Cameron County Erosion Analysis

TGLO Contract No. 10-103-006, Work Order No. 6531

Study of Future Shoreline Change and Public Cost Implications of Beachfront Development

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Participating TGLO staff include Natalie Bell (project manager), Jason Pinchback, Melissa Porter, Angela Sunley, and Scot Friedman.

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CONTRACTED WORK

The Texas Coastal Management Program (CMP) desires to perform a coastal processes technical analysis and related policy analysis of the costs associated with alternative Gulf shoreline management approaches on Padre Island north of the City of South Padre Island. Grant funds were secured for this project through the GOMESA Program for this purpose. CMP selected coastal technical and policy expertise through the Texas General Land Office's (GLO) existing Professional Service Providers list. The project team consists of LJA Engineering, Inc. and Peter A. Ravella Consulting (PARC).

The following task descriptions were prepared following internal team discussions and interaction with GLO staff, recognizing the constraints of a limited budget, procedural timelines, grant fulfillment requirements, available data and information, and GLO's and the County's desired long term goals for the utility of the plan.

The area of focus is the relatively undeveloped barrier island portion of Cameron County to the north of the city limits of the City of South Padre Island, including areas within the City's Extra-Territorial Jurisdiction or ETJ.

Services focus on three efforts: (1) using existing data, characterize the combination of sand budget and changing sea level at this location as it relates to variations in the landward-seaward location of the beach-dune system on a time scale measured in decades, particularly the interactive map product "Geohazards and Geoenvironments of South Padre Island, Texas, Harte Research Institute, Texas A&M University - Corpus Christi (2012); (2) informed by the results of the first effort, discuss the benefits and consequences of alternative beachfront development practices from the perspectives of the property owners, the local government and other public and private stakeholders, and the natural resource; and (3) report the results in a manner and format suitable for reasoned discussion by the local decision makers and stakeholders that will ultimately shape the development of this resource.

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C Texas Natural Resources Code Title 2, Subtitle C, Ch. 33, Subchapter H – Coastal Erosion and I – Coastal Protection and Improvement, §§33.601-33.663

D SPIProperty.com Learn About North Island Land

E My Harlingen News – Opportunity for Investment, Beachfront Development Begins on South Padre Islands North End in Anticipation of $1.5 Billion Regional Transportation Development Plan (myharlingennews.com/?p=18591)

F Cameron County Regional Mobility Authority Strategic Plan 2012 – 2016

G Notice of Public Hearing – South Padre Island 2nd Access Project

H Texas Administrative Code Title 31, Part 1, Ch 15, Subchapter B, Rule §15.42

I Geohazards Map of South Padre Island, Texas – Overview Presentation published by Texas Coastal Coordination Council and the Harte Research Institute (http://geohazards.tamucc.edu/southpadre/SPIgeohaz.html)

J[1] Cameron County Erosion Protection, Public Beach Access, Coastal Construction and Dune Protection and Beach Management Plan (EPP) – 2012

K US Code 2011 Title 43, Ch. 29, Subchapter III, Section 1356a (43 USC §1356a)

L[1] Coastal Erosion Planning and Response Act Report to the 81st Texas Legislature (TGLO)

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KEY FINDINGS

1. The study area can support a tremendous amount of beneficial real estate development, economic activity and associated public revenue. Whether new revenue streams can overcome costs of maintaining the beach-dune system in the long term will depend upon land use and development decisions made in the near future (months and years). A balanced approach of setbacks matched to the time scale of land uses along with positive intervention funded by revenue streams generated from new economic activity is desirable and feasible. (See §1.0; §7.0)

2. Recent events such as the extension of utilities, discussion of a second causeway to SPI, and improving economic conditions are likely to result in relatively rapid development of the beachfront in the study area over the next decade and beyond. (§1.3)

3. The "Cameron County Erosion Protection, Public Beach Access, Coastal Construction and Dune Protection and Beach Management Plan" (Plan) as adopted by Cameron County on August 14, 2012, cannot effectively maintain a static position of the Gulf beach shoreline without incurring high costs for maintenance of a healthy beach-dune system. The Plan promotes maximum-seaward development by current landowners at the expense of future landowners and the public. Further, the Plan cannot be adopted by the state without changes to state law or agency rules. (§2.0)

4. The Plan is not suited for managed retreat and presumes that public revenue streams will be used to maintain a static shoreline location. However, there is no basis for state and federal expenditures until significant development has occurred to provide an economic base worthy of protection. Such an economic base is probably at least a decade away. Further, federal and state revenue streams of the required magnitude are highly unlikely to materialize in the coming years given existing fiscal constraints. Realistically, the Plan should either be primarily locally funded or reconsidered altogether. Stakeholders should plan for future shoreline management costs in the range of $30 million to $78 million per five-mile beach nourishment project, each with a 5-year renourishment interval. (§1.3.4; §6.3; §6.4, §7.1)

5. Cameron County should not expect to achieve a result similar to that of the shoreline management program implemented by the city of South Padre Island over the past decade without a significantly greater funding commitment and the identification of a feasible long-term source of beach compatible sand other than maintenance dredging material from the Brazos Santiago Pass. A commitment to sand source identification should be integral to the Plan. (§2.0; §5.1; §6.0)

6. The scale of the Erosion Protection Dune System (EPDS) included in the Plan as the primary landowner response to shoreline retreat at the time of development is overwhelmed by the scale of the ongoing sand deficit in the study area and should not be relied upon as a primary defense against shoreline retreat. Further, much of the sand transport occurs beneath the waterline and is unaffected by dunes. Without a

committed program of beach nourishment to counteract rising sea level and the ongoing deficit of sand, there is no reasonable likelihood that the EPDS alone will result in a meaningful reduction of shoreline retreat, public expenditures for post-storm losses, or damage to private property and public infrastructure. (§3.0; §4.0)

7. The proposed EPDS approach presumes that a stable dune system can be created and maintained within a zone between 180 and 255 ft landward of the existing MLW line. Unlike other areas of the Texas coast such as Galveston, there are no existing stable (vegetated) dunes in the undeveloped study area located as close to MLW. Installation of an EPDS at this relatively seaward position on the beach profile reduces its functionality and life expectancy relative to a dune system placed higher and farther from the shoreline similar to naturally-occurring dunes. (§3.0)

8. The Plan allows construction of improvements within 280 feet landward of mean low water (MLW), without regard to the time scale of the proposed land use. This approach assures conflict and high beach maintenance costs for long-lived development projects while presuming elsewhere in the Plan that public expenditures will be used to resolve the conflict. In the alternative, managed retreat strategies can be implemented that match land use time scales to achievable retreat rates. For example, short-lived structures could be located closer to the beach while high-rise construction could be located farther back. Serious consideration should be given to the landward-seaward location of both the existing and future alignment of Park Road 100 as part of any reconsideration of the Plan. (§2.0; §5.0; §7.0)

9. The Gulf shoreline in the study area is retreating at a long-term average rate of about twelve feet per year. (§3.1; §4.0)

10. The long-term rate is the cumulative result of individual yearly changes that can vary between advances of over ten feet to retreats of over thirty feet as seen in actual data from recent decades in the study area. The small retreat rate seen in the last several years is attributable to relatively benign storm conditions that should not be viewed as a change in the long term trend nor relied upon for planning purposes in the years to come. (§3.0; §4.2; §4.3)

11. The long-term average sand deficit to be overcome to maintain a static shoreline position is on the order of 60,000 cubic yards of sand per mile of beach per year. The current (or any future) position of the shoreline can only be maintained on a time scale of years to decades by proactive means such as significant and on-going beach nourishment and dune restoration to offset the sand deficit. By comparison, the sand quantity contained within the proposed EPDS, a one-time commitment, is similar in magnitude to the average sand deficit for a single year. (§4.1; §7.4)

12. Implementation of the Plan will result in a discontinuous EPDS because its landward-seaward location on a particular tract will be dependent upon the shoreline location at the time the tract is permitted. The allowable landward-seaward location of buildings on neighboring properties will vary unpredictably for the same reason. (§2.0)

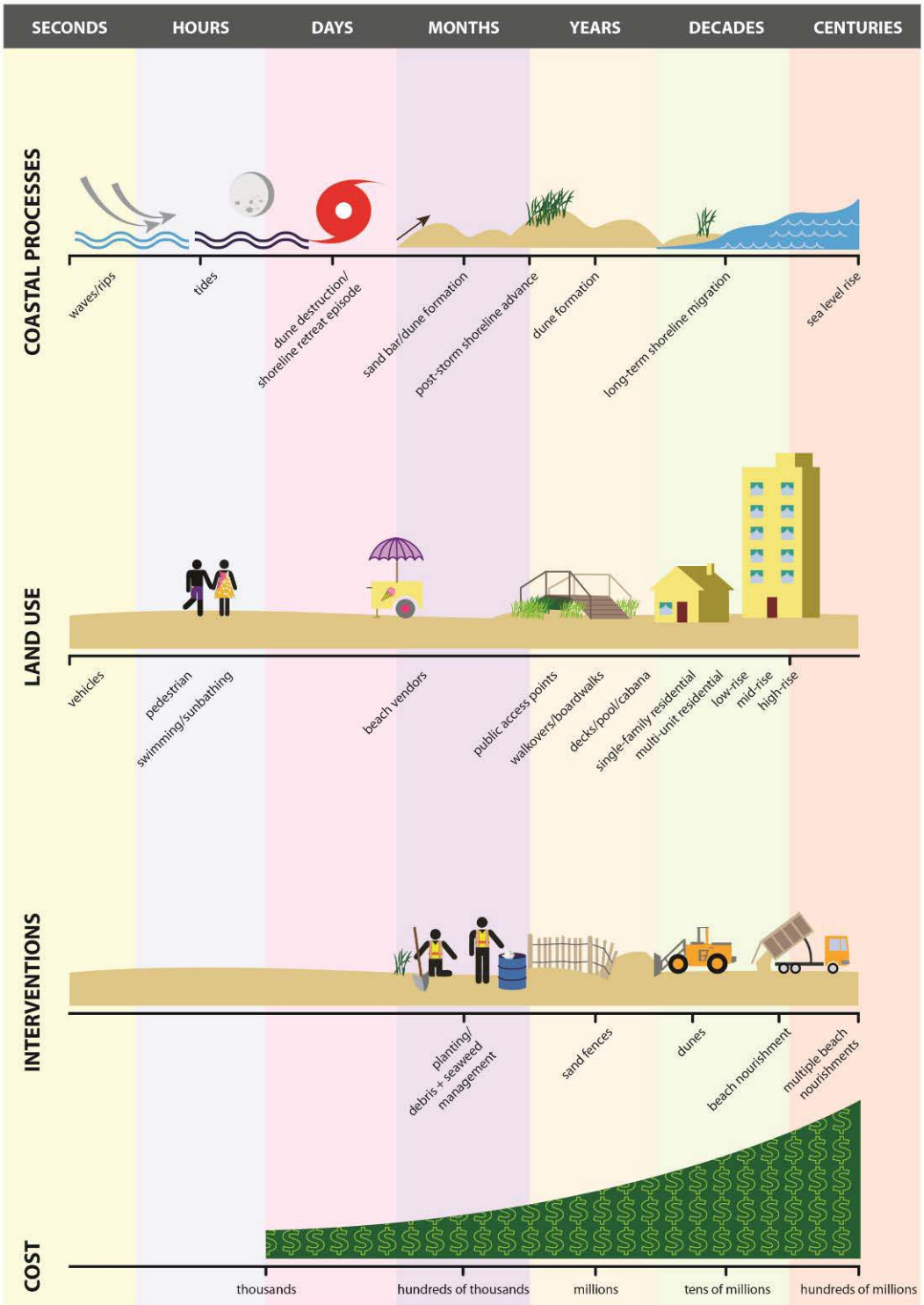

Figure 0-1 Relevant Time Scales

1.0 Study Setting

1.1 Legal Setting

The State of Texas has long recognized both the benefits and risks of development on its coastal barrier islands. Beginning with the adoption of the Coastal Management Program in 1997, the state has sought to balance the benefits of economic growth in the coastal region with the risks presented by storms and hurricanes. Coastal communities – especially those on barrier islands -- have grown over the years and this development has expanded the economy, increased the tax base, and provided substantial benefits to both the public and private sectors. However, the Texas coast is subject to the threat of significant storms and hurricanes and experience has proven that barrier island development imposes specific risks on private property owners, investors and to taxpayers statewide.

