TASK IV DELIVERABLE
FINAL REPORT TO THE TEXAS GENERAL LAND OFFICE
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STRATEGIES FOR MANAGING SEDIMENT ON PUBLIC BEACHES CITY OF PORT ARANSAS, TEXAS

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INTRODUCTION

In 2005, Hurricanes Emily, Katrina, and Rita deposited large amounts of sand on the public beaches of Port Aransas, Texas. Because the City of Port Aransas (City) is the custodian of the public beach within its borders, it ensures that access is not blocked or prohibited. In response to the storm deposits, the City relocated the accumulated sand to the water's edge and along the line of vegetation. Some local residents became concerned about potential impacts of this procedure on beach stability. To address the concerns, the City Council created the Beach Maintenance Committee (BMC) composed of local scientists, business people, and residents to review the beach maintenance actions and provide the City Council with recommendations for management practices for beach cleaning and disposal of unwanted trash that would comply with local, state, and federal rules for erosion response, dune protection, and public access.

The objective of this study is to review the beach management practices of the City and recommend alternatives to existing practices to ensure public beach access, and protection of the beach/dune environment. This report provides background information on beach use, maintenance practices, shoreline change patterns, and discussions by the BMC, and recommends changes in some maintenance practices.

The City of Port Aransas is a destination resort located at the north end of Mustang Island in south Texas (Figure 1). The main attraction is the 7.5 miles of white, sandy beaches that line the Gulf of Mexico. The small town with 3700 year-round residents changes into a bustling community of 80,000 during the peak visitation periods (Spring Break and summer weekends in June through August) (D. Parsons, City of Port Aransas, 2006, personal communication). The additional human insurgence places stresses on the management of the beach/dune environment as tourists can have different expectations for their beach experience than local residents. All management efforts need to provide an accessible environment that is safe and clean.

The City approved a set of policies for managing this complex natural resource that is prone to flooding and provides protection to highly valued land: the *Port Aransas Coastal Management Plan* (1995). This plan, adopted by the City and certified as rule by the Texas General Land Office (Land Office) provides the baseline policies for preserving the public use of the beach and ensuring protection of dunes.

Figure 1. City of Port Aransas location map, aerial vertical photograph, and photograph of the dunes and beach.

The City is bound by its *Coastal Management Plan* to protect access to and use of the public beaches (section VIII, B. 3 on page 33). The City has interpreted this section to maintain trouble-free driving on the beach road (or vehicular travel way) as it has continued this practice for a several decades. The City's Public Works Department is responsible for not only beach maintenance and cleaning, but for the City's sanitation, roads, and rights of way. The Public Works Director determines when the beaches are cleaned or when the vehicular travel way needs maintenance. Determinations are based upon use and conditions, and are not a regularly scheduled or routine activity. Figure 2 shows the nomenclature typically used by the City for its beaches.

Figure 2. Aerial photograph of a section of public beach in Port Aransas with terminology describing areas (base photograph from http://earth.google.com).

ISSUES

Preserving public access to the beaches and keeping them clean are two priority issues for the City. Another critical component that should be incorporated in the City's access and cleaning priorities is the protection of existing foredunes, and the practice of allowing natural dune formation. Dunes are essential for providing a sand supply to the beaches and for protecting landward properties during storms.

As a destination resort, the City hosts tourists from Texas and elsewhere who are drawn to the Gulf waters and white sandy beaches. The City charges a parking fee to offset the costs of maintaining public access and permits can be obtained from various locations within the City including beach vendors. Two issues of concern arise from the popularity of the City's beaches: maintaining access (while protecting dunes) and keeping the beaches clean.

ISSUE #1 MAINTAINING ACCESS, VEHICULAR TRAVEL WAYS, AND PEDESTRIAN SAFETY AREAS

Vehicular Travel Way and Beach Parking

Driving on the beach is a well established tradition in Texas as the long stretches of beach were the first traveled roadways and the City continues the tradition. To maintain a usable road surface ("hard pack") for trouble-free driving by both four-wheel and two-wheel drive vehicles, the City's Public Works

staff generally grades (blades) the vehicular travel way (beach road) and the beach parking area. Blading the backshore area occurs more often during dry periods, when the water table occurs at greater depths.

In the summer of 2006, blading was not necessary to maintain the travel way because of wetter conditions and an elevated water table (Figure 3). At times, when it is necessary to remove the sand from the travel way and parking area, the sand is pushed into the pedestrian beach area and spread above the mean high water (MHW) line. The sand from the travel way typically does not contain trash.

Figure 3. View of the City's vehicular travel way located on the backshore adjacent to the dunes. This area has not been bladed since June 2006 (photograph taken August 8, 2006).

