ternyik, Dune Stabilization Methods and Criteria, 1979.
S - Secondary-permanent S
BR - bare root stock
B&B - balled and burlapped
1-0 - one year old
2-0 - two year old
Size - height or pounds per acre
A-1 - foredune or frontal areas
A-2 - deflation plain or wet interdune
A-3 - open sand areas
A-4 - older stabilized dunes
CA - commercially available
FC - field collection
SP - spacing inches, feet, cc-complete cover
Season - planting dates (optimum)

Crest Grading:

Limited grading of sand from crest areas above the 26 foot elevation is allowed by this plan. These specifications should be followed carefully to minimize damage to dune vegetation and to stability of the foredune. If done improperly, grading can destroy stabilizing vegetation, cause unwanted sand accretion on adjacent lots and homes, and substantially increase potential for ocean flood damage.

Timing:

1. Grading should generally be done between November 1 and March 15. Beachgrass planted or fertilized subsequent to grading will grow best at this time of the year.

2. Grading may be done at other times of the year but is not encouraged. If grading is done between March 15 and November the foredune should be temporarily stabilized by discing of rye grass straw into the graded crest immediately after grading to prevent wind movement of sand.

3. Planting and fertilization of european beachgrass should be done in the following November-March season. Planting should be done directly into the ryegrass and spacing may be increased to 24 inch centers.

Conditions:

The crest area to be graded must be more than 4 feet above the 100-year flood elevation; in most of the Nedonna area this is the 26-foot elevation (MSL).

Equipment:

A bulldozer with size depending upon the extent of the area to be graded.

Method:

1. The area to be graded should be staked by a qualified individual in advance of grading, so that the operator knows the limits on the area and the depth of grading to occur (setting elevations is simplified by the fact that elevations were marked on most homes in a December 1985 survey by Handforth & Larson Engineers of Manzanita).

2. The management authority should be notified so that a representative can view the staked area, the grading operation, and the completed grading.

3. The bulldozer should get to the lots through the jetty parking lot and along the beach. The bulldozer should minimize crossing the foreslope.

Placement of Graded Sand:

1. The first priority for placement of graded sand is filling of low

spots in the crest to the 26-foot elevation. This need not be done if low spots are planted with beachgrass and fertilized consistent with the specifications in this plan. (This approach is feasible at Nedonna Beach because the foredune is at or above the 100-year flood level. Consequently, only relatively minor amounts of accretion are necessary to repair the foredune. In other areas where low spots are really major breaches, filling of the breach to at least the 100-year flood level should be a prerequisite to any grading.)

2. Low spots in the crest on the lot or adjacent lots (i.e., below the 26 foot elevation) are the priority location for graded material (see Figure 10). The management authority should identify spots on adjacent lots appropriate for filling which need additional sand. These low spots should be filled to to the 26 foot elevation. (This will result in a crest roughly 50-75 feet wide at a uniform 26 feet height, except in Subarea E, where the crest is 100-125 feet wide.)