In 1999, the 76th Texas legislature passed the Coastal Erosion Planning & Response Act (CEPRA) as a way to focus state attention on the problem of shoreline retreat and to expand the state resources available to address coastal erosion problems. As the GLO explained in the description of the program:

> The purpose of the CEPRA Program is to implement coastal erosion response projects and related studies to reduce the effects of and to understand the processes of coastal erosion as it continues to threaten public beaches, natural resources, coastal development, public infrastructure, and public and private property. Under CEPRA, the General Land Office (GLO) implements erosion response projects and studies through collaboration and a matching funds partnership with federal, state, and local governments, non-profit organizations and other potential project partners.
>
> If the Legislature appropriates funding, the CEPRA program provides funding on a biennial basis for the following types of projects and studies, with priority given to projects that include construction of an erosion response solution during the biennium. The following types of projects are generally considered for funding:
>
> - Beach nourishment on both Gulf of Mexico and bay beaches
> - Shoreline stabilization
> - Habitat restoration and protection
> - Dune restoration
> - Beneficial uses of dredged material for beach nourishment, habitat restoration, etc.
> - Coastal erosion related studies and investigations
> - Demonstration projects
> - Structure relocation and debris removal

As made clear in the 2009 update to the State Erosion Response Plan, securing adequate taxpayer revenues for the CEPRA Program has been a challenge.

> "Although the CEPRA program exists, there is no dedicated funding source assigned to the Act and therefore CEPRA must compete for funding every biennium."[2]

Since its implementation in 2000, CEPRA funding amounts have varied each biennium; however, requests for funding assistance have always exceed the amounts made available by the legislature. As of 2010, more than $76 million in public funds had been allocated for erosion response projects. During the same period, more than $585 million have been requested for projects. According to the State Erosion Response Plan Update (2009), the appropriated state funds have been leveraged with $114,670,530 in partner funds of which $65,755,899 represent federal funds that have been provided in cash and in-kind. In total, 211 erosion response projects were funded in CEPRA Cycles I to V, with 25 additional projects being planned in the current Cycle VI biennium.

In 2009, in the aftermath of Hurricane Ike and response to continued concerns about the threat of coastal storms to coastal property and to the taxpayers of the state, the Texas Legislature passed House Bill 2571, the Erosion Response Act. The law, codified in Texas Natural Resources Code §33.607(g), was later amended by House Bill (HB) 2819, 80th Legislature and §33.607(e), (f), and (g) as amended by HB 2073, 81st Legislature.

The purpose of the law was to encourage local coastal governments to undertake and adopt erosion response plans with the specific intent of reducing the financial risk transferred to Texas taxpayers by barrier island development. In 2010, pursuant to authority granted in the law, the General Land Office adopted the administrative rules necessary to implement the law. As stated in the preamble for adoption to the rules:

> Texas Natural Resources Code §33.607(g) as amended by House Bill (HB) 2819, 80th Legislature and §33.607(e), (f), and (g) as amended by HB 2073, 81st Legislature authorize the Commissioner to adopt rules for the establishment and implementation of Erosion Response Plans. Section 33.607(e) requires a local government subject to Chapters 61 and 63 to use historical erosion data and the coastal erosion response plan published by the Commissioner under §33.602 to <u>prepare a local plan for reducing public expenditures for erosion and storm damage losses to public and private properties</u>. Plans developed under §33.607(e) may include a set-back line that will accommodate a shoreline retreat (emphasis added).

The new law is intended to promote better coastal planning at the local government level and thereby reduce future public expenditures that arise when storms and hurricanes impact the coast, as they inevitably will do. In adopting the program rules, the Land Office made clear its concern "with loss of structures and public infrastructure due to

[2] State Erosion Response Plan, 2009 Update, page i.

storm damage and erosion, disaster response costs, and loss of life."[3]

The statute recognizes the importance of public awareness and education as a cornerstone of sensible shoreline development, directing the land office to "coordinate with other agencies to increase public awareness through public education concerning the causes of erosion, the consequences of erosion, the importance of barrier islands, dunes, and bays as a natural defense against storms and hurricanes; and erosion avoidance techniques.[4]

In the law, the Legislature encouraged coastal local governments, including Cameron County, "to use historical erosion data to prepare a plan for reducing public expenditures for erosion and storm damage losses to public and private property, including public beaches, by establishing and implementing a building set-back line that will accommodate a shoreline retreat."[5]

The local erosion response plans may include provisions for establishing a building setback, protecting public beach access and the public beach easement, and procedures for preserving, restoring, and enhancing critical sand dunes that are necessary to protect public and private property from storms and erosion. The local governments are required to use the information in the Statewide Erosion Response Plan and the historical erosion rates calculated by the UT Bureau of Economic Geology when developing the local erosion plans.

Ultimately, all local erosion response plans will be submitted to the Land Office for review and certification as consistent with state law. After the Land Office's approval, the plans will be posted in the Texas Register for public comment and then formally adopted by rule and incorporated in the local dune protection and beach access plans as an appendix.

While the specific components of each local plan are not dictated in the Land Office rules, cities and counties that fail to prepare an erosion response plan that fulfils the legislative objectives will be ineligible for state grant assistance under certain programs, including the Coastal Erosion Planning and Response Act.

The state's efforts to encourage better local planning for barrier island development are not new. In 1996, the Land Office, at the direction of the Legislature, prepared the first Statewide Erosion Response Plan. This plan "was created to identify critical coastal erosion areas designated by the Texas Land Commissioner to assist in prioritizing coastal erosion response projects and studies." The plan was updated in 2004 and again in 2009.

The 2009 plan identified current critical erosion areas for prioritized erosion response actions and, for the first time, provided new information to help local governments develop their own local erosion response plans. The 2009 update also included information on the economics of erosion response measures and the value of maintaining a healthy beach and dune system, as well as maintaining setbacks for future

[3] Adoption Preamble, TAC §15.17, Erosion Response Plans, as proposed in 35 TexReg 5175
[4] Texas Natural Resources Code – Section 33.607(a).
[5] Texas Natural Resources Code – Section 33.607(e).

development.

The economic analysis in the 2009 update tested a "no action" response to the location of a 50-year shoreline erosion line in seven priority areas along the Gulf Coast, including South Padre Island. This analysis estimated damages to existing structures and land when the 50-year shoreline moved landward of the structures and compared beach visitation benefits for different beach loss scenarios. In the economic analysis report prepared by Taylor Engineering, the authors explained the general nature of the shoreline erosion problem facing barrier island communities:

> "Estimating structures and land damage potential requires an understanding of the sources of Texas' erosion problems. The first source of erosion — the unimpeded landward and seaward movement of the shoreline — has occurred naturally since early times. However, the human enterprise of beach development characterizes a second source of erosion. Beach development, spurred by the desire of visitors, residents, and industries to live and work close to the Gulf of Mexico has, in many ways, fixed the boundary between land and sea. Once established, people now want to hold this boundary to preserve their large investments. The desire to fix the beach boundary has overcome the patience needed to allow nature to restore an eroded shoreline. Ongoing erosion, caused by man's presence on the shoreline or a function of continued natural beach processes, generally leads to either monetary loss from storm damage or large expenditures for shore protection to prevent the loss."[6]

The State Erosion Response Plan Update (2009) included the following specific recommendations in areas, such as South Padre Island, where the erosion rate typically exceeds two feet/year:

- Design beach nourishment projects to meet the requirements for protection from a significant storm event (this includes the construction of a substantial dune).
- In cooperation with the USACE, utilize sand from maintenance of navigation channels and disposal sites.
- Investigate the participation of shorefront landowners in paying a greater share of the cost since those properties benefit the most from such projects.
- If hard structures are proposed for erosion response, design to minimize downdrift impacts to adjacent shorelines and provide monetary assurances in case the project fails and requires removal.
- Commit to long-term project monitoring to evaluate project effectiveness and improve future project designs.

The state of Texas, through a series of legislative and administrative actions over the last

[6] Krecic, M. R., Hunt, W., and Lawson, G. P., 2009, Economic Analyses for Update of the 2009 Texas Coast Wide Erosion Response Plan, Taylor Engineering, Inc. Final Report to the Texas General Land Office, Jacksonville, FL, p. i-ii.

two decades, has exhibited an increasing awareness of the threat of shoreline retreat to public safety, infrastructure, and private development on barrier islands. The state has appropriately asked local barrier island governments to take a fresh look at their coastal land development practices with the specific objective of reducing public expenditures for erosion and storm damage losses to public and private property, including public beaches, by establishing and implementing a building set-back line that will accommodate a shoreline retreat.

1.2 Regional Shoreline Setting

The South Padre Island shoreline is a continuous, sandy beach/dune system within the City of South Padre Island and extending to the south and north of the City limits. To the south, about 1 mile of beach separates the City portion of the beach from the north jetty of the Brazos Santiago Pass. To the north of the City, over twenty nine miles of undeveloped beach, five miles of which is within the City's extraterritorial jurisdiction (ETJ), separates the northerly City limit from Mansfield channel and the southerly limit of the Padre Island National Seashore.

Padre Island is impacted by coastal geologic forces typical of barrier islands the world over. The main processes affecting the island are sediment transport due to wind and wave action along the shoreline, constructive and destructive forces associated with wave activity, and fluctuations in sea level. These forces act to transport sand both alongshore and across shore. The primary features found on SPI include the primary foreshore dunes that are immediately landward of the beach face, the historic secondary dunes found landward of the primary dunes, back-barrier flats on the leeward side of the island, washover fans, washover channels, inlet channel, tidal deltas, and marshes.

The 113-mile long Padre Island originated from sediments eroded from the Rio Grande delta roughly 3,400 to 1,900 years before the present (Brown and Hartmann, 1980). At that time, the sediment supply of the once-prograding Rio Grande River delta diminished causing the delta to subside and erode. The eroding delta sediment was reworked by waves and tides to form offshore shoals. These shoals began to coalesce and transgress landward to form a peninsula attached to the Rio Grande deltaic headland. Continued sediment transport and northward spit-accretion resulted in the formation of Padre Island. Since 1957, Padre Island has been split into North Padre Island and South Padre Island by Mansfield channel. To this day, the barrier island continues its landward transgression.

South Padre Island is a wave-dominated barrier island with evidence of frequent occurrences of tidal overwash. The dune system varies in size and distribution from large, narrow sandy dunes, to wide, low-crested dunes. The island narrows from north to south from roughly 5 miles near Mansfield channel to approximately 0.5 miles at the narrowest sections. Over the long term (years to decades), more sand travels toward the north than to the south at this point along the Gulf shoreline. As a result, construction of the Brazos-Santiago Pass jetties caused sand to accumulate on the south side of the south jetty, while the beach to the north of the north jetty was sediment-deprived. The result was a rapid retreat of the Gulf shoreline in the southern reaches of the City. City beaches are also adjusting to ongoing sea level rise by migrating landward and upward over the long term.

1.3 General Development Setting

The purpose of this section is to generally identify the conditions and circumstances that are likely to promote future development in the study area. While predictions of future economic activity and development growth are difficult, a confluence of circumstances appears to be emerging that will promote new and extensive development on the north end of South Padre Island.