Grading the vehicular travel way can be considered beach scraping or an artificial manipulation of the beach profile and that has invoked discussions on beach and dune stability and impact to native fauna. In some areas of the U.S. coast, scraping the dry portion of the beach has become a practice for protecting dunes and structures. Here, as in some other areas of the Texas coast, this practice is used to allow continued public driving access. However, scraping the back beach can destroy coppice mounds, prevent new coppice mounds from forming, and can lower the beach elevation. This can allow storm surge, waves, and run-up to propagate further inland as the volume of beach sand is decreased. Studies have found that modest scraping of "surplus" sand and placing it at the toe of the dunes helps protect them, but conclude that this practice should be used only as a temporary measure (Kana and Svetlichny, 1982; Bruun, 1983) and limited to the area inundated by daily tides (McNinch and Wells, 1992). Most of the City's beaches are wide enough so that the location of the vehicular travel way is not exposed to the normal range of tidal waters. However, scraping the vehicular travel way should only be completed in an emergency situation.

Environmental issues may also arise when the travel way is scraped. In this portion of the Texas coast, some endangered sea turtle species nest in the backshore and dunes, and scraping could potentially destroy nests. A 1998 study of the impacts of beach scraping on macroinvertebrates on Bogue Banks, North Carolina found that ghost crabs did not recover for six to eight months following the scraping event, and that they probably would not recover if the beach was scraped every year (Lindquist, 2001). The Lindquist study suggests that moving beach sand, even within the beach/dune system, can have deleterious consequences and should be limited to emergencies only. But how do you balance providing relatively trouble-free public access with protecting the wildlife that helps draw the public to the beaches? The City's *Coastal Management Plan* (1995) prohibits beach maintenance activities that result in the "significant redistribution of sand or alter the beach profile" (see section VIII, B, 12 on page 39). According to some residents, "significant" quantities of sand have been removed or relocated, and the beach profile has been lowered so that ground water floods the beach road after high rain events. Current scraping practices should be evaluated and altered to minimize the impacts to the beach/dune system and its native fauna. Monitoring the maintenance activity with respect to changes in the beach profile and impacts to fauna can provide the information that can be used to better manage the vehicular travel way.

Pedestrian Beach (Safety) Area

The Pedestrian Beach Area is marked by wooden bollards on the beach and is a designated safety area free from vehicles from the water to the backshore (Figure 2). This protected area stretches from Lantana Drive (south) to Access Road 1A (Figure 4). The pedestrian beach is heavily used by the local population, tourists, and concessionaires who rent beach umbrellas and sell beach permits and other items. This area is inundated by tidal waters and seaweed and trash from the Gulf of Mexico are often deposited here.

Clearing trash and debris from the pedestrian beach areas is usually completed manually by the Public Works staff and front-end loaders are used to remove large amounts of accumulated seaweed. Normal amounts of seaweed are left on the beach throughout the City limits. The seaweed provides food and habitat for shorebirds and invertebrates, and it can trap blowing sand.

Figure 4. Aerial photograph showing beach access roads in the City of Port Aransas (base photograph from http://earth.google.com).

ISSUE #2 MARINE DEBRIS, RECREATIONAL TRASH, ORGANIC DEPOSITS

The amount of marine debris along Mustang Island and North Padre Island can sometimes be overwhelming. Figure 5 shows a recent deposit of seaweed. Marine debris and floating organic material are deposited as a result of two Gulf currents – the Loop Current which moves water from the Mexican Yucatan Peninsula to the Florida Straits, and its offshoot Gyre Current, an opposing current that moves southwestward along the Texas coast. Prevailing winds from the southeast push the marine debris onshore. While recreational trash is a problem, the majority of the trash appears to be from shrimp boats (Amos, undated report to the Padre Island National Seashore).

To maintain a safe pedestrian area and driving and parking areas, the City has removed trash and excessive seaweed deposited on the beach using a front-end loader. The mixture of seaweed, sand, and trash were placed in piles adjacent to the vegetation line along the landward boundary of the vehicular travel way. Sometimes, seaweed was taken to southern areas (near Access Road 1) where there is less public use and the shoreline is eroding. The deposits can facilitate the creation of new dunes. The City must limit the trash in the seaweed so as not to create solid waste according to rules of the Texas Commission of Environmental Quality (TCEQ) (Texas Administrative Code 30 Ch. 330 Municipal Solid Waste §§330.1-330.25). In addition, large amounts of decaying seaweed can create an unpleasant odor.

Figure 5. Photograph showing a pocket of extreme amounts of seaweed deposited in the pedestrian beach area.

SHORELINE CHANGE

As the state geological survey, the Texas Bureau of Economic Geology (BEG) is directed to determine shoreline change rates for the Gulf and bay beaches. Shoreline change rates are indicators of beach stability or erosion and are helpful for planning and managing coastal projects. Previous studies have combined aerial photography and beach profiles to determine shoreline change over time periods ranging from short term -1970's to 1980's (Paine and Morton, 1989) to long-term – 1800's to 1982 (Morton, 1993). These publications provide the trends for particular time periods but those trends may change as the shoreline is in constant flux due to the dynamics of sediment supply, long-term relative sea level rise, and episodic storm events. The latest shoreline mapping technique uses LIDAR (Light Detection and Ranging) surveys and beach profiles to measure the topography of the beaches and dunes. The BEG compares the elevation information gained from these surveys with historical shorelines to calculate annual rates of shoreline change (Gibeaut, et. al, 2001).