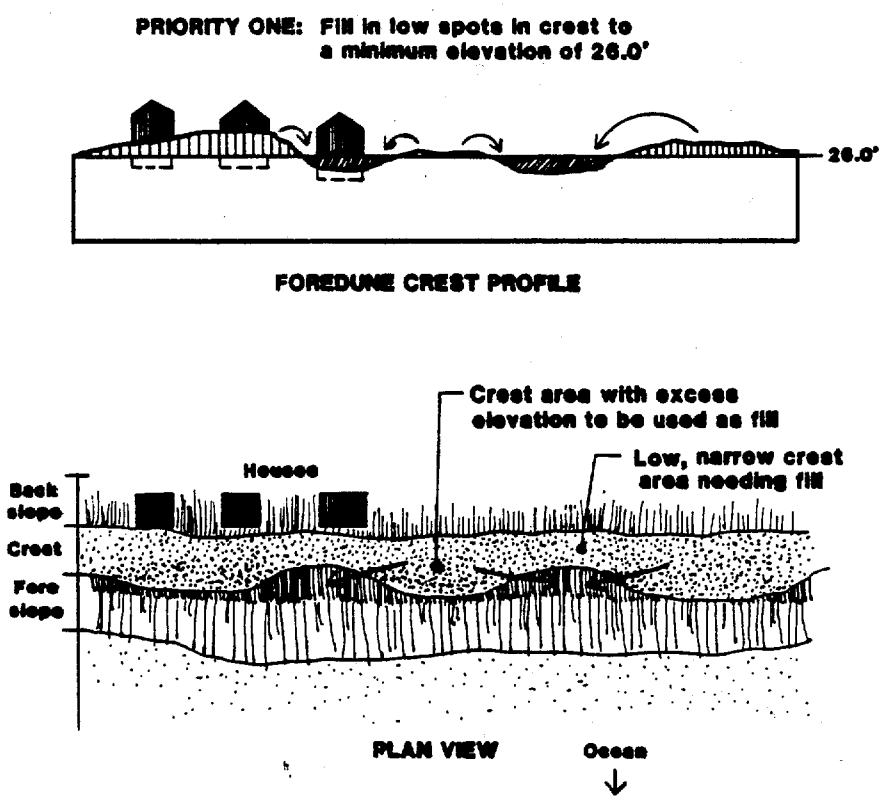


Figure 10: Placement of Graded Sand

3. Where the adjacent lots are at the minimum elevation, crest grading can be done in two ways:

   (a) A series of short passes pushing sand directly oceanward from the crest to the foreslope.

   (b) One or several passes along the crest of the foredune with the blade angled so that sand is deposited on the foreslope.

In either case sand should simply be pushed onto the foreslope. Where a substantial amount of sand is placed on the foreslope it should be smoothed out to create an even slope. If only a small amount of sand is graded forward, the bulldozer should not attempt to smooth the sand forward on the foreslope.

Tapering:

If the crest of adjacent ungraded lots is more than 4-feet higher or lower than graded lots, the grading should taper the crest into these areas rather than leave a right angle cut at the lot line.

Minimum Area:

Grading should be done over several lots at a time to achieve a uniform crest height throughout. However, grading may be done on a lot-by-lot basis provided all other specifications are met.

Fertilizing:

Areas graded less than 3 feet should be promptly fertilized per the fertilization recommendations for beachgrass plantings. Fertilizer should be applied to graded sand placed on the crest and foreslope as well.

Planting Beachgrass:

Areas graded more than 3 feet in height should be replanted with european beachgrass at 18 inch spacing. Any graded crest area with less than 30% vegetative cover should also be replanted with european beachgrass.

Monitoring:

1. The management authority should inspect the site before and after grading to confirm that grading and other measures have been done in compliance with specifications here.

2. Permits for grading should be conditioned to require reestablishment of vegetation on all areas affected by grading or filling. The management authority should inspect the graded area periodically after grading and recommend remedial measures at those times. Failure to comply should provide for management authority authorization to reestablish vegetation at the permittee's expense.

Foreslope Shaping:

Foreslope shaping is appropriate in limited situations to establish an even slope for maximum accretion of sand and foredune slope growth. Shaping should only be done when the present foreslope is so uneven and hummocky that it significantly impedes growth of the foredune.

Equipment:

Lightest possible bulldozers should be used since less sand will be moved than for crest grading.

Slope:

Grading should attempt to establish an even slope at an angle between 25% to 33% slope (between 1 to 3 and 1 to 4) depending on the amount of sand available.

Distribution:

Unless sand is placed as a result of approved grading elsewhere, shaping should only re-distribute sand presently on the foreslope. Only sand from the foreslope should be moved. Grading of sand from the crest or the beach onto the foreslope is regulated separately as grading or beach bulldozing and may be appropriate to provide sand for grading if there is a surplus of sand in these areas.

Minimum Area:

Shaping should occur over several lots at a time as shown on the grading plan map.

Tapering:

Shaped areas should be tapered into adjacent unshaped areas to avoid creating wind erosion or accretion problems.

Method:

Shaping should move as little sand as possible to establish an even slope (i.e., top off hummocks). The operator should make as few passes as possible and should avoid damaging vegetation on the crest of the foredune.

Fertilization:

Vegetated areas that are not seriously damaged or buried more than 3 feet of sand should be immediately fertilized.

Plantings:

Unvegetated areas and areas covered by more than 3 feet of sand should be immediately replanted with european beachgrass according to planting specifications.

Mowing Beachgrass:

Mowing of beachgrass is generally discouraged because, once cut, grass temporarily loses most of its ability to trap windblown sand. However, mowing can be an approrpiate management tool to maintain views across the crest or to promote even sand deposition on the foreslope.

General Requirements:

1. Mowing should be done between March and October.

2. Mowing should be done with a "weed-eater" type machine. Grass should be cut as evenly as possible levaing six to eight inches of grass remaining above ground.

3. Mowed areas should be fertilized immediately with 21-0-0 ammonium sulfate at a rate 2 1/2 pounds per 1000 square feet and watered.