1.3.1 Emerging Real Estate Market

The undeveloped land on South Padre Island may be one of the best barrier island investment opportunities in the United States. According to one of many reputable real estate firms in the area, miles of beachfront land are "available for purchase and development, and at prices much lower than in the past. This is the opportunity of a lifetime for the right developer, or for an individual who wants beach land for future use!"[7]

A typical announcement of the parcels available for purchase is shown below.

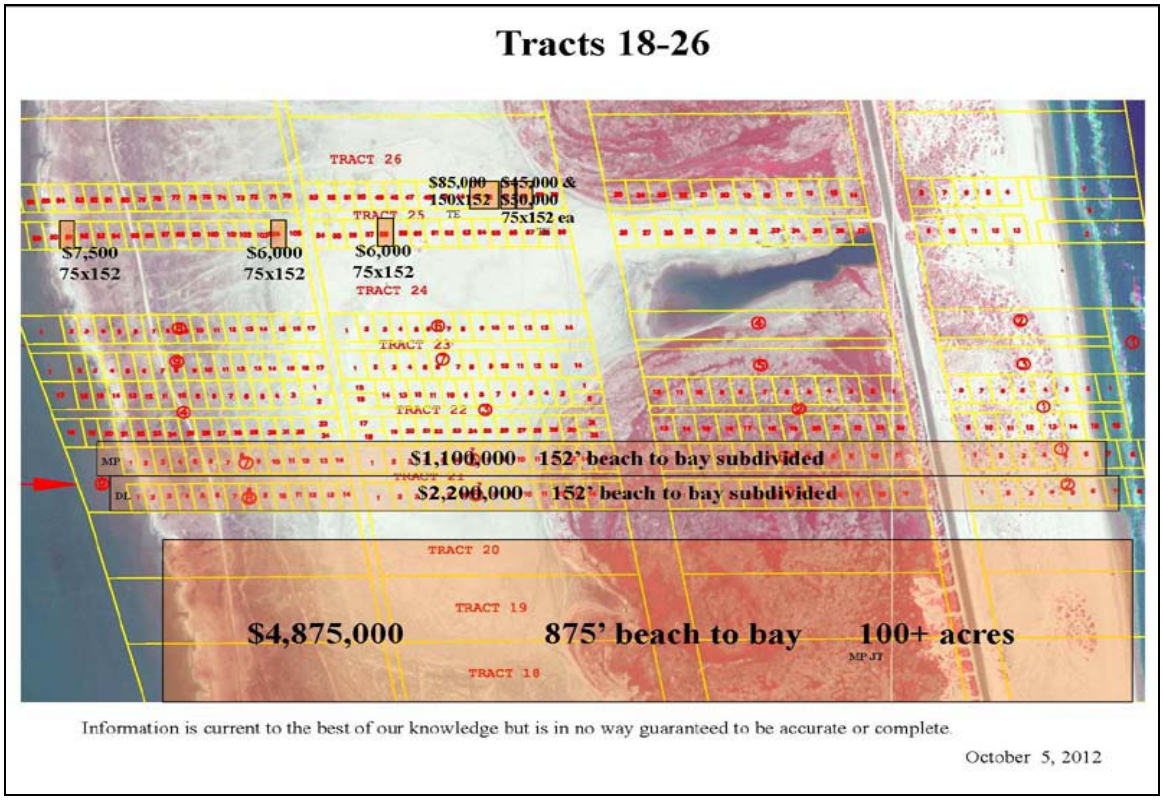

Figure 1-1: Parcels available for purchase in Tracts 18-26

[7] South Padre Coastal Real Estate website, www.spiproperty.com

For firms in the business of selling real estate, claims of "once in a life time opportunities" are to be expected but in this case the claims may well prove to be true. Several factors strongly indicate that the circumstance may be conducive to rapid development of the parcels north of the Shores Development on South Padre Island. One real estate firm explains the confluence of factors driving the emerging real estate market this way:

> "The undeveloped land north of the town of South Padre Island presents an excellent opportunity for developers and individuals to purchase beachfront lots and acreage at reasonable prices. In the last two years, we have seen water, sewer, and electric utilities extended into some of these areas, as far as 1 mile north of Beach Access 6. The most significant news has been the announcement of a second causeway from the mainland to the undeveloped part of the island. This will make South Padre Island more easily accessible from points to the west and the north, and we believe this will be the key element in launching significant future development." [8]

According to recent press reports, new development opportunities are attracting investors from around the county:

> "A new era of development began today when construction crews broke ground on the *CIBOLA* Subdivision on the North End of South Padre Island, TX. *CIBOLA* will have residential beachfront lots starting at $350,000, and reservations are now being accepted by Troy Giles Realty. The developer, Angela Edwards of Edwards Coastal Land Development, credited Cameron County's $1.5 Billion Transportation System Development Plan and the incredible beauty of the Island as catalysts for the development.[9]
>
> Angela Edwards, an attorney from Massachusetts and President of Edwards Coastal Land Development, and her husband Rick, an avid surfer, fell in love with South Padre Island six years ago and immediately began investing in the Island, purchasing beachfront and rental properties.
>
> "The beaches are spectacular and consistently ranked in the top 10 in the Country" stated Ms. Edwards. Former residents of Fairfield County CT's "Gold Coast" and Manhattan Beach, CA, the Edwards quickly recognized the incredible value of South Padre Island and its potential for future growth. "Where else can you purchase a $500,000, 4 bedroom house a ½ block from the beach and generate $60,000+ a year in rental income?" remarked Mr. Edwards.

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[8] South Padre Coastal Real Estate website, www.spiproperty.com

[9] www.myharlingennews.com, "Opportunity for Investment, Beachfront Development Begins on South Padre Island's North End In Anticipation Of $1.5 Billion Regional Transportation Development Plan," Thursday, March 3rd, 2011.

"Cameron County, Laguna Madre Water District, South Padre Island and local banks, such as Lone Star National Bank, have some great people at the helm who have been incredibly supportive. We are all extremely excited to share this beautiful island with new investors and friends." Ms. Edwards said.

Judge Carlos Cascos, Cameron County's highest elected official, commented, "With the future construction of the causeway on the North End of South Padre Island, I am extremely pleased that entrepreneurs such as Ms. Edwards are investing in the continued growth of Cameron County. Her investment will create jobs, spur economic development and enhance our quality of life. I applaud Ms. Edwards on her vision and commitment to Cameron County."

"Now is the time to invest in North Island while beachfront property is still relatively inexpensive, in advance of the Second Access long-awaited public hearing, which will be held this summer," revealed Ms. Edwards.

Arnie Creinin, President/CEO of Coastal Lifestyles Inc., a South Padre Island luxury rental and property management company, also recognized the huge development potential. Mr. Creinin managed a major resort in Destin, FL in the early 90s and compared that area's successful growth to the opportunity now available on South Padre. "The North Island right now reminds me of Destin 20 years ago," remarked Mr. Creinin. "Angela Edwards's enthusiasm is contagious and I know that her success will attract new investors to the Island," remarked Mr. Creinin.

Ms. Edwards concluded, "It is an exciting time and I look forward to continue working with Cameron County and South Padre Island officials on new projects as a Land Development Consultant for other developers. There is fantastic opportunity here and I welcome others to become a part of the success on South Padre Island's up-and-coming north end."

A comprehensive review of the real estate market is beyond the scope of this study and none is offered. While real estate and investment experts may disagree on the likely pace and timing of the development within the study areas, it appears that circumstances are more favorable now for vigorous development in the study area than in the past. Under these conditions, it is prudent for state and local leaders, most especially Cameron County, to examine the potential implications of shoreline retreat and expanded development in the study area and the potential cost to taxpayers locally and statewide.

1.3.2 Extension of Utilities

In 2009, the Laguna Madre Water District (LMWD), which provides water and waste water services on South Padre Island, completed an extension of utility services five-miles north of the existing Andy Bowie Wastewater Treatment Plant located adjacent to the SPI Birding Center. The extended lines were described by the LMWD as: (1)

16-inch water line; (2) 8-inch force main; (3) 12-inch reuse line; and (4) two lift stations. According to LMWD, the water and wastewater utility extensions are designed to serve the north end development in the study area for many years.

The extension of basic utility services into the undeveloped portions of the study area eliminated one important impediment to future development.

1.3.3 South Padre Island Second Access (new causeway to mainland)

South Texas, including South Padre Island, continues to be an attractive business and tourist destination and continues to see tremendous growth in population and surge of economic development. According to the Cameron County Regional Mobility Authority (CCRMA), the population of the Brownsville-Matamoros and McAllen-Reynosa areas combined is estimated to double between 2010 and 2040 from 3.5 million to 7 million residents. As regional population continues to grow rapidly, as more jobs are created, and more businesses locate in this area, the area will continue to face the growing transportation challenges.[10]

In 2012, the CCRMA advanced plans for the South Padre Island Second Access or causeway. The Second Access will connect South Padre Island's undeveloped north end to the mainland and is planned as part of CCRMA's $1.5 Billion Transportation System Development Plan.

The proposed causeway consists of three major components: the mainland roadways, the bridge crossing the Laguna Madre, and the island roadway. The mainland roadway component would consist of a four-lane facility within a 150-foot right-of-way (ROW) from SH 100 north to Buena Vista Drive, Laguna Vista Drive or FM 510 (depending upon the alternative chosen) and a 400-foot ROW from the end of the 150-foot section to the Laguna Madre.

The Laguna Madre crossing component, which would be access controlled and tolled, would consist of four lanes within a single 80-foot wide bridge.

The island roadway component of the project would consist of two typical sections. The first typical section would consist of four lanes and extend from the bridge to an intersection with Park Road 100 within a 400-foot ROW. The second typical section reflects improvements to Park Road 100 and would extend from the intersection with Park Road 100 south to the project terminus. Within this area, Park Road 100 would be reconstructed as a four-lane roadway with sidewalks within the 200-foot existing Park Road 100 ROW.

According to CCRMA, the need for the proposed project is to improve public safety, enhance local and regional mobility, and provide the infrastructure necessary to

[10] Cameron County Regional Mobility Authority (CCRMA), Strategic Plan, 2012 – 2016, page 2.

support economic development. Additionally, environmental sensitivity is an important component of the project need.[11]

