ALTERNATIVE SHORELINE TREATMENT GUIDELINE

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Alternative
Shoreline Treatment Guideline

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SHORELINE PROTECTION

Alternative to Bulkhead and Onshore Rip-Rap

Preface

There are several options for protecting shorelines against erosion. Private landowners, especially those with a fairly small amount of waterfront often use bulkhead and/or rip-rap (large rock or broken concrete pieces) to stabilize their shorelines. A main concern when converting shoreline to bulkheads, and to a lesser extent rip-rap, is the loss of shoreline marsh. These intertidal marshes are important habitat for many wildlife species including birds and economically valuable fisheries species. The Galveston Bay system has lost over 20% of its tidal marshes since the 1940's. Some areas, such as the bayside of Galveston Island, are hit even harder with marsh losses upwards of 80%.

If you have noticed decreasing amounts of marsh on Galveston Island State Park, you're right. The intertidal marsh has declined from 1,100 acres to 200 acres. This has been in part to subsidence, which drowns the marshes as the water depths reach levels too deep for the marsh grasses to survive. The loss of this soil-stabilizing vegetation only makes the shoreline more vulnerable to erosion. In this way, more and more marsh and shoreline are rapidly converted to open water. Whatever the reasons, landowners face a constant battle to preserve their property from this type of loss.

Innovative efforts have been taken within the Galveston Bay estuary to deal with shoreline erosion without eliminating shoreline and creating marsh at the same time. Some public lands, such as those at Anahuac and Brazoria National Wildlife Refuge, have built wave break structures from shell and/or rip-rap walls a little offshore rather than directly on shore. Not only do these structures act as wavebreaks, robbing the waves of their energy and erosion power, they cause the sediment-laden waves to drop their loads landward of the wavebreak. In some places, this process can build up enough sediment so that the water level becomes shallow enough to support marsh grasses without the need of extra fill-dirt. The wavebreak itself becomes encrusted with oysters, becoming an artificial reef.

A local private landowner, Mr. Moore, has managed to create a smaller version of this technique in front of his bayside home on Eckert Bayou. Mr. Moore was faced with an eroding shoreline that threatened his land and home. He approached the problem in a new way. He designed a shoreline protection structure that combined the elements of both bulkhead/rip-rap and a marsh and oyster reef. He has created valuable habitat that meets many important wildlife needs which also serves to protect his property from erosion. In addition to these important features, the wavebreak is very aesthetically appealing. It creates a green band of smooth cordgrass (*Spartina alterniflora*) that follows the shoreline. The habitat value was evident as the marsh became established, providing the enjoyable opportunity to view nature's wildlife.

Any landowner can use this method for shoreline protection, but more importantly, it also restores lost habitat. It can improve the fishing in front of your property. If there is an existing bulkhead, this type of marsh and breakwater in front can provide valuable habitat and add a second layer of protection to the shoreline. Bulkheads are susceptible to being undercut and are expensive to replace. The alternative method can combine bulkhead, breakwater, and marsh to serve many important and self-sustaining functions, i.e., each element of this group helps preserve the others. This is a cost-effective alternative to conventional bulkheading.

A U.S. Army, Corps of Engineers (COE) permit is required for the construction of this structure. Contact the COE, Galveston District Office – Regulatory Division for more information. The COE will solicit comments from the public, federal, state, and local agencies, and other interested parties in order to consider and evaluate the impacts of this proposed activity. A Texas Commission on Environmental Quality (TCEQ) certification is also required. During the processing of the COE permit application, the TCEQ will review the application to determine if the work will comply with water quality standards. Both the permit and water quality certification are required for this type of project, or conventional bulkheading. Do not get discouraged, the rewards when the project is completed will be worth your time and efforts.