When the long-term (1800's and 1930's to 1980's and 2000) shorelines are compared, the Gulf beaches of Mustang Island and North Padre Island are experiencing net erosion (Morton, 1993; Gibeaut, et al, 2001). Figure 6 shows the shoreline changes for the City with the trends as provided in the figure legend (BEG http://coastal.beg.utexas.edu/website/coastal%5Fhazards2/viewer.htm). The beaches here vary from erosion (about -1.5 meters [4.92 feet] per year) in the southern region of the City limits to accretion (about +0.5 meters [1.64 feet] per year) near the Horace Caldwell Pier (Gibeaut, et. al, 2001). The installation of the Aransas Pass jetties in 1911 has led to the impoundment of sand on both sides of the pass and the shoreline change rates vary from erosion (- 6 ft/yr) to stable (-2 ft/yr to +2ft/yr) and accreting (+3 ft/yr). Data providing specific shoreline change rates in numerical format are available from the BEG at http://coastal.beg.utexas.edu/website/coastal%5Fhazards2/viewer.htm.

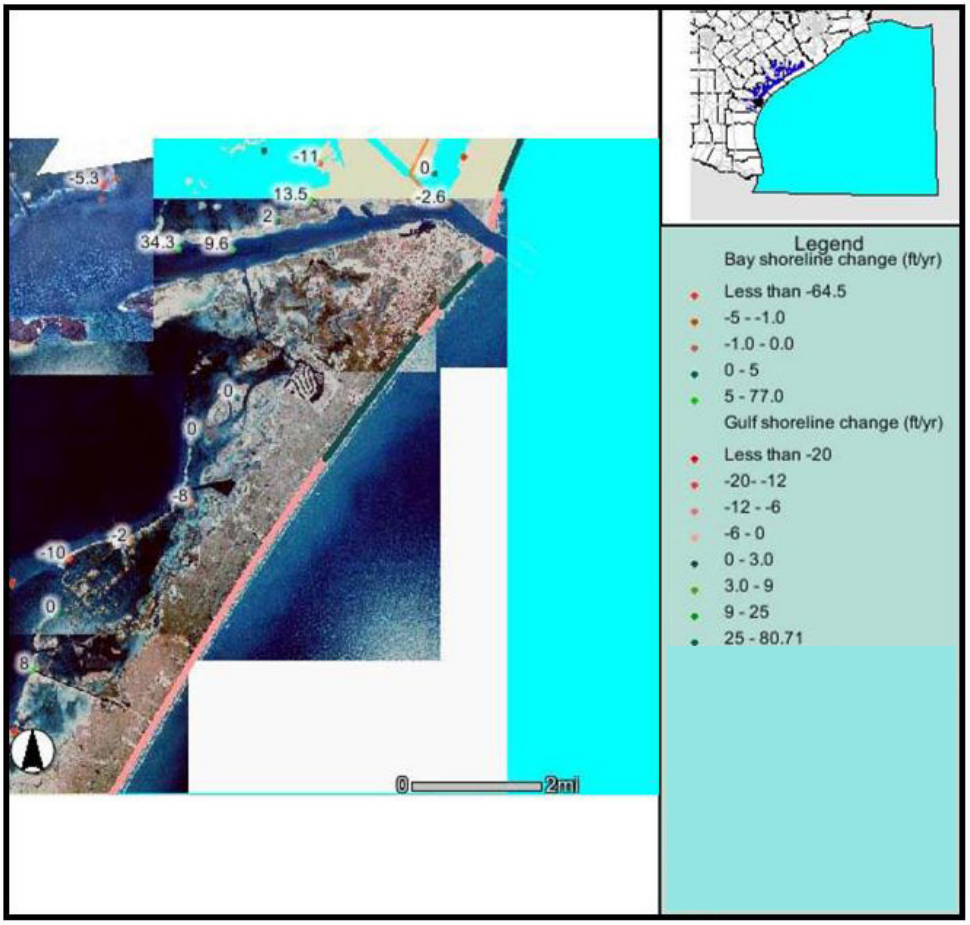


Figure 6. Shoreline change map for northern Mustang Island and including the City of Port Aransas. In general, pink dots represent erosional and green dots represent stable shorelines (from the University of Texas at Austin Bureau of Economic Geology http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm).

OPTIONS DISCUSSED BY THE BEACH MAINTENANCE COMMITTEE (BMC)

The bulk of discussions by the BMC were about the City's beach maintenance activities, beach access, dune protection, and environmental concerns. Local citizens provided input and City staff provided information on how beaches were maintained and offered ideas for changes to maintenance procedures. This section summarizes ideas that were discussed by the BMC and other information that may help the City in making management decisions.