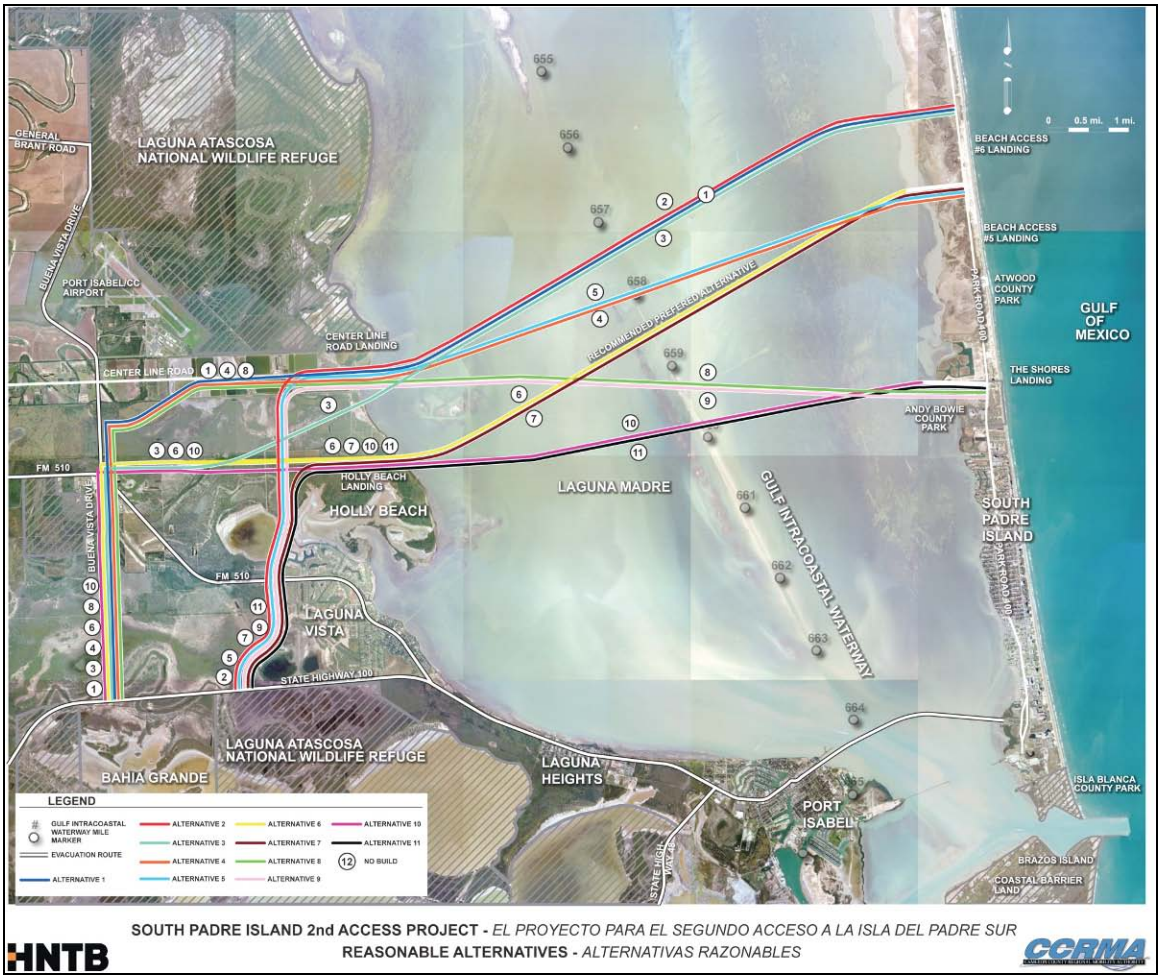

Figure 1-2: Proposed Second Access causeway alignments

The new causeway is expected to be funded by private equity investment, toll revenue financing, and roadway dedicated funds. According to CCRMA, the new causeway "will provide the infrastructure necessary to support economic development in the region and provide faster and improved access to South Padre Island." Once the new causeway is completed, CCRMA estimates that vehicle access to the undeveloped South Padre Island study area will be only 22 minutes from Harlingen International Airport.

In July 2012, CCRMA conducted the public hearing on the draft Environmental Impact Statement for the project, presenting alternative alignments for the new

[11] NOTICE OF PUBLIC HEARING, SOUTH PADRE ISLAND 2nd ACCESS PROJECT, CAMERON COUNTY, July 17, 2012, Cameron County Regional Mobility Authority (CCRMA), in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA).

causeway, which are presented above in Figure 1-2. The authority is moving forward to complete and seek approval of the Final Environmental Impact Statement (FEIS) in coordination with Texas Department of Transportation (TxDOT) and the Federal Highway Administration. Upon approval of the FEIS, the Authority expects to begin the process to secure project financing and enter the necessary Comprehensive Development Agreement (CDA) to construct the project.

The preliminary estimate for the cost of the new causeway is $562 million according to TxDOT. While no reliable schedule for the construction of the causeway has been released, efforts to pursue the project continue at the local and state level. The potential construction of a second causeway to South Padre Island would substantially improve access the island's undeveloped parcels and is likely to be a significant factor driving accelerated interest in development within the study area.

1.3.4 Future Financial Responsibility for Shoreline Management

On the assumption that accelerated development in the north end of South Padre Island is likely to occur and the recognition that the shoreline within the study area is eroding, it is useful to identify the potential parties that would be financially responsible for contending with continued shoreline retreat in the future.

One unavoidable conclusion of the technical analysis in this study (Worsham and Brown, 2012, see Appendix N) is that the current position of the shoreline – including the beach and dune system within the study area – cannot reasonably be expected to remain where it is. As shown in Section 3 of this report, the shoreline position is expected to be some 350 feet landward of its current position within 30 years.

In the absence of development, the retreat of the shoreline in the study area creates no imperative for new beach nourishment or dune restoration projects or for other shoreline management responses such as the installation of jetties, groins or shoreline armoring. In fact, as discussed in Section 1.3.5, numerous beachfront lots that were platted for development are now submerged. These land losses, while significant for the landowners, were no impetus for public action at city, county or state level.

Once sufficient development value has been constructed in the study area, the inevitable collision of the retreating shoreline and the potential damage to public infrastructure and private investments will occur, creating significant political pressure to maintain the shoreline position seaward of the new structures.

There are three entities likely to be financially responsible for future shoreline management costs in the study area: (1) Cameron County; (2) the City of South Padre Island; and (3) the State of Texas, through the Texas General Land Office. Each of these entities has a legal role in the management of shoreline erosion in Texas.

Cameron County: The undeveloped land in the study area lies within Cameron County and outside of the current city limits of the City of South Padre Island. As development proceeds and shoreline management projects arise, Cameron County is likely to be the principle local government responsible for developing and financing

projects to maintain the current shoreline position. The County's explicit understanding of its role in future shoreline management projects is made clear in the Cameron County Erosion Response Plan, which is evaluated in Section 2 of this report.

City of South Padre Island: The City of South Padre Island – and its taxpayers – are likely to be responsible for significant shoreline management costs to sustain the current shoreline position in the study area. The City's interest in and responsibility for future development can arise in two ways. First, the city must approve subdivisions established within 5 miles of their northern-most town limit. This area includes much of the property within the study area and lies within the Extraterritorial Jurisdiction (ETJ) of the city. The city has established subdivision requirements and other ordinances that are likely to govern new development in the study area. For example, applicants wishing to undertake projects in the study area must comply with certain ordinances adopted by the city. In general, the city requires the submittal of a development plat to the Planning and Zoning Committee. The submission will generally include the design of all infrastructure improvements such as curbs, gutters, streets, storm drains, surface drainage, street lighting, and other utilities.

Second, in addition to its regulatory oversight of the ETJ, the city may also annex certain parcels as they are developed in the future. The city's financial responsibility for future shoreline project costs is likely to arise through both its oversight of the ETJ and its annexation of parcels as they are developed.

State of Texas-General Land Office. The state of Texas, acting through the Texas General Land Office, is the lead coastal agency and administrator of the Texas Coastal Management Program (CMP) and the Coastal Erosion Planning and Response Act (CEPRA). In general, both the CMP and CEPRA programs are likely to be sources of future state funds for the management of the shoreline retreat problems in the study area.

As explained by the GLO, the purpose of the CEPRA program is to implement coastal erosion response projects and related studies to reduce the effects of and to understand the processes of coastal erosion as it continues to threaten public beaches, natural resources, coastal development, public infrastructure, and public and private property. Under CEPRA, GLO implements erosion response projects and studies through collaboration and a matching funds partnership with federal, state, and local governments, non-profit organizations and other potential project partners.

If the Legislature appropriates funding, the CEPRA program provides funding for projects and studies, including beach nourishment on both Gulf of Mexico and bay beaches, shoreline stabilization, habitat restoration and protection, and dune restoration, with priority given to projects that include construction of an erosion response solution during the biennium. Depending on the cost sharing agreements reached, the state share of shore protection projects such as beach nourishment are

typically 40-75% of the costs and, in rare instances, the Land office can choose to pay 100% of a beach nourishment project.[12]

Federal Government. The federal shore protection program is managed by the U.S. Army Corps of Engineers through project authorizations typically included in the Water Resources Development Act (WRDA). The latest Water Resources Development Act was enacted in 2007 as Public Law 110-114. Congressional hearings to re-authorize WRDA were held as recently as September 2012 but the new WRDA bill has not yet been passed. Through WRDA, the federal government can authorize and undertake federal shore protection projects, including beach nourishment. Federal shore protection projects require significant development and investigation that can easily require more than a decade of effort by local, state and federal officials. Federal law proscribes detailed findings and determinations to move a federal shore protection project forward and projects literally require multiple "acts of Congress" to move forward. Around the country, federal beach nourishment projects – even those that have been authorized, designed and permitted – are languishing as Congress struggles to pay for the beach nourishment and shoreline projects it has already approved or is required to maintain.

Therefore, the federal government is not identified as a potential source of future funding for shoreline management in the Cameron County study areas because: (1) new "federal starts" to add beach projects to the federal shore protection program are highly restricted for budget reasons; and (2) there is no reasonable basis to believe that a "federal interest" in maintaining the shoreline in the study area could be found.

1.3.5 Early Lessons Learned – Previously Platted Lots in the Study Area

Predicting future shoreline positions is a complex endeavor, which is analyzed in this report in later sections. It is useful as well to examine the fate of previously platted lots in the study area that were planned for development but are now submerged.

Under contract with the GLO, the Harte Research Institute (HRI) developed interactive coastal geohazard maps for three barrier islands on the Texas coast—Galveston Island, Mustang Island and South Padre Island.[13] According to HRI, "These maps show areas that vary in their susceptibility to, and function for, mitigating the effects of geological processes including relative sea-level rise, erosion and storm-surge flooding and washover." The maps provide tools and resources to

[12] 31 TAC §15.42, Funding Projects From the Coastal Erosion Response Account

[13] The Coastal and Marine Geospatial Lab of the Harte Research Institute created the HRI geohazard map for Gulf of Mexico Studies Program at Texas A&M University - Corpus Christi. The SPI Geohazard Mad is found at http://geohazards.tamucc.edu/southpadre/SPIgeohaz.html#. The Bureau of Economic Geology at the University of Texas at Austin conducted the Lidar survey and processed the data to produce the digital elevation model A, Report of the Texas Coastal Coordination Council pursuant to National Oceanic and Atmospheric Administration, Award No. NA08NOS4190458.

help land planners, coastal managers and citizens understand the potential changes that wetlands, dunes and beaches could undergo in the decades to come.

The South Padre Island Geohazard map shows areas that vary in susceptibility to the effects of coastal geological processes, such as (1) relative sea-level rise (including land subsidence), (2) erosion, (3) storm-surge flooding and washover, and (4) present and future location of critical environments. Additional data layers in the map show the various geo-environments, upland land use zones, and the elevation of each lot along the shoreline.

Most interesting for this study is that the South Padre Island Geohazard map includes the data layer identifying platted parcels in the study area and includes parcel ownership data, which is not included here for privacy purposes. To illustrate the utility of the HRI geohazard map, two exhibits produced with the interactive map are shown below. These sample products are sufficient to illustrate the significant changes in the shoreline position have already rendered existing platted beachfront lots undevelopable, either because the lots are submerged or because they lie wholly or partially within the public beach easement.