Breakwater Guideline

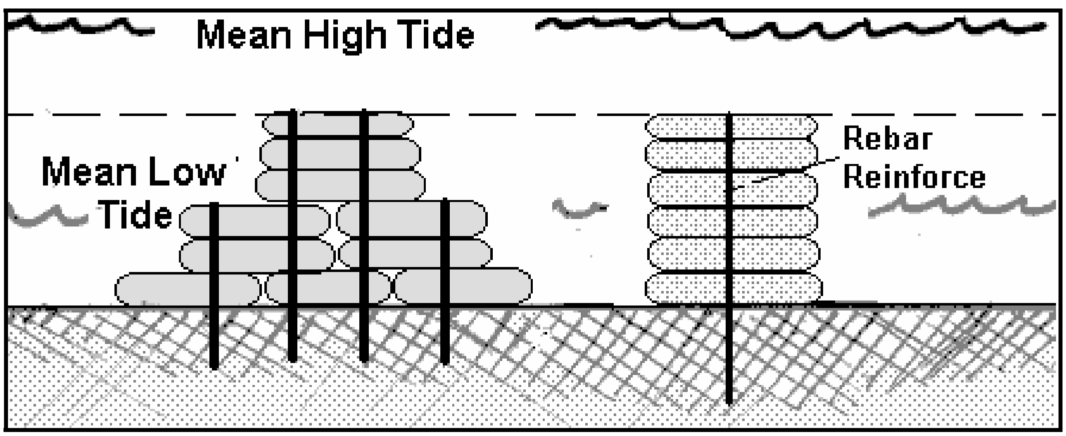
(Check the Tide Charts and schedule the construction when tides will be low, this will make the construction of the wavebreak easier.)

It is best to begin this project during the winter months (Nov, Dec, Jan). This time frame usually provides the lowest tides, making construction of the wavebreak much easier. Beginning the project during the winter allows adequate time for the fill materials to settle before planting begins. The ideal months to begin planting are February through May. Planting during these months provides the marsh grass a chance to become established during the growing season. This will allow the vegetation several months of growing before the following winter arrives.

1 Build a wavebreak structure.

1.1 The first step in constructing a wavebreak structure is to determine both the mean low tide and the mean high tide levels. The crest of the wavebreak structure should be built to the height between mean high and mean low tide levels. Check the tide charts to determine the tide levels. When the tide is at a normal low, secure a pole in the ground where you want your wavebreak to be constructed. Mark the pole with a permanent marker at the water level. Then add the number of inches shown in the tide chart to the water level mark, then mark the pole again. Leave the pole in the water until there is a normal high tide. Again, mark the pole at the water level. Leave the pole in the ground. Subtract the number of inches given in the tide chart from the high tide mark. When the tide goes out again, mark the pole with the difference from the tide chart. These two adjustment marks on the pole should be at the same location. If there is a small variation of a couple inches, just take the difference. This will be the height at which the wavebreak should be constructed.

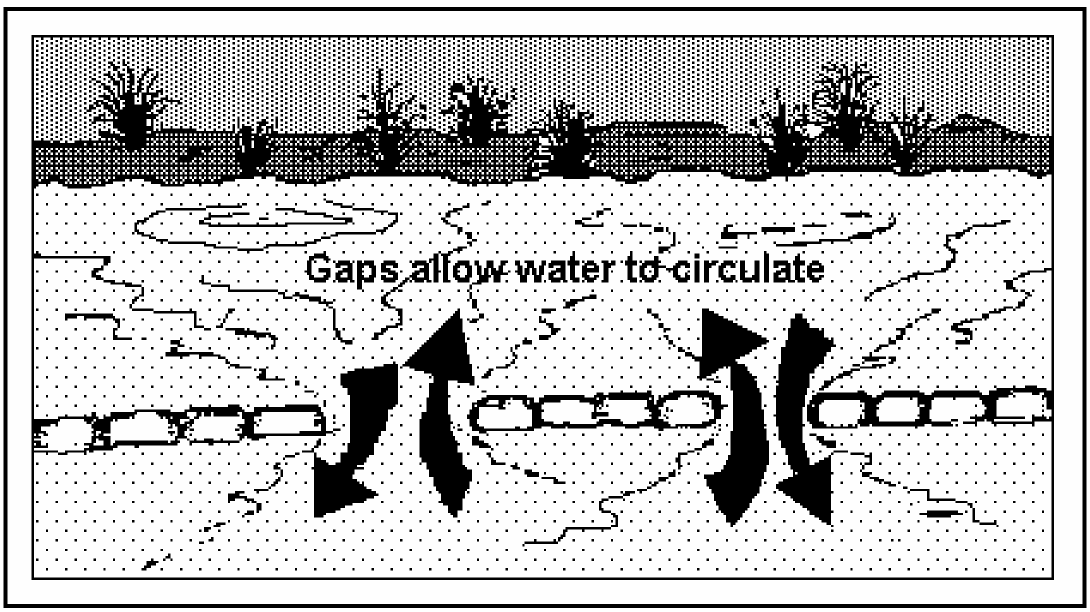
Figure 1. Wavebreak structure in reference to mean high and mean low tides.