Mowing for View Maintenance:

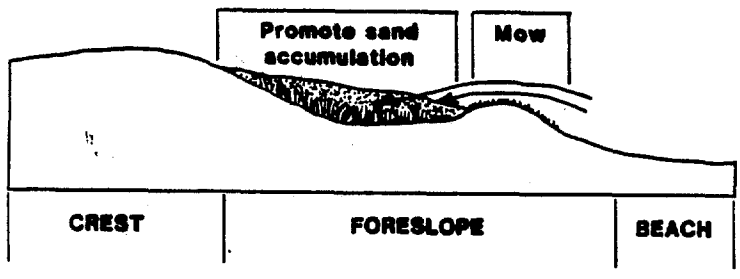
The foreslope should have at least 60% mature unmowed beachgrass cover to assure capture of accreting sand.

Mowing to Promote an Even Foreslope:

Mowing of foreslope vegetation is appropriate where the foreslope is accreting unevenly. Uneven accretion is usually indicated by a trough or a series of hummocks forward of the crest area. The high spots in the foreslope captured some accreting sand with the balance passing through to the crest. Mowing is recommended to allow sand to be captured in low spots to provide a smooth even angle to the foreslope. This technique should promote capture of sand on the foreslope reducing the need for future grading of the crest.

1. Foreslope mowing should only be done when low spots in the foreslope (which will remain unmowed) have at least 60% mature unmowed vegetation. Areas with less than 60% cover should be planted with european beachgrass at 18 inch spacing.

2. Mowed grass should be scattered in unmowed low-spots to promote capture of windblown sand.



Plant grasses on a 24" spacing, mow high area to allow sand to pass through and into low, unmowed area.

Figure 11: Recommendations for Beachgrass Mowing

Sand Fencing:

Type of Fence: Four foot high, wooden lath snow fencing or plastic fencing (such as Mirafi). (Green or tan is preferred color for plastic fencing.)

Posts: Six foot heavy-duty steel posts.

Wire: 14-gauge galvanized steel wire.

Placement: Fencing should be located as shown on the plan maps for placement. Fencing should be placed in two parallel rows 30-35 feet apart. Posts should be driven 2 feet into the ground at 10 foot intervals. Fencing should be firmly attached to each post at the top, middle and bottom. The fences should be anchored with guy wires at 50 foot intervals. End posts should be anchored in three directions. Cover the base of the fence with a mat of rye-grass straw (not wheat straw) 18 inches wide and 2 inches deep and cover the straw with sand.