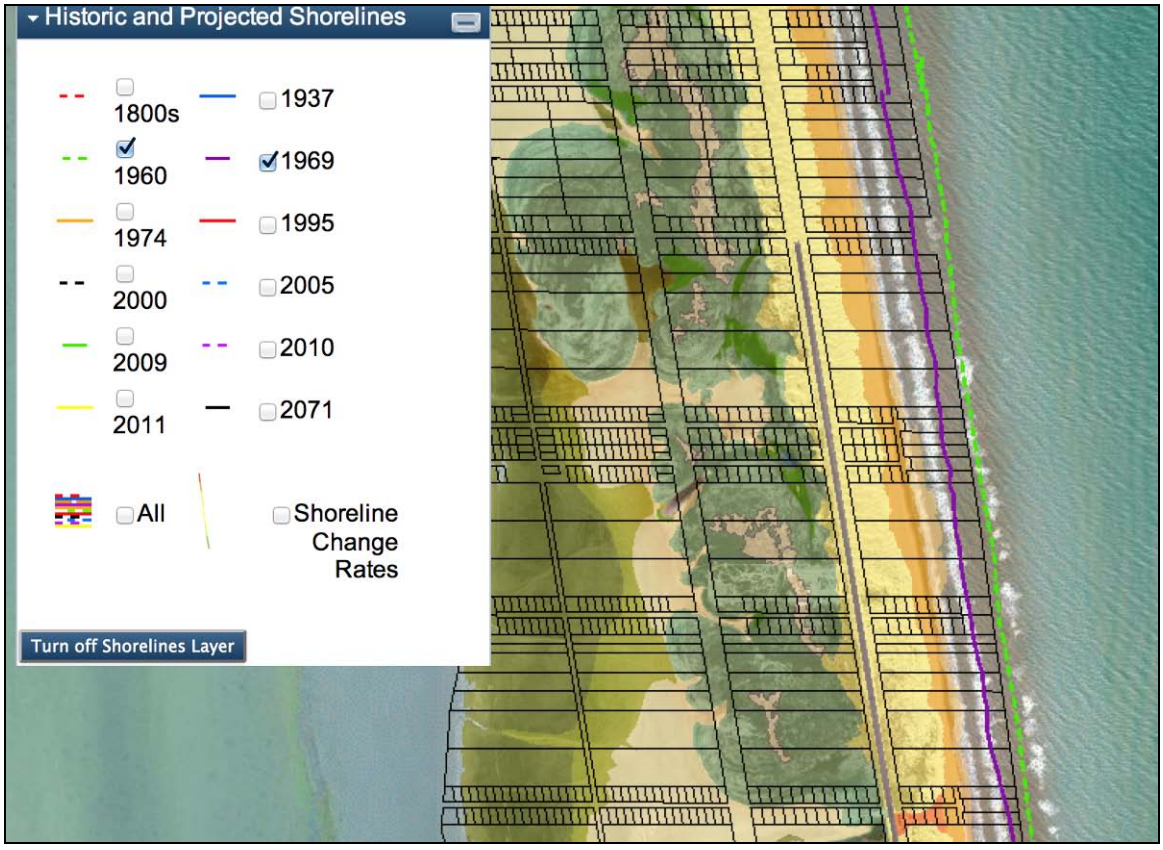

Figure 1-3: Representative sample view of the South Padre Island Geohazard map

The geohazard map does not indentify when any particular plat or lot lines were proposed or approved. However, by using the shoreline positions data layer, it is possible to show the shoreline positions decades ago and to determine when the lots that are now submerged were likely above water. It can be reasonably assumed that no platted lots were approved when they would have been submerged. As shown in the sample map below, the platted lots would have likely been on land in about 1960 and partially impacted by erosion as early as 1967. In the exhibit above, the 1960 and 1969 shoreline positions are shown along with the location and boundary lines for all platted lots in this portion of the study area. It is clear that several beachfront lots that may have been potentially developable 50 years ago are now unusable.

In the exhibit below is a closer look at the lots near the northern terminus of Park Road 100, along with the shoreline positions in 1960, 1969 and 2011. In 1960, all of the platted lots on the beachfront appear to be above the water line, as represented by the green 1960 shoreline position line. By 1969, many seaward-most beachfront lots were already impacted by shoreline retreat, as indicated by the purple line showing the 1969 shoreline position. By 2011, more than a dozen lots once slated for development four or five decades ago can no longer be considered developable.

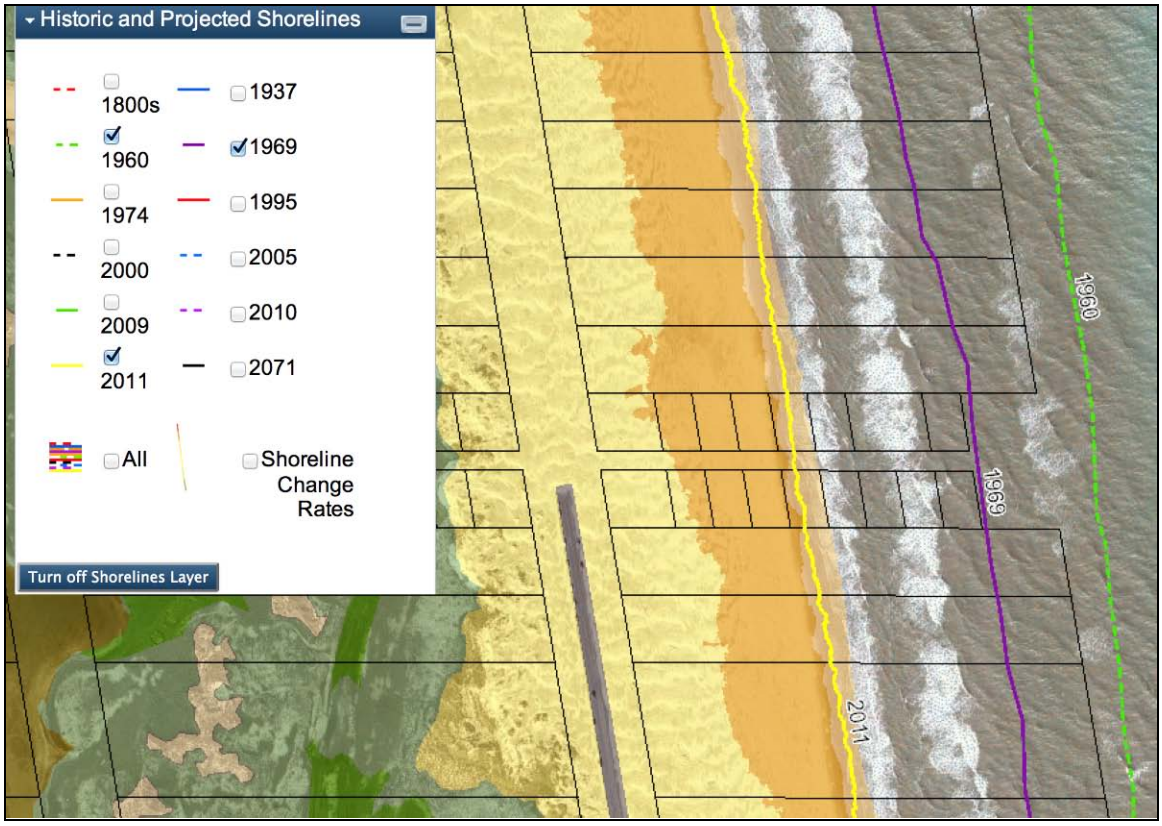

Figure 1-4: View of parcels and historic shorelines at the north end of Park Road 100

While the loss of these parcels caused some economic injury to the landowners, the shoreline retreat over the last 50 years did not prompt any significant effort by the county, city or state to restore the shoreline position to its once more seaward

position. The lack of past action was both expected and sensible. In the absence of any risk to development or significant public infrastructure, state and local officials are generally free to ignore erosion and shoreline retreat as a natural and ordinary example of barrier island shoreline dynamics.

However, once beachfront parcels are sufficiently developed, the expectations of stakeholders—the investors, landowners, beachgoers, tourists, barrier island communities and local elected officials—can be expected to change. In many coastal communities, the stakeholders, once the plats are approved and developed, effectively enter into a pact declaring that the shoreline position will be maintained at a location seaward of the development. Unless the forces that have driven shoreline retreat for centuries suddenly dissipate, new beachfront developments planned and located immediately adjacent to the current shoreline position will force the community to commit themselves either to an exceptionally rare program of retreat or to a costly shoreline management program such as beach nourishment.

The simple lesson from the 1960s is that the real estate investors and the local government that approved the subdivision plats did not take into account future shoreline retreat. In their defense, little data or technical understanding of shoreline change dynamics existed at the time. Now, with the community's own subsequent experience to draw upon and the extensive information and data made available by researchers such as the Harte Research Institute, Cameron County and the SPI community have a unique opportunity in the nation to plan future development in the study area with a much greater appreciation of the shoreline changes that are sure to come.

2.0 Summary of Cameron County Erosion Protection Plan

The Cameron County submission in response to the state directive to prepare an erosion response plan, entitled "Cameron County Erosion Protection, Public Beach Access, Coastal Construction and Dune Protection and Beach Management Plan," (Plan) was adopted by Cameron County on August 14, 2012. The proposed plan was before the General Land Office for review during the preparation of this report.

The proposed plan includes an erosion response strategy, called the County Erosion Protection Plan (EPP), as well as significant sections dedicated to beach access, permit application procedures, reform of the beach and dune permitting process, and the county's regulatory relationship with the General Land Office. The analysis below is limited to those portions of the Plan that can be characterized as the erosion response plan. Specifically, the analysis is limited to those provisions of the EPP that dictate the seaward location of new construction along the beachfront and the establishment of "Erosion Protection Dunes" (EPDs).

In the submission to GLO, the county outlines the goals and objectives of the Erosion Protection Plan (EPP):

> a) Reduce public expenditures for erosion and storm damage losses to public and private property, including public beaches;
> b) Assure public beach access through improvements to existing access points and advanced design of future access points;
> c) Ensure the health and stability of existing dune systems and vegetation;
> d) Encourage the natural recovery of dunes and beaches following storm-induced erosion; and
> e) Provide for the establishment of new dunes through restoration and enhancement projects.

To accomplish these goals and "local" objectives, the county seeks to regulate the location of beachfront construction and to encourage the establishment of a new continuous dune along all unincorporated beaches in the county. The cornerstone of the county's plan is the voluntary establishment of what is called the Erosion Protection Dune System (EPDS). As stated in the plan,

> "The County's Erosion Protection Plan (EPP) addresses land loss conditions along16-miles of Gulf coastline in the unincorporated limits of South Padre Island and on Boca Chica Beach. It calls for the establishment of a continuous Erosion Protection Dune System (EPDS) north and south of the corporate limits of the City of South Padre Island, Texas, extending eventually to the county lines in both directions. The planned Erosion Protection Dune System is considered by the Cameron County Commissioners Court to be the most practicable defense to storm damage

> and is considered key to the protection of public and private property within the critical dune area.[14]

The county explains that the creation of the contemplated EPDS "will allow property owners to haul in or relocate beach quality sand to construct dunes in poorly defended areas, i.e., areas not protected by erosion protection dunes as described in the Erosion Protection Plan."[15]

The planned dune system – the EPDS – is to be created through the voluntary efforts of beachfront property owners contemporaneous with the development of their property. The plan includes specific incentives through simplified and more flexible permitting procedures as an inducement for landowner participation in the dune plan. As explained by the county,

> "Those landowners who voluntarily construct an EPDS adjacent to their land or cooperate with this Erosion Protection Plan and its goal of establishing an Erosion Protection Dune System by granting a limited easement over land within the Dune Conservation Zone where the System shall be located shall enjoy the benefits of fewer land use restrictions upon applying for Coastal Construction and Dune Protection Permits in view of the greater flood event protection benefit derived from the presence of the EPDS across the seaward side of their property.[16]

The EPDS conceptually describes the county's intent to establish a protective dune along the Gulf beach. The EPP dictates the area in which this dune is to be built – called the Dune Conservation Zone (DCZ) -- and its basic characteristics of the dune. The EPP specifies that the Dune Conservation Zone will be "located near the landward limit of the Public Beach." Rather than relying on reference to the Line of Vegetation to delineate the location for the new dune zone, the county specifies that the seaward extent of the DCZ will be located 180 feet landward of the mean low water (MLW) line. The county also specifies that the DCZ will be 75-feet wide, meaning the landward extent of the Erosion Protection Dune will be no more than 255 feet landward of MLW. The plan says:

> "The dune conservation zone is bounded seaward by a line drawn parallel to and one hundred and eighty (180) feet from mean low tide and landward by a line drawn parallel and seventy-five (75) feet from the seaward boundary. The dune conservation zone is considered a moving zone depending on beach erosion or accretion conditions."