<u>*Purpose*</u>: The wavebreak will serve two important functions. It will protect the shoreline from erosional wave energy and act as a sediment trap to extract sand/silt from the waves. For that purpose, the height of the wavebreak needs to be between mean high and mean low tide, so that waves will cover the structure at high tide and expose it at low tide. Three 80-pound sacrete bags stacked on top of each other will give you 1 foot of elevation in height, and seven bags layed end-to-end will give you about 5 feet of length. The substrate bottom will also factor in the design and adequate number of bags required to reach the target elevation for the breakwater. If the height of the wavebreak is more than a foot or so, stacking the sacrete in a pyramid shaped pattern is suggested to ensure that the structure does not tip or fall over. Also consider stacking the materials with the pyramid method if the wave energy is high. Approximately 170 sacks of materials are needed for $100ft^{-2}$ of area when stacked on top of one another.

1.2 If rip-rap (broken concrete blocks) already exists along the present shoreline, all or part of it can be used to construct the wave break by moving and stacking it a short distance from and parallel to the existing shoreline. If rip-rap is not available, sacrete can be used. QUICKRETE ® is another material which can be used for shoreline erosion, and has been approved for use by the U.S. Army Corps of Engineers. The material is packaged in biodegradable 80-pound paper bags which reduces the amount of labor. The bags must be placed abutted against each other to ensure that the fill materials placed behind the berm do not wash out. Leave gaps (a one foot break for every 50 foot of wavebreak) in the barrier to allow for water circulation as well as ingress and egress of marine organisms. Once the break is layed out, the berm must be solidified using a concrete slurry. This will ensure that the fill materials do not wash out from behind the wavebreak. This will aid in complying with Texas Water Quality Standards as required by Section 401 of the Federal Clean Water Act and pursuant to Title 30 Texas Administrative Code, Chapter 279.

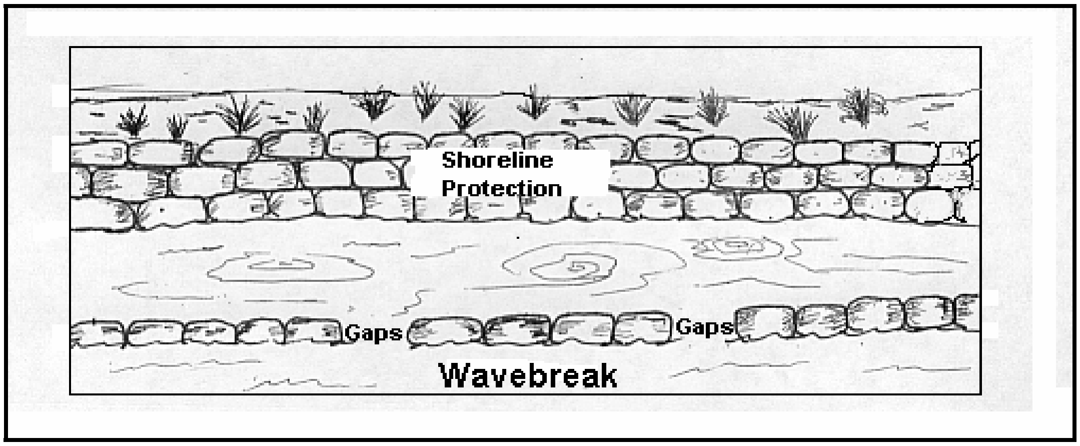
Figure 2. Gaps in the breakwater allow for adequate ingress and egress of nutrient-rich water and living marine resources.



Purpose: The wavebreak structure does not necessarily need to be parallel to the shoreline, but it will be the outside edge of the newly created marsh. The gaps in the wavebreak allow circulation of water, which transfer living marine organisms and the necessary organic matter needed to sustain this habitat.

1.3 A second wall can be constructed behind the wavebreak structure. This is the area where the shoreline or old bulkhead is located. This will not always be necessary. In many places, the single wavebreak is sufficient. However, if a second wall is desired, the original bulkhead may serve as this structure. This wall may be as high as the landowner desires.

Figure 3. The wavebreak structure may contain an additional wall along the shoreline to help prevent shoreline erosion.