1. Dividing beach maintenance practices into three work zones.

The BMC and City staff discussed alternative beach maintenance strategies for different sections of the beach. Area A represents the pedestrian beaches from Lantana Drive to Access Road 1A. This area receives the most day use as many people walk to the beach from homes, condominiums, and motels. Area B represents the beach parking area from Access Road 1A to Access Road 1. This area receives the most "pull-up" parking. Access Road 1 south to the City limits represents Area C which is the least developed and receives the least amount of visitors. Discussions focused on prioritizing the City's

maintenance in each management area. The consensus was that Area A would be given highest priority because of its heavy use. The bollards that mark the landward limit of the Pedestrian Beach actually extend about 200 feet south of Access Road 1A, into Area B, but management criteria will follow those set for the Pedestrian Beach in Area A. Area B would be considered a transition zone between intensively managed Area A and minimally managed Area C (Port Aransas Beach Maintenance Committee, 2006).

Figures 7, 8, and 9 show the three management areas with the corresponding shoreline change rates as provided by the BEG in the *Texas Coastal Hazards Atlas* ArcIMS data set (http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm). The purpose of adding the shoreline change rates to the management area maps is to show where eroding beaches occur and beach maintenance practices should take into consideration the fluctuations of the shoreline. Eroding shorelines could become potential flood hazard areas and it may be possible to mitigate the effects of shoreline erosion during beach cleaning by placing collected seaweed along the vegetation to trap blowing sand.

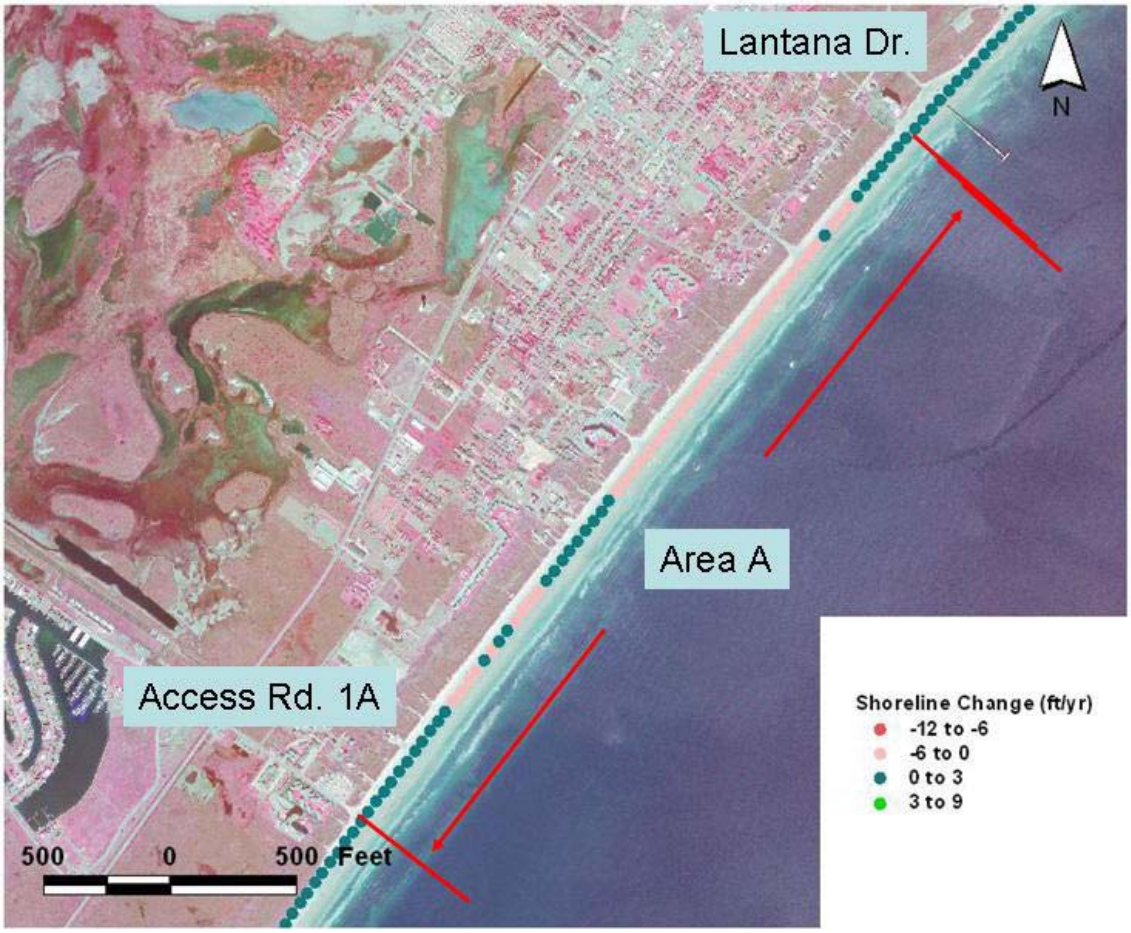


Figure 7. Aerial photograph showing proposed management Area A and the corresponding shoreline change rates. Pink circles represent erosional trends and green circles represent stable trends (sources: digital shoreline change http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm and DOQQ data from the Texas Natural Resources Information System at http://www.tnris.org/NAIPSearch/CountyQuads.jsp?Counties=355&map.x=440&map.y=163).