The Erosion Protection Dunes (EPDs) upon which the county relies for shoreline protection and reduction of future post-storm public expenditures must be constructed within the 75-foot wide Dune Conservation Zone. The plan says:

---

[14] Cameron County Erosion Protection, Public Beach Access, Coastal Construction and Dune Protection and Beach Management Plan, page 5.
[15] Ibid. @ 8.
[16] Cameron County EPP, pg. 21

> "EPDs shall be located within the Dune Conservation Zone (DCZ). The Erosion Protection Dune System (EPDS) shall be a continuous natural (with or without manmade enhancement) or manmade dune system spanning the length of the unincorporated beaches of Cameron County."[17]

Finally, the county plan specifies the basic characteristics for the EPDs, requiring that the dunes be planted with native dune vegetation over 50% of its surface area when installed and that the dune height reach 75% of FEMA base flood elevation:

> "EPDs, as initially constructed or enhanced, shall have a minimum 3:1 slope with a minimum width of fifty (50) feet and a maximum width of seventy-five (75) feet entirely contained within the Dune Conservation Zone. (See Figure 2-1). The seaward toe of a manmade or enhanced EPD may not extend farther seaward than the seaward limit of the DCZ."

The following schematic is included in the plan to illustrate the configuration and general location of future Erosion Protection Dune.

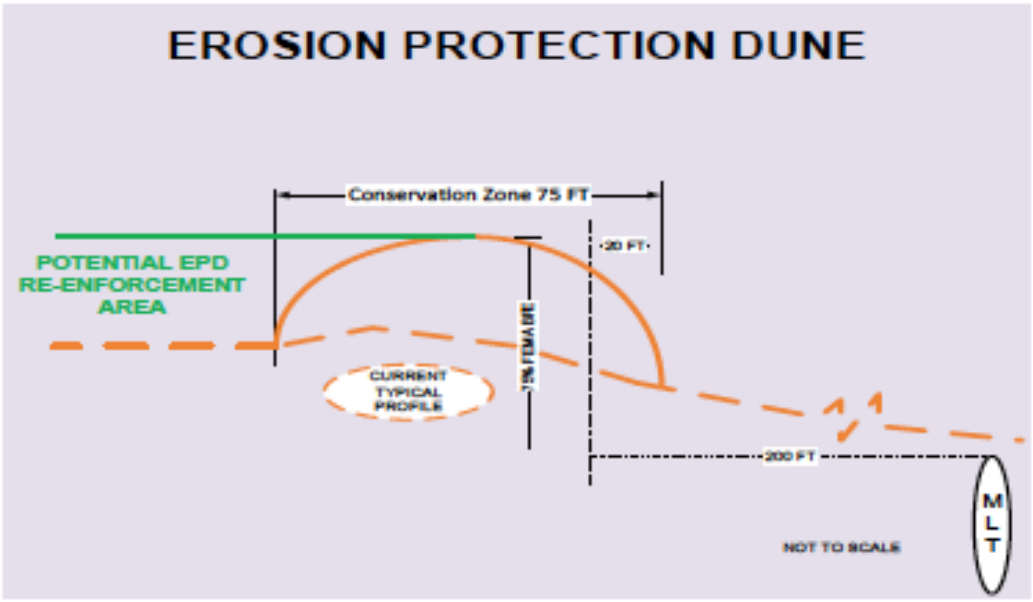

Figure 2-1: Figure 6 from the Erosion Protection Plan showing the EPDS Dune and Dune Conservation Zone

In the Erosion Protection Plan, the "building line" and "setback line" are used to define the maximum seaward location of future improvements along the beachfront. The plan describes these lines as follows:

> Building Line: "The 'building line' is "the landward boundary of the Dune Conservation Zone" on parcels protected by an Erosion Protection Dune System

[17] Cameron County EPP, pg. 16

> or when Erosion Protections Dunes will be established contemporaneously with erection of improvements.
>
> Setback Line: "Where an EPDS exists or is to be contemporaneously built as part of the project, the building "set-back line" is set at 25 feet landward of the building line."

Perhaps the most powerful incentive for property owners to participate in the EPDS and to create Erosion Protection Dunes in the Dune Conservation Zone is the setback penalty that is imposed if no dunes exist or are built when the improvements are installed. The plan says that in this case, "the 'building line' and 'building set-back line' are the same -- a line 200-foot landward and running parallel to the landward boundary of the dune conservation zone."[18] Effectively, when owners fail to participate in the EPDS, construction must be located an additional 175 feet landward of the setback line that would apply of they did elect to participate in the system.

The Erosion Protection Plan (EPP) also expresses the county's general interest in beach nourishment and identifies potential sand sources for such efforts. First, the county takes notice of the coordinated beach nourishment efforts undertaken by Cameron County and the City of South Padre Island that "have been of substantial value in preserving and restoring beach in eroding areas." Second, the County expresses its intent to "continue to undertake beach nourishment efforts in cooperation with the General Land Office and the USCE (sic) under the Section 933 program and/or other available programs to widen the beach in the eroding areas and to use a portion of available materials to construct a continuous Erosion Protection Dune System along the entire length of the beach within the County's jurisdiction."[19]

The EPP does not identify or evaluate any beach nourishment project and makes no mention of the potential length, width, volume, timing, location, or cost of future beach nourishment projects. The EPP does, however, generally identify and evaluate three potential sand sources that could be used for shoreline management:

> "DREDGING MATERIAL FROM SHIP CHANNEL: One practical source of beach nourishment material is from the dredging of the Brownsville Ship Channel, which occurs about every two years. This material has been a primary source of erosion response within the limits of the City of South Padre Island, Texas, and areas either side of it and could be utilized south of the ship channel at Boca Chica beach where needed. Otherwise, County beach nourishment activity to be expected from redirected ship channel material depends on pumping distance, quantity and quality of material, costs and funding."
>
> "DREDGING MATERIAL OFFSHORE: A theoretical source of material for County beach nourishment is offshore dredging within practical

[18] Cameron County Erosion Protection, Public Beach Access, Coastal Construction and Dune Protection and Beach Management Plan, Section IV. Coastal Construction and Dune Protection, pg 4

[19] Cameron County EPP, pg. 8

> pumping distance to County jurisdiction beaches. The County, through the efforts of its CBMC (County Beach Management committee) will explore all available resources for the funding of a comprehensive beach nourishment program alone or conjunction with the City of South Padre Island utilizing known and exploring the feasibility of using theoretical sand sources. Feasibility of dredging along the Laguna Madre side of the Island gulf side beach nourishment will be explored."
>
> "BLOWN SAND: Another known source of beach nourishment material is from the sand that blows over Park Road 100 North of the City of South Padre Island and in existing public beach access easements. The distances from the location of the sand to the beach are realistic distances to haul sand and adequate access is available for the required machinery. The amount of sand material drifting over the highway varies from year to year, but has provided adequate volumes to replenish beach at several locations. The sand is also considered a possible resource for beachfront construction permitting requiring compensation and/or mitigation in critical dune areas. The CBMC and Parks Department personnel have reached an understanding with TXDOT that the blown sand may be used for these purposes. This agreement should and will be formalized."[20]

The GLO guidelines governing development of erosion response plans do not require local governments to submit conceptual designs for shoreline management projects so the lack of detail in the Cameron County EPP on this subject is not unexpected or inappropriate. However, as identified in other sections of this report, undertaking beach nourishment projects in the study area north of the Shores Subdivision must be undertaken if the county's erosion protection dune strategy is to succeed. Because the City of South Padre Island's beneficial use project with the Corps cannot be readily extended into the study area, any county beach nourishment effort is expected to be considerably more expensive than the beach nourishment efforts undertaken by the city over the last decade.

Perhaps in recognition of the difficulty of undertaking new beach nourishment projects as new development occurs in the study area, the county EPP calls for a "cooperative funding approach with the city, state, federal government, property owners and others to meet this challenge. [21] The plan says:

> Cameron County will undertake efforts in cooperation with private landowners, General Land Office, TxDOT, the USCE (sic), and all other governmental entities, agencies and programs, to construct a continuous Erosion Protection Dune System along the entire length of South Padre Island within Cameron County's jurisdiction and Boca Chica Beach and actively seek out funding for shoreline beach nourishment using high quality compatible materials. Cameron County shall utilize all reasonable efforts to find and provide funding from private, local, state, and federal

[20] Cameron County EPP, pg. 8-9

[21] Cameron County EPP, pg. 23-24

sources for the creation of a special district to be called the Cameron County Erosion Protection District to construct, manage and maintain an EPDS and provide for post storm mitigation of the EPDS. The County or District or both shall pursue funding from:

- NOAA Programs and Grants
- GLO Program and Grants
- Coastal Erosion Planning and Response Act (CEPRA)
- Coastal Impact Assistance Program (CIAP)
- Coastal Management Program (CMP)
- Beach Maintenance Reimbursement Fund (BMR)
- Beach User Fees (BUF)
- Coastal and Estuarine Land Conservation Program (CELCP)
- Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)
- Gulf of Mexico Energy Security Act (GOMESA) funds
- Homeowner Associations (HOAs)
- Local Coastal Foundations
- Private Gifts and Contributions
- FEMA Storm Protection or Hazard

The perceived need for large-scale beach nourishment projects in the study area is unlikely to arise until there is sufficient development density along the shoreline and that development is seriously threatened by shoreline retreat. The absence of details included in the county plan requires that the review of the plan focus most attention on the proposed Erosion Protection Dune.

3.0 Study Area Shoreline Movement, Processes and Time Scale

3.1 Characterization of the Landward/Seaward Migration of the BD system

Existing and new data were gathered and assimilated as part of the study scope to provide a sound basis for technical and policy analyses and recommendations. The data and analysis help to answer the question of how the shoreline location has changed and should be expected to change in the future.

As noted in the Technical Memo (see Appendix N) and reiterated elsewhere in this report, the long term historical trend of shoreline movement in Cameron County north of the SPI city limit is a landward retreat of about twelve feet per year. It is reasonable for planning purposes to project this rate into the future while also considering potential factors that could increase or decrease this rate.

As a practical matter, the long term retreat should be viewed as a series of individual events (tropical storms and hurricanes) causing shoreline retreat on a scale of tens of feet, connected by potentially long periods of recovery during which the shoreline is stable or may even advance toward its pre-storm location.

Discussions of past and future changes must be framed in terms of time intervals or time scales. With the goal of informing decision makers on issues relating to coastal development, the time scale of interest extends for years, decades, and the better part of the coming century. These are the time scales of anticipated coastal development ranging from simple beach access amenities to high rise commercial and residential buildings built tomorrow or several decades from now.

Considering these time scales and the associated cumulative retreat, Cameron County decision makers should consider the likelihood of hundreds of feet of shoreline retreat over the development life cycle of the county's Gulf of Mexico frontage. In the alternative, allowance should be made for the cost of intervention into the long-term coastal processes leading to shoreline retreat, likely meaning projects to deliver very large quantities of imported sand to the beach system.

3.2 Coastal Processes at Work

Coastal processes can be categorized by the time scales within which they operate. Numerous coastal processes operate at time scales ranging from seconds to multiple decades.

Wind-generated waves have a period of a few seconds and affect a relatively narrow segment of the beach profile; each wave can move individual sand grains a few feet. Tides have a period of several hours and can create or destroy sand surface formations near the shoreline. Wave-generated currents operate on a time scale of hours to days and can move large sand quantities in the nearshore region. The cumulative effects of millions of waves, thousands of tide cycles, and years of currents can transform the location and character of the entire beach/dune system.

The importance of the concept of time scales to this study is that intervention activities must focus on coastal processes that operate at time scales that match the desired or chosen coastal land use.