<u>Purpose</u>: If there is substantial erosion to the shoreline, and there is no bulkhead, it might be beneficial to create a second wall. This can be accomplished by stacking bags of sacrete in a brick pattern. Rebar may be used to reinforce the structure.

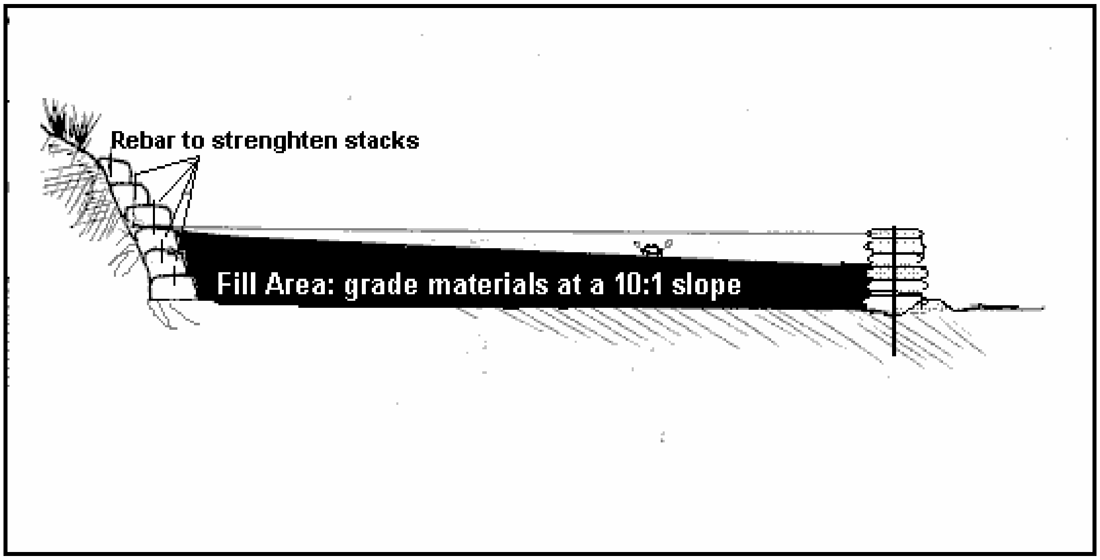
2 Raise the substrate to an elevation sufficient to support marsh grasses

2.1 Place stockpiled fill material behind the wavebreak at an elevation to match nearby marsh. The level will change somewhat as the natural wave and tidal action bring in additional materials within the berm area. The COE requires that "approved" fill material be used on this type of project. Rake the fill/sand material in a gradual slope from the shoreline to the berm, the fill should be graded to elevations similar to adjacent or nearby smooth cordgrass *(Spartina alterniflora)* marsh.

2.2 Allow the fill materials to settle.

2.3 The final slope of the site should be 10:1.

Figure 4. The wavebreak structure may be strengthened using rebar and the marsh should be created with a 10:1 slope.