Figure 8. Aerial photograph showing proposed management Area A and the corresponding shoreline change rates. Pink circles represent erosional trends and green circles represent stable trends (sources: digital shoreline change http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm and DOQQ data from the Texas Natural Resources Information System at http://www.tnris.org/NAIPSearch/CountyQuads.jsp?Counties=355&map.x=440&map.y=163).

Figure 9. Aerial photograph showing proposed management Area A and the corresponding shoreline change rates. Pink circles represent erosional trends and green circles represent stable trends (sources: digital shoreline change http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm and DOQQ data from the Texas Natural Resources Information System at http://www.tnris.org/NAIPSearch/CountyQuads.jsp?Counties=355&map.x=440&map.y=163).

2. Limiting grading of the vehicular travel way by adding water on the backshore to maintain trafficability.

Under dry conditions, backshore sands tend to be soft and it can be difficult for two-wheel drive vehicles to operate easily. Sandy beaches are firmer when damp and can support traffic. Wetting the beaches can increase the tensile strength, cohesion, and friction of the sand surface (Kim and Sture, 2004). In theory, wetting could improve the trafficability on the backshore. The City would need to experiment with the amounts of water added to the backshore, and determine the required reapplication schedule. The use of fresh water was suggested for ecological reasons, but could add to maintenance costs if treated drinking water is used rather than non potable water. This action may also involve drilling new wells and

acquiring permits for allocation. Though, this suggestion could be a worthwhile endeavor if traffic can move freely on the travel way.

3. Moving the bollards that are located along the line of vegetation seaward 25 to 40 feet so that traffic can continue on a harder surface and to allow natural dune growth.

The City beaches have a good supply of sand and wind to move it. These are essential circumstances for sand to accumulate in the landward side of the bollards and eventually form dunes, and this is a positive benefit for storm protection. However, moving the bollards seaward could reduce the size of the beach where the public now has free and unrestricted access. Also, if the bollards that line the Pedestrian Beach safety area are moved seaward, this could reduce the amount of space that is available for visitors between the high water line and the bollards.

The rules for restored dunes adopted under the City's *Coastal Management Plan* state that the restored area extend no further seaward than 20 feet of the landward boundary of the public beach (line of vegetation) and should not restrict public use at normal high tide (see section VIII, B. 9 on page 36). The City may be able to negotiate this distance with the Texas General Land Office (Land Office) and the Office of the Attorney General if the City can demonstrate that dunes could naturally form seaward of the 20-foot boundary.

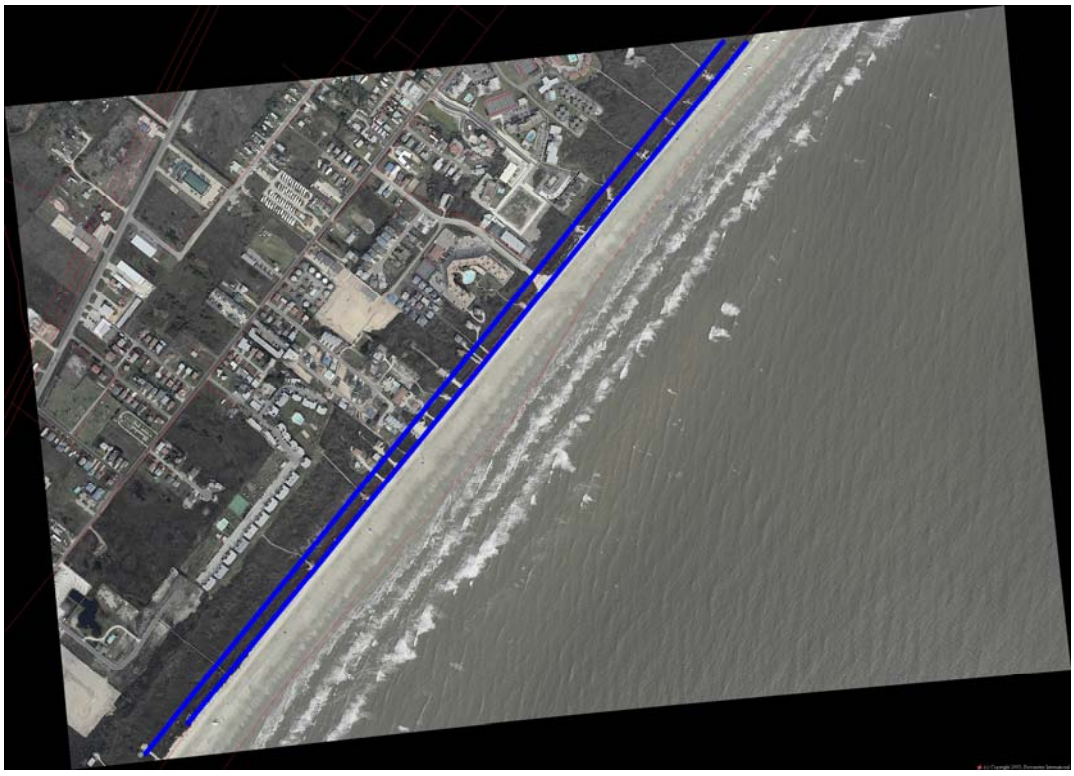
In addition, care needs to be taken in moving the vehicular travel way seaward. The beach surface should be sufficiently firm to carry vehicles. Soft zones can be common on the beach and can be found typically near the upper level of wave run-up at high tide (because air pockets can be trapped under the wet sand).