For example, a single dune enhancement or restoration episode affects coastal processes operating on a scale of months to a few years at most. While appropriate for protecting nearby development in the short term, it does little to affect processes acting on a scale of years to decades. Dune enhancement should not be expected to overcome long-term, regional shoreline retreat.

In part, this is because the segment of the beach profile where dunes evolve is but a small percentage of the active beach, which extends from the dunes into the nearshore portion of the Gulf of Mexico. Long-term processes, and interventions intended to affect them, must account for the entire beach profile.

Coastal storms operate on time scales of hours to days. However, the size, duration, and intensity of a storm can result in destructive impacts on a scale that overcomes years' worth of other constructive coastal process impacts.

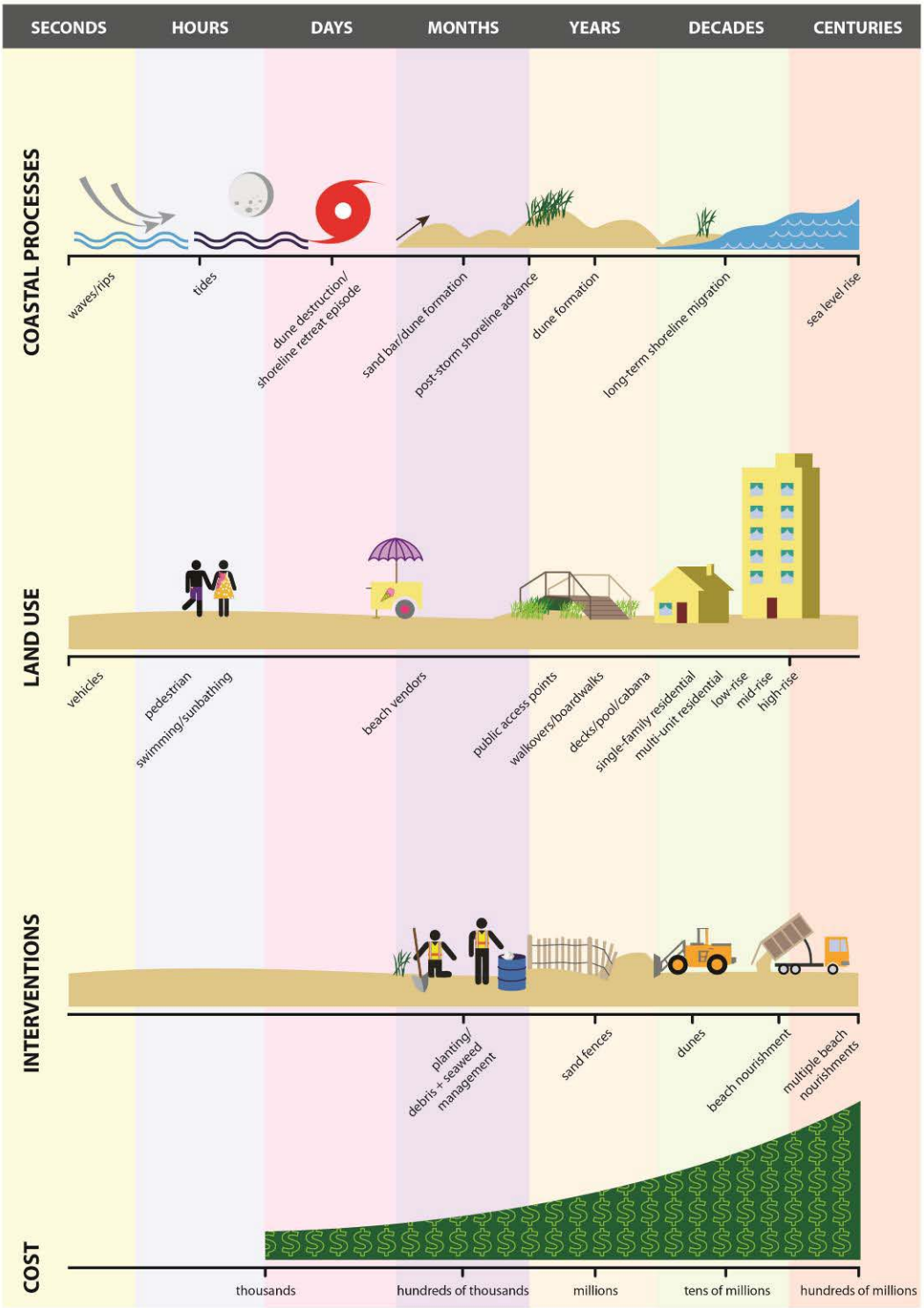

Figure 3-1: Relevant Time Scales

3.3 Mitigating factors affecting landward-seaward migration of BD system

Natural factors affecting the landward-seaward migration of the BD system primarily include the time series of large storm events and intervening recovery periods, the balance or imbalance of incoming and outgoing sediment, and relative sea level including the absolute rise or fall of sea level combined with land subsidence or rebound.

Human interventions affecting beach migration primarily include activities that either increase or decrease the available sediment supply. Incoming along-shore sediment supply is decreased by updrift obstructions such as navigation works or groins extending seaward of the beach. Sediment supply is also decreased by pavement of landward areas, removal for use as fill, increased landward wind transport due to vegetation loss and pedestrian/vehicular traffic, and structural measures that reduce the natural wave-dissipating characteristics of the beach.

Positive human interventions include beach nourishment with imported sand, sand fencing to reduce wind transport and vegetation disturbance, irrigation of dune vegetation, and management measures to reduce pavement, use as fill, etc.

3.4 Range of likely outcomes on a multi-decade scale

The spectrum of potential outcomes can be envisioned as follows. At one extreme is the possibility that the present shoreline location can be maintained. The likelihood that the shoreline location could advance seaward or even remain near its present location over the next 50 to 100 years without significant intervention at high cost is beyond the realm of potential outcomes absent a reversal of rising sea level trends. Should decades of benign storm conditions occur relative to recent history, such costs could be reduced, at best.

The rising sea level trend locally is a combination of actual sea level rise associated with warmer global temperatures (expanding sea water volumes and adding glacial melt) in addition to a lesser contribution of regional land subsidence. The subsidence component is caused by natural soil consolidation over the long term and is unlikely to slow or reverse. The rise of absolute sea level could only slow or reverse if global temperatures cool.

At the other extreme is a combination of an increased rate of relative sea level rise, lack of positive sediment supply intervention, and continued or increased negative sediment supply intervention. To this we could add a time series of storm events that is more frequent or more intense than in recent history.

The rate of sea level rise could increase if global temperatures rise more quickly than in recent decades. Rising relative sea level has the effect of “drowning” the beach. Without an influx of sand, the beach migrates landward in response. In this scenario, shoreline retreat occurs even if there is no net sand loss from the beach system.

Shifting the discussion to likely outcomes instead of potential outcomes, several potentially important factors should be considered. The measured sea level trend in

south Texas over the last hundred years is relatively steady at about one foot per century[22]. Extrapolating that rate forward seems reasonable when balancing predictions of future accelerated sea level rise due to anthropogenic global warming with the observed slowing of the rate in recent years as measured by nearby water level gauges. Similarly, there is little basis upon which to change the storm frequency relative to the long-term historical record.

Direct positive sediment supply interventions in the study reach are not likely to be forthcoming until there is a significant level of developed value to be protected. The time frame to achieve this level of development is uncertain but is on the order of years to decades into the future.

The effects of other sediment supply interventions may be mixed. On the one hand, the negative effects of the navigation inlet and jetties at Brazos Santiago Pass to the south of the City of SPI will likely continue but are being mitigated somewhat of late by beneficial use placement of dredged materials onto SPI beaches. On the other hand, development activities in the study reach north of SPI may pave otherwise active sand sources, use sources as fill for other purposes, increase vegetation disturbance, and decrease dune system integrity.

Once the study area becomes developed, the retreat rate may be decreased by positive sediment supply interventions (e.g., beach nourishment) if appropriate finance measures are in place.

These factors suggest a continuation of trends of shoreline movement at a time scale of multiple decades, with considerable year to year variation depending upon the future storm record.

[22] Harte Institute

4.0 Shoreline Change Estimates, Uncertainties, and Variability

The technical analysis conducted as part of this study supports the conclusion that historical shoreline retreat trends are likely to continue in the absence of intervention. In summary, the long term retreat is about 9 ft/yr in Section 1 (0 to 5 miles north of the city limit), 12 ft/yr in Section 2 (5 to 15 miles north of the city limit), and 13 ft/yr in Section 3 (15 to 18 miles north of the city limit), with an overall average of about 12 ft/yr.

4.1 Relating Shoreline Change to Sand Volume

Based on the available data including original data acquired for this study, beach profile change was quantified in terms of volume loss for the unincorporated Cameron County shoreline. Any change in the shoreline position, and hence the equilibrium profile, in the positive direction requires the introduction of enough sediment to be distributed throughout this active sediment transport zone.[23] Regardless of what is placed on the dry beach, around 0.6 CY (cubic yards) of sediment is required below the water line per along-shore foot of beach to advance the profile 1 foot. The calculated retreat rates outlined above indicate that this number approaches 1 CY of sediment per alongshore foot of beach to shift the combined the terrestrial and subaqueous profiles 1 foot seaward.

The average rate of retreat within the study area as estimated by the BEG is twelve feet per year. Based on the above estimate of volume change per foot of shoreline change, that translates into a deficit of twelve CY per year per foot of beach, or 60,000 CY per mile per year (rounded).

By comparison, the locally-proposed Erosion Protection Dune System (EPDS) consists of a one-time placement of roughly 7 to 12 CY of material per foot of beach, i.e., offsetting about one year's worth of the long term sand deficit. If the sand placed in the EPDS comes from the beachfront site, its positive effect on the long-term sand deficit is diminished further. There is no reasonable basis to conclude that establishing a one-time 75-foot wide dune (base width) to a height of 75% of the Base Flood Elevation will have any measurable impact on the long-term rate of shoreline erosion. Further, because no vegetated dunes exist in the project area at a location 180 feet from MLW, there is no reasonable basis to conclude that the dune will be sustainable at the proposed location over time.

4.2 Scale of Intervention Measures

Intervention measures should be appropriately matched with proposed land uses in terms of size and time scales.

For example, a zero- or minimal-cost approach to shoreline location management must be matched with a land use that avoids areas likely to be affected by shoreline retreat for the duration of that land use.

[23] A depth of closure (a measure of the seaward extent of the active beach) of -16 feet was used in this study as a basis for calculating volume change.

At the other extreme, any intent to maintain a static shoreline location must be matched with land uses that can generate significant revenue streams that can be devoted to maintenance measures, perhaps in combination with the political clout to attract transfers of resources from external sources.

4.2.1 Zero Intervention

At first glance, a zero-intervention approach to shoreline management would appear to be straightforward and relatively cost-free from a government agency perspective. However, this is likely to be far from the case in actuality.

In order for zero-intervention to succeed, it must be matched with land uses that can be adapted to actual shoreline changes over time. This approach will generally require long-lived and immobile structures to be located landward of the beach-dune system as it is forecast to exist at the end of the structure's life cycle. The required setback from the present shoreline will thus vary according to the time scale of the land use, where low-cost or mobile uses can be close to the beach but high-rise development must be located many hundreds of feet landward.

Implementation of this strategy will likely require an intrusive regulatory program that will be neither easy nor inexpensive to develop, gain approval, or operate.

4.2.2 Maximum Intervention

A maximum-intervention approach would seek to maintain a relatively static shoreline location over the life cycle of adjacent development. The success of this approach is dependent upon the successful estimation of intervention costs and equally successful accumulation of financial resources to cover those costs.