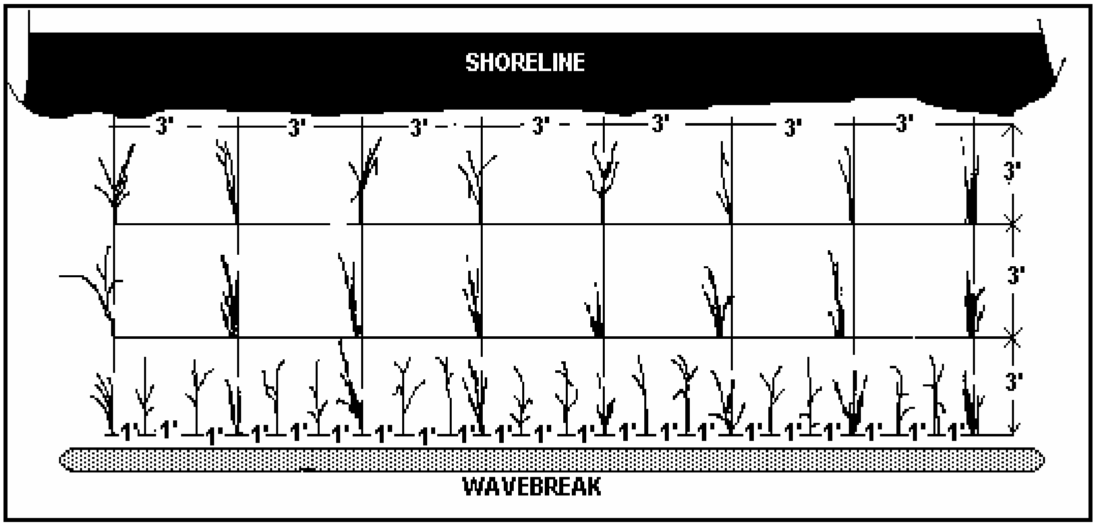
3 *Marsh Grass Planting*

3.1 Plant the area with smooth cordgrass (*Spartina alterniflora*). This aquatic plant has an elaborate root structure that will help hold the substrate intact to reduce erosion and provide habitat for marine organisms. *Spartina alterniflora* is a perennial grass growing from extensive rhizomes. Culms are erect, 2 to 4 feet tall, thick, and spongy; leaves are wide and tapering. The seed head is a long panicle with tight, erect spikes. The plant grows in intermediate to saline marshes, often forming dense stands over broad areas. It is a major contributor of detritus to aquatic food chains. This plant is native to the Gulf Coast, and restoration of this species has been highly successful.

3.2 Sprigs (individual stems) should be planted on 3-foot centers. Ensure that the root structure of the plant is below the substrate, this will increase the recovery time and stimulate growth. Also, ensure that the stem is securely set in the substrate by compacting the soil around the base of the stem. This will prevent the plant from being washed-out. Sprigs closest to the wavebreak should be planted on one-foot centers to increase establishment of vegetation.

3.3 If the water level is low, ensure that the freshly planted smooth cordgrass receives plenty of water. Don't worry about over watering.

Figure 5. Plants along the shoreline should be planted on 3-foot centers and on 1-foot centers near the wavebreak to prevent the plants from being washed out.



4 Performance & Monitoring

4.1 A vegetative survey of the site must be conducted within 60 days following the completion of the initial planting. Calculate the percent of plants that have survived. If at least 50 percent of the plants have not survived, a second planting effort will be required.

4.2 The second planting must occur within 30 days. A written report detailing the survival results must be submitted to the COE and General Land Office following the survey.

4.3 If at least 70 percent canopy coverage is not achieved within the first year of planting, additional plantings shall be made. Reports must be submitted for 2 years from the date of the initial plantings.

Regulatory Agencies:

Corps of Engineers:
U.S. Army Corps of Engineers
Regulatory Branch, CESWG-CO-RE
U.S. Army Engineer District, Galveston
CESWG-PE-R
P.O. Box 1220
Galveston, TX 77551
Phone: 409-766-3930
Fax:409-766-3931

Texas Commission on Environmental Quality:
Texas Natural Resource Conservation Commission
Watershed Management Division
P.O. Box 13087
Capitol Station
Austin, Texas 78711

Texas General Land Office:
Texas General Land Office
11811 North D. St.
LaPorte, Texas 77571
Phone: 281-470-1191
Fax: 281-470-8071

Natural Resource Conservation Service:
Natural Resource Conservation Service
Attn: Eddie Seidensticker
7705 W. Bay Rd.
Baytown, Texas 77520
Phone: 281-383-4285
Fax: 281-383-4286

Table 1. Estimated project costs for constructing a breakwater.

Wavebreak	
Item	Size
Front Wall	300' x 3 ' = 900 square feet
Sides	3' x 30' = 90 square feet
Total	990 square feet
Wavebreak calculations: 170 bags of material are needed for 100 square feet of barrier 990 cubic feet / 100 square feet = 9.9 9.9 x 170 bags = 1,683 bags of material 1,683 bags x $2.50/bag = $4,207.50	

Figure 6. Dimensions of breakwater.