4. Using the land owned by the Land Office as a test area for seaweed and sand disposal.

One suggested alternative location for placing sand and seaweed is known as the Land Office land. Figures 10a and 10b are aerial photos showing the general location of this "wedge" of land which is located between Lantana Drive and Access Road 1A. Figure 11 shows the general morphology of the area behind the present-day foredunes. Prior to the installation of the Aransas Pass jetties in 1911, this land would have been classified morphologically as the backshore and foredunes (seaward of the line of vegetation). Since construction of the jetties, this portion of the shoreline has widened, new foredunes formed, and the line of vegetation moved seaward. The Land Office issues leases and easements for the few structures that are located in this area. The land is conveniently located to the public beaches, but any City dune project or test area for seaweed disposal located on this land will require consultation with the Land Office.

a.

b.



Figures 10 a. and b. Aerial photographs showing the approximate location of the land owned by the Land Office (between the blue lines). (Photographs courtesy of D. Parsons, City of Port Aransas, 2006.)

Figure 11. Photograph of the Land Office land behind the present-day foredunes (view to the south).

5. Finding a commercial use for seaweed.

Information on commercial uses of seaweed for fertilizer is available through many websites. (An example can be found at Neptune's Harvest – an organic fertilizer that is a combination of fish and seaweed http://www.dirtworks.net/Neptune's-Information.html). The City may want to investigate the feasibility of selling the seaweed to a processor, but only for excessive beach deposits, not for offshore commercial harvest. The seaweed may need to be free of trash to be marketable. The City may also want to compost trash-free seaweed at an off-beach location and use it for fertilizer on City properties.

6. Testing beach cleaning equipment.

Appendix A provides a list of websites for purchasing beach cleaning machinery. Some of the machinery has been used by other U.S. coastal communities with success in both dry and wet sand. Some communities fabricate their own beach-cleaning machines (J. Van Fossen, City of Ocean City, Maryland, personal communication, 2006). Many companies would provide demonstrations of their products at no cost to the City.

7. Testing snow blower-type of equipment to project seaweed only into existing foredunes.

The City should carefully coordinate a demonstration project for the projection of seaweed into the dunes, as the activity will definitely raise attention from visitors. Items to monitor include elevation and vegetation changes in the demonstration area.

8. Allowing light seaweed accumulations to remain on the beach.

Allowing the natural accumulation of seaweed on the public beach serves to provide food and habitat for shorebirds and invertebrates, and it can trap blowing sand. Some tourists may consider the beach dirty, however the City could provide pamphlets that describe the importance of leaving some seaweed on the beach.

9. Taking advantage of natural driving areas in areas with no Pedestrian Beach safety area.

The southern portion of the Pedestrian Beach safety area ends near Access Road 1A. South to the City limits, the City allows parking closer to the Gulf and through beach drivers can follow the vehicular travel way designated by the City. The vehicular travel way could be moved seaward to more firm areas of the beach; however, the City may need to review or alter its code (Section 23-143 of the Port Aransas Code) that prohibits the operation and parking of vehicles within 50 feet of the water's edge.

10. Avoiding depositing sand in the seaward direction.

With the use of new beach cleaning equipment or new management techniques of the vehicular travel way, there should be very little to no need to relocate sand. However, in the case of emergencies, the City should designate an area to receive redistributed sand. The Port Aransas *Coastal Management Plan* states that sand should be returned to a location seaward of the City's dune protection line or within critical dune areas (section VIII, B., 12, page 39). This can include areas seaward along the vegetation line, or with consultation, the land owned by the Land Office. If the beach area from the spring high tide line and seaward is chosen for the redistribution of sands, then the City must apply for a permit from the US Army Corps of Engineers (USACE), (Section 404 (b)(1) of the Clean Water Act 33 U.S.C. 1344 and Section 10 of the Rivers and Harbors Act of 1899 33 U.S.C. 403) (Figure 12). Permit applications are subject to public notice and comment, and the USACE must address public concerns when considering issuing, denying, or conditioning a permit.