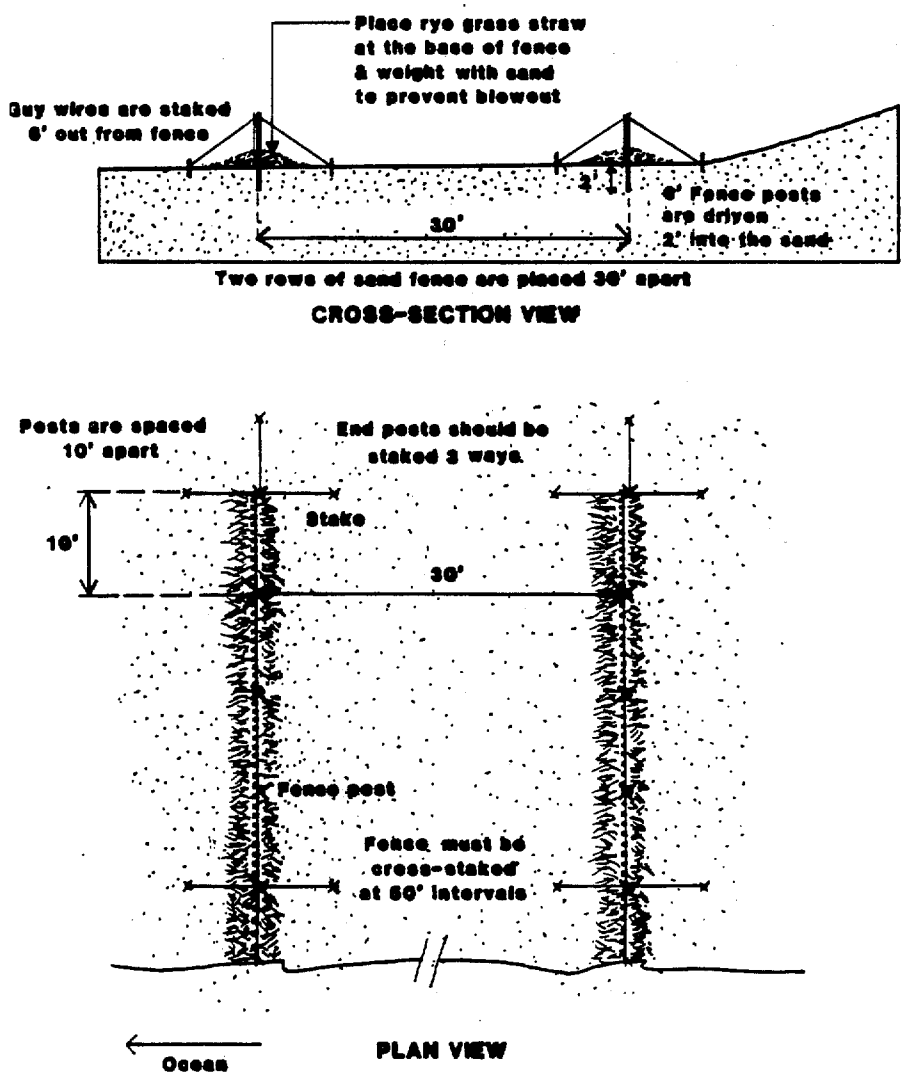


Figure 12: Placing and Spacing of Sand Fencing

Timing:

Fencing should be placed from November 15 to January 1 to maximize capture of wind blown sand. Fences may be placed at other times of the year but will fill more slowly.

Beachgrass Planting:

Once the sand fences have filled or substantially filled (i.e., within 6 inches of the top of the fence), beachgrass should be planted according to specifications for beachgrass planting following surface grading to provide an even surface for planting.

- The foreslope (i.e., in front of the seaward sand fence) to a width of approximately 35 feet should be planted at 18-inch centers.
- The crest (between the parallel sand fences) should be planted at 18-inch centers.
- The back portion from the shoreward sand fence approximately 24-feet should be planted on 18-inch centers.

Other:

1. Fences must be repaired if damaged by erosion or vandalism.
2. Signs should be placed at public access points to explain the purpose of sand fencing projects to encourage public cooperation.

Access Through Sand Fences

The specifications provided here should be applied to both pedestrian and vehicle access through sand-fenced areas should be provided according to the following specifications:

Cross-Fencing:

The parallel rows of sand fencing should be cross-fenced at the access to keep pedestrians and vehicles in the access and to capture sand.

Width:

Pedestrian accesses should be four to five feet wide. Vehicle accesses should be 10-12 feet wide.

Forward Fence:

A third sand fence should be placed 10-12 feet seaward of and parallel to the main sand fences in front of the access opening. The fence should overlap the opening by at least 5 feet on each end.

Orientation: Accesses should be oriented directly east-west.

Signing:

Public accesses should be signed both on the beach and landward to encourage use and discourage crossing the sand fence.

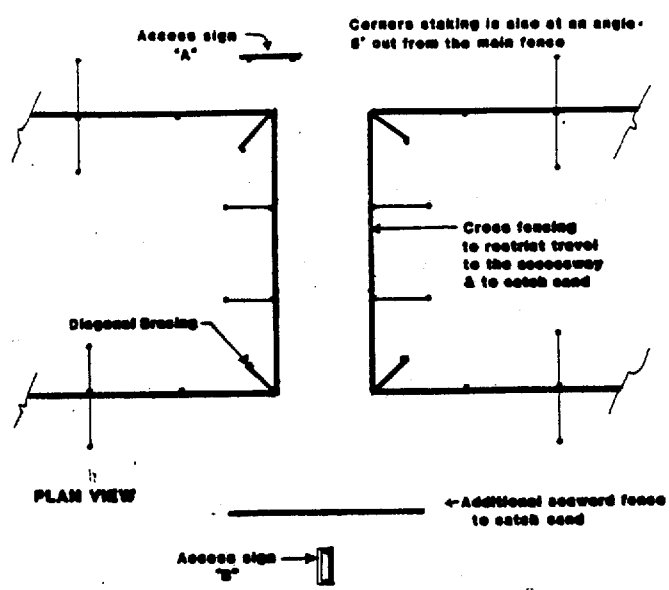


Figure 13: Accessways Through Sand Fencing

Revegetation:

Once vegetation is well established on the stabilized dune, the access way should be fenced and stabilized and a new access established through a vegetated portion of the foredune. European beachgrass should be used and all other recommendations for planting should be followed.