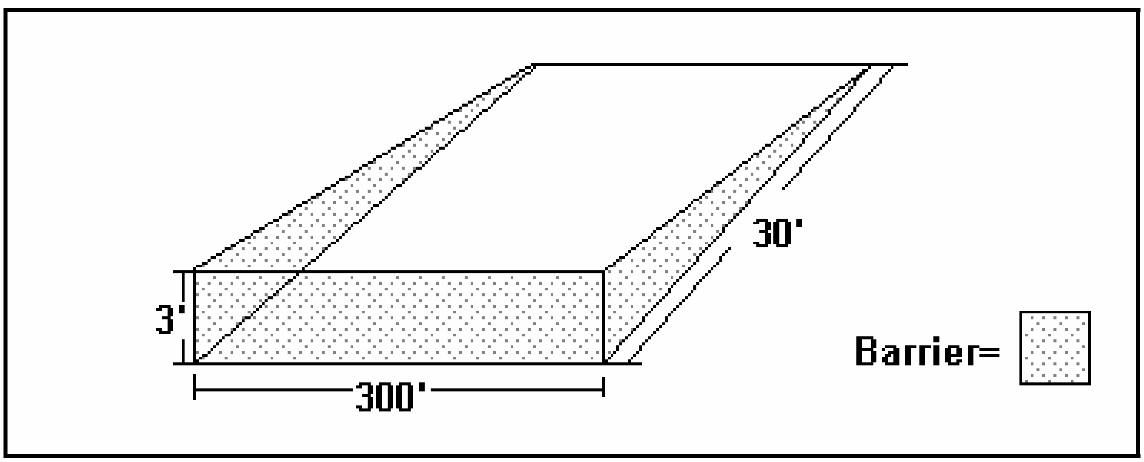


Table 2. Estimated project costs for fill materials.

Fill Materials
Calculations:
30' x 2' x 300' = 18,000 cubic feet
18,000 cubic feet / 2 (half the square) = 9,000 cubic feet
9,000 cubic feet / 27 (convert cubic feet to cubic yards) = 333 cubic yards
333 cubic yards x $15 per cubic yard = $ 4,995 for fill material

Figure 7. Dimensions of fill material.

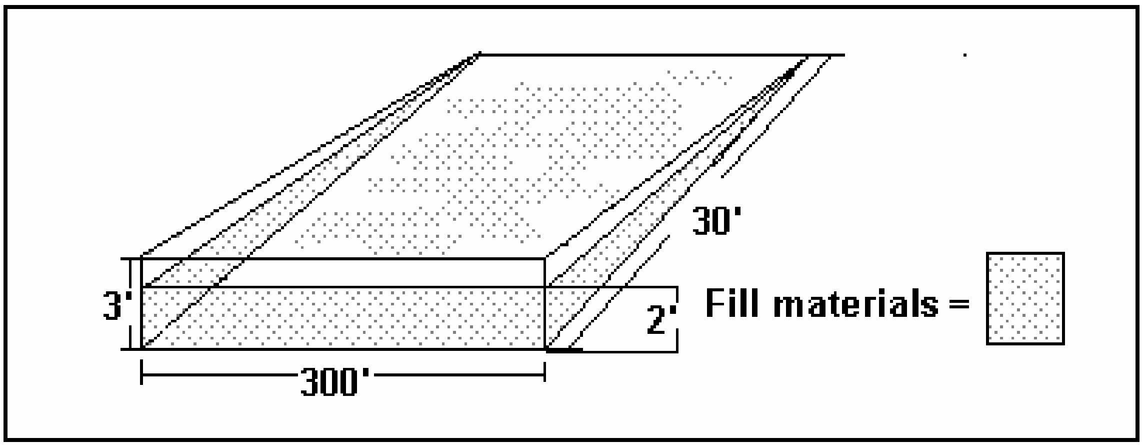


Table 3. Cost breakdown to construct a breakwater. The prior costs incurred while creating a similar shoreline protection.

Item#	Nomenclature	Unit of Issue	Qty.	Unit Price	Total Price
1	COE permit application fee	ea	1	10.00	10.00
2	Sackcrete	bag	1008	2.50	2520.00
3	Freight for sacrete	load	2	235.20	470.04
4	Strecthing materials	pallet	24	4.00	96.00
5	Pallet Deposit	ea	26	12.00	312.00
6	Spyder charge	ea	1	35.00	35.00
7	Tax on materials	load	2	98.82	197.64
8	Oyster shells	sack	70	1.25	87.50
9	Ready mix concrete	bg	40	2.66	106.40
10	Fill soil	load	45	55.00	2475.00
11	Labor (bags) *$7/hr x 3 men	hr	21	20.00	420.00
12	Labor	days	3	600.00	1800.00
13	Backhoe	days	2	150.00	300.00
14	Smooth cordgrass *One gallon pots	pot	400	3.50	1400.00
15	Labor for planting	hr.	6	20.00	120.00
Total costs incurred:					**10349.58**

The site was 150' in length, and was a distance of 26 feet from the shoreline. The berm on the shoreline was created to a height of 32".