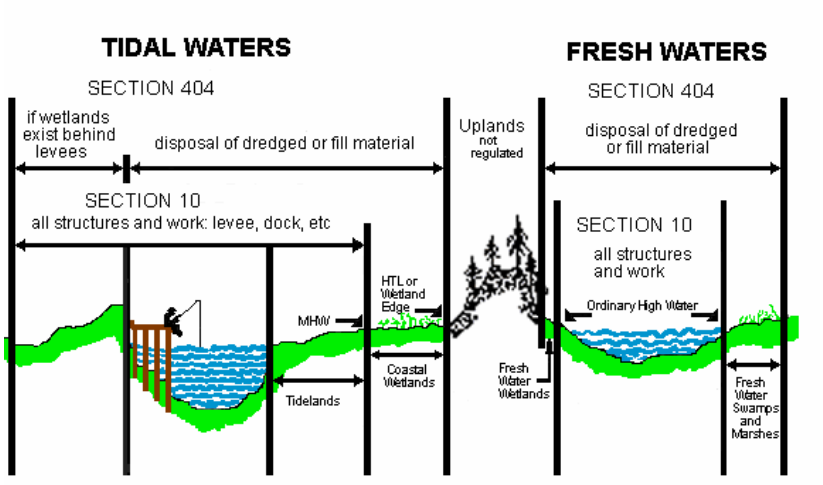


Figure 12. Illustration showing U.S. Army Corps of Engineers permitting jurisdiction (from USACE, http://www.spn.usace.army.mil/regulatory/jd.html, 2006)

RECOMMENDATIONS

The goal for the City should be to maintain a clean, natural, and public-accessible beach using the best management strategies in regards to the environment. The following recommendations are provided as ideas for the City to consider for its beach maintenance practices.

I. MAINTENANCE OF VEHICULAR TRAVEL WAYS

1. Determine seasonal traffic patterns and maintenance needs for peak use times or special events and establish maintenance goals and methods for obtaining them.

2. Halt the practice of using box blades, graders, or front-end loaders to scrape the travel way unless emergency conditions exist.

3. Establish a protocol for emergency relocation of sand from the vehicular beach travel way. Example actions are:

    a. Redirect sand that accumulates from storm deposits, taking care not to lower the beach profile below the pre-storm elevation, and place sand in pre-determined areas (General Land Office land or along the line of vegetation on the eroding stretches of shoreline-avoid areas located seaward of the spring high tide line unless a permit from the US Army Corps of Engineers has been obtained); or
    b. No Action - Leave newly deposited sand in travel way and reroute travel way; or
    c. Allow scraping of the travel way only when the City determines that public safety is at risk; or
    d. Designate emergency placement areas.

4. Relocate the landward bollards of the beach vehicular travel way no more than 20 feet seaward of the line of vegetation if there is enough room for vehicles to pass, if the bollards do no interfere with normal high tide, and the Pedestrian Beach safety area is unaffected. The 20-foot determination is a requirement stated in the City's *Coastal Management Plan* regarding restored dunes on public beaches (section VIII, B. 9 on page 36). The bollards can be compared to sand fencing in that the bollards can be used to mark the landward limit of public access and can slow winds allowing sand deposition and dune growth. The Land Office (and Office of the Attorney General) may choose to negotiate this distance with the City if the City can show that dunes would naturally form. Such evidence could include aerial photographs, beach/dune profiles, or on-ground photographs of former locations of the foredunes. The City and the Land Office could evaluate the impacts of the bollards on public beach access and dune growth at a later time and renegotiate moving the bollards further seaward.

5. The City should inspect driving conditions and post placards for drivability (ex. soft – four-wheel drive only).

6. Provide public information pamphlets with Beach Parking Permits or placards that discuss driving in soft sand, suggest limiting beach driving hours to daytime and early evening in case help is needed, and provide numbers of towing companies.

II. REMOVAL AND DISPOSAL OF MARINE DEBRIS, RECREATIONAL TRASH, AND SEAWEED

1. Purchase or design and utilize beach cleaning equipment that can separate trash, seaweed, and sand. (See Appendix A for information on beach-cleaning equipment.) The equipment should be designed to remove debris on wet sand in the high public use areas such as the Pedestrian-only beach and be able to handle excessive amounts of seaweed.

2. Clean beaches during times when visitation is minimized (late night or early morning).

3. Haul away separated recreational trash and marine debris to a local transfer area or landfill.

4. Establish a protocol for responding to excessive seaweed deposits that includes the following:

    a. Create a temporary off-beach storage site.
    b. Extract trash from seaweed prior to moving to storage site.
    c. Temporarily store seaweed to compost. (The clean-up, staging, trash extraction, and composting would not require a municipal solid waste permit from the TCEQ – see 30 TAC §330.13 (g) and §332 for information on exemptions).

5. Allow light accumulations of seaweed to remain on the beach.

6. Utilize restricted beach cleaning practices during sea turtle nesting season. Example actions are:

    a. Hand pick only.
    b. Use mechanical methods for beach cleaning during daylight hours after a check on nesting activities.
    c. Cordon off nest areas and avoid cleaning these areas with heavy equipment.

7. Hire seasonal employees or utilize the Sunny Beaches non-profit organization (http://www.sunnybeaches.org) for additional assistance in hand picking beach debris.

8. Provide training for all beach cleaning equipment operators.

9. Provide public information pamphlets with the beach parking permits that describe the importance of the beach/dune system, the natural environment and its flora and fauna, marine debris, proper disposal of recreational trash, and how to drive on a beach. Encourage good stewardship of the public beach and nesting areas.

10. Request that state and federal authorities continue to support and enforce rules for disposing of marine debris (MARPOL – marine pollution from ships).

III. RECOMMENDATIONS BY MANAGEMENT AREA

A. AREA A (LANTANA DRIVE TO ACCESS ROAD 1A)

1. Relocate dune bollards no more than 20 feet seaward if the bollards do not interfere with normal high tide, and the Pedestrian Beach safety area is unaffected. The City could negotiate the distance if it can show that dunes would naturally form seaward (see discussion on pages 12 - item #3 and 16 - item #4).

2. Discontinue scraping of vehicular travel way during wet seasons. Determine the feasibility and water and cost estimates for wetting the vehicular travel way during drier conditions.

3. Extensively hand pick trash or use beach cleaning equipment that can separate trash and seaweed from wet sand in the Pedestrian Beach safety area.

4. Develop a protocol for removal of excess sand, seaweed, and trash.

B. AREA B (ACCESS ROAD 1A TO ACCESS ROAD 1)

1. Discontinue scraping of vehicular travel way during wet seasons. Determine the feasibility and water and cost estimates for wetting the vehicular travel way during drier conditions.

2. Use beach cleaning equipment on the beach that can separate trash and seaweed from wet sand.

C. AREA C (ACCESS ROAD 1 TO THE CITY LIMITS)

1. Discontinue scraping of vehicular travel way during wet seasons. Determine the feasibility and water and cost estimates for wetting the vehicular travel way during drier conditions.

2. Use beach cleaning equipment on the beach that can separate trash and seaweed from wet sand.

3. At a minimum, provide vehicular travel way maintenance and seaweed clean up seaward of residential areas and at designated camping areas.

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Port Aransas Coastal Management Plan, 1995, adopted by rule by the General Land Office http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=31&pt=1&ch=15&rl=24.

Funding

Funding for the purchase of new beach-cleaning equipment is available through a competitive grant process from the Land Office Beach Maintenance Reimbursement Fund Program (http://www.glo.state.tx.us/coastal/beachmaintenance/index.html); the Coastal Impact Assistance Program (http://www.glo.state.tx.us/coastal/ciap/index.html); or the Coastal Management Program (http://www.glo.state.tx.us/coastal/grants/index.html). In addition, the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program offers competitive grants for marine debris prevention and removal projects (http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners_funding/callforprojects2.html). Public information documents may also be supported by these programs.

APPENDIX A INFORMATION SOURCES

List of Websites that Offer Beach Cleaning Equipment

1. Barber Surf Rake http://www.hbarber.com/cleaners/SurfRake/specifications.aspx
2. Cherrington http://www.cherrington.net/pulltype.htm#4000
3. Beach Tech http://www.beach-tech.com
4. S40 Beach Cleaner http://www.sisis.com/machinery/S40.html
5. Rockland Beach King II http://www.cleanbeach.com/beachking.htm
6. Beach Groomers http://www.beachgroomers.com
7. Contant Snow Blower http://www.citysnowblowers.com/indexan.htm
8. National Air Vibrator Company (industrial vibrating tables and shakers) http://www.navco.org
9. Broyhill Beach and Park Maintenance System http://www.broyhill.com/pages/beach_loadnpack.cfm

Other Websites of Interest

1. Beach cleaning practices of Ocean City, MD; San Diego, CA; and Minneapolis, MN http://www.americancityandcounty.com/mag/government_day_beach/

2. Beach cleaning equipment used in Ocean City, MD http://www.town.ocean-city.md.us/pwmaint/beachdivision.html

3. BEG shoreline change maps http://coastal.beg.utexas.edu/website/lowercoast/viewer.htm

4. Texas Natural Resource Information System (TNRIS) base maps (DOQQ) http://www.tnris.org/NAIPSearch/CountyQuads.jsp?Counties=355&map.x=440&map.y=163

5. Trafficability on beaches:

   Mulhearn, P. J., 2001, Methods of obtaining soil strength data for modeling vehicle trafficability on beaches, DSTO Aeronautical and Maritime Research Laboratory Report No. DSTO-GD-0299, Victoria Australia, 20 pp. http://www.dsto.defence.gov.au/publications/2379/DSTO-GD-0299.pdf#search=%22trafficability%20on%20beaches%22

   U.S. Marine Corps (USMC Training Manual): http://www.tpub.com/content/USMC/mcwp212/css/mcwp212_106.htm