As applies to Cameron County, maximum intervention implies repetitive beach nourishment on a large scale using sand imported from outside of the active beach-dune system. The magnitude of sand needed is on the order of millions of cubic yards and tens of millions of dollars or more. The feasibility of such a nourishment program is affected by both technical and financial constraints. Technically, one or more sources of compatible sand must be available to accomplish the physical task of long-term nourishment along with the financial means to identify, procure and deliver the sand.

An initial beach nourishment project is not likely to attract public financial support unless there is a significant density of development in place in the study area. Otherwise, the nourishment costs outweigh the public benefits. For this reason, even if a maximum intervention approach is desired, it is most likely that a shoreline location at some time in the future (years to a decade or more hence) is a more likely location to take a stand against retreat, as compared to the present-day location.

The feasibility of attracting financing for large-scale beach nourishment from non-local sources (e.g., state and federal government agencies) is generally proportional to the showing of local support for the project as measured by the level of local funding

applied as match. The greater the local contribution, the greater the likely external funding that can be attracted.

4.3 Uncertainty

Actual events in the near term will vary widely from long term average estimates. Even the limited LIDAR data sets available for the period 2000 to 2011 include annual retreat rates that are three times the long term average. The variability in the shoreline position and beach profile can vary significantly over as little time as half a season, more so if the beach is impacted by a significant storm event. Following such events, or even based on the adjacent upland topography, the beach will react in different ways.

The shoreline positions outlined in Figure 8 of the Technical Memo (see Appendix N) are good indicators of what can happen in the short term, as storms in 2008 significantly shifted the shoreline landward as much as 100 feet, narrowing the beach. In some places, the beach has been recovering swiftly with the shoreline adjusting back to near its 2000 position while in others the recovery has been much slower. Advancing shorelines seen in 2005 were wiped away in three years due to storm events.

The differences in shoreline response illustrate the uncertainty that comes from comparing small scale reactions to long term trends spatially as well. Based on some of the individual survey profiles, calculations would show that the beach has accumulated sediment, even as the analysis shows that the span of beach as a whole is losing sediment. Much caution should be used when using short-term data to draw long-term conclusions.

There is similar uncertainty in potential external sources of project funding. State and federal programs that represent potential partners vary widely according to many factors, especially political dynamics that are difficult to anticipate. As discussed in Section 6, federal funding sources are especially uncertain, while state programs are presently funded on a year to year basis with no dedicated source.

4.4 Effect of Variability on Local Plans

Based on the County's proposed Erosion Response Plan (August 2012), the EPDS is constructed 180 feet from the MLW line on the day of construction. At the published shoreline change rates, if 10 years elapses (or a single significant storm occurs) between EPDS construction on adjacent properties, the EPDS is assured to be non-continuous. This can work both ways in the case of beach recovery following a storm event, where a seaward lot that may not be suitable for construction one year may be suitable for development at a later date, resulting in a EPDS that is discontinuous seaward.

The primary source of naturally forced variability in the data comes from the number and severity of storms experienced by the location in question. Large storm events can mobilize a greater amount of sediment and transport it out of the active zone. Significant changes in the typical wind profiles in a given month or year can alter the

balance of sediment transport along the coast, resulting in more accretion or erosion. This variability affects not only the calculation of required volume to maintain a shoreline position, but also the time scale over which a re-nourishment effort becomes necessary.

Human intervention provides another source of variability in the rates and volumes. A developed shoreline may be expected to behave and perform differently than a natural shoreline. If development reduces sediment availability to the active beach/dune system, the variability will have a negative trend. Dune stabilization efforts, seaweed management, and nourishment projects similarly have positive impacts. Even the nourishments that take place inside the incorporated limits will have an impact on the sediment supply to the northern parts of the County.

5.0 Shoreline Management Response Methods & Costs

Responses to shoreline retreat can vary between passive retreat and hard structural armoring. In a study location perhaps best known for its beautiful, accessible beaches, this discussion is limited to intervention methods and costs to influence the shoreline retreat rate while retaining the natural qualities of the beach-dune system. Practically speaking, this means managing on-site and imported sand resources. Implied within this realm are related issues such as dune protection and restoration and regulatory programs relating to the conservation of the sand resource.

The quantity and associated cost of imported sand necessary to "balance" the local system will depend upon a variety of choices made locally and also upon factors beyond local control (storm cycles, etc.). However, it is a near certainty that imported sand will be a component of the local shoreline management program. Over the long term, the total shoreline management costs to the local community (and any external funding entities) will likely be proportional to the cost of obtaining sand.

Accordingly, funding strategies (see Section 6) can be contemplated based on the scale of sand quantities required to balance a given proposed shoreline management approach.

5.1 Expected Sand Sources

A variety of potential sand sources can be considered for long term planning purposes. Sediment characteristics and suitability for different size and time horizons varies among the sources. The following is a broad-brush list of likely sources of sand for use on beaches in the study area.

- Beneficial Use of Dredged Material (BUDM) from Brazos-Santiago Pass
- BUDM from the Gulf Intracoastal Waterway (GIWW)
- Offshore Cameron County
- Offshore Willacy County (Port Mansfield)
- Historical On-Site Dunes
- Active On-Site Dunes
- Land Cut Private Sources
- Other Inland Private Sources

The cost of imported sand placed on beaches and dunes in the study area is primarily a function of transportation distance and method. For large quantities, hydraulic dredging can be the most cost-effective method if a source can be identified. Based on the list above, unit costs of transportation and placement can range between roughly $10/CY for nearby sources to upwards of $25/CY for distance sources requiring double-handling. Planning, design, and regulatory costs can add 50% to these unit costs for a total project.

5.2 Inapplicability of City of SPI Historic Building Line

Given the proximity of the study area to existing development within the City of South Padre Island, the City's approach to beachfront development is of interest. However, the shoreline management strategy and development pattern in the City is unique and not well-suited to serve as a model for future planning in the Cameron County study area. For many years, an adjudicated building line, often referred to as the historic building line or HBL, has governed the seaward limit of development in the City of South Padre Island. With consent of the GLO, the HBL supersedes the line of vegetation that would typically serve as the landward limit of the public beach in other jurisdictions.

When first established, the HBL was some 400 ft landward of the shoreline. Subsequent shoreline retreat (at rates smaller than that of the Cameron County study area) now results in conflict between beachfront construction at this line and the active beach-dune system. The City's historic building line does not extend into the study area, though the county is not precluded from seeking to do so.

5.3 Line of Vegetation vs. Lack of Vegetation

Traditionally, as codified in state statute and GLO rules, the landward limit of the public beach has been demarcated by the Line of Vegetation. This is problematic in the study area because the combination of heat and wind-induced sand movement results in an inconsistent location and elevation of dune vegetation relative to the shoreline location. It is not uncommon for dune fields to extend hundreds of feet landward of the beach without vegetation, as is the case at the north end of Park Road 100. The City program has not needed to address these effects.

In the study area, the landward extent of the public beach remains to be clarified and established through consultation between the county and GLO.

5.4 No USACE Beneficial Use Sand Source

The City's approach to shoreline management has consisted primarily of dune restoration and the beneficial use of dredged material from the federally-maintained navigation channel through Brazos-Santiago Pass. This successful collaboration has resulted in multiple applications of large quantities of beach-quality sand into the beach system within the city. The City currently utilizes all sand available and suitable from the federal channel maintenance activities and this collaboration is likely to continue. Because no excess sand from the pass over and above what the city now utilizes is likely to be available, the County cannot reasonably rely on this sand source to address shoreline erosion in the study area.

6.0 Funding a Shoreline Management Program

6.1 General Revenue Need

South Padre Island is one of the great barrier islands still available for development in the United States, attracting visitors and investors from all over the state, nation and the world. Not surprisingly, a principle attraction for visitors and investors alike, in no small way, is access to the Gulf of Mexico. The Gulf shoreline may well be the most critical element of the County's future economic infrastructure on the island and central to the quality of life of the island's residents.

As new development takes place in the study area, the beach will be the highest priority for ongoing nourishment and protection against erosion and shoreline retreat. Well managed, the Gulf beaches in the study area will remain a cornerstone of the county's economy for decades to come.

Like any other infrastructure element, the Gulf beach in the study area will require care and investment to ensure continuation of the benefits provided by the beach. In general, on-going capital costs for the Gulf shoreline include beach nourishment, dune restoration, and beach access upgrades such as additional walkovers and improved public parking areas. Ongoing beach operation costs such as trash pickup, seaweed scraping, repair of existing accesses and the costs of beach patrols will also be incurred. Future acquisition of parcels on the Gulf beach may also be needed as public access needs expand. Finally, planning, design and permitting costs will be incurred for all shoreline improvements.

It is clear that these shoreline management costs will be persistent and substantial though the specific magnitude of costs must remain uncertain at this point. Creation of a dedicated Shoreline Management Fund within the County budget may be an effective way to plan for and manage the on-going costs for these efforts. Preliminary costs for management of the Gulf shoreline were identified in Section 5 and expanded upon below.

6.1.1 Potential Project Costs – Annual/10 year

Based on the estimate in Section 4 of volume change, there is a deficit of twelve CY per year per foot of beach, or 60,000 CY per mile per year. The actual amount varies from place to place in the study area. At a cost of $10/CY of sediment, this amounts to over $600,000 per mile per year to maintain the shoreline at its current position over the long term.

The actual volume loss varies from place to place in the study area but for the purposes of estimating the typical sand replacement volume necessary to offset the erosion rate, 12 cubic yards per foot of beach per year is reasonable. Below, the rough costs of offsetting the sand losses in the study area are calculated per mile and per year. The cost of a five-mile and a ten-mile project is also calculated, assuming the necessary replacement volume to be 12 CY per foot per year.

Table 6-1: COSTS OF BEACH NOURISHMENT

Sand Nourishment Volume Per Foot Per Year (CY)	Cost per Cubic Yard Placed	Annual Beach Nourishment Cost Per Mile	Five Year Beach Nourishment Cost Per One Mile	Five Year Beach Nourishment Cost for Five Miles	Five Year Beach Nourishment cost for Ten Miles
12	$10	$633,000	$3,168,000	$15,840,000	$31,680,000
12	$15	$950,400	$4,752,000	$23,760,000	$47,520,000
12	$20	$1,267,200	$6,336,000	$31,680,000	$63,360,000
12	$25	$1,575,000	$7,875,000	$39,375,000	$78,750,000

Other nourishment project costs of pre-construction planning, engineering and design, permitting, government agency coordination (assuming multi-agency cost participation), finance, and real estate costs (easements, rights-of-way, etc.) could add 50% to this basic material cost such that the overall cost could approach $1 million per mile per year. At 18 miles the total annual cost could be $18 million. The cost per decade, a nominal nourishment interval, would be as much as $180 million.

6.2 Local Revenue Sources and Options

As the county considers the cost of future shoreline management costs in the study area, the county may wish to establish a dedicated shoreline management fund. Such a fund could be used to pay for the county's future share of shoreline management costs. Locally, there are three potential revenue streams that could be created to fund the account: (1) *Ad valorem* Revenues (2) Hotel Occupancy Tax Revenues, and/or (3) a Special Improvement District.

6.2.1 Ad valorem Revenues

Cameron County has an *ad valorum* property tax rate of $0.384291 per $100 of property valuation. The net taxable value of property in the county was $14.933 billion for the 2012 tax year and is expected to generate $61,478,869 in property taxes at a 100% collection rate.

The county may wish to consider a dedicated *ad valorem* assessment as a contributing revenue stream to a dedicated shoreline management account. Based on a total assessed value of property in the County of about $14.933 billion, an increase in the *ad valorem* tax rate of 1cent/$100 value would generate about $1.5 million per year for a dedicated shoreline management account.

6.2.2 Hotel Occupancy Tax Revenues

As new development occurs in the study area, Cameron County is likely to see an increase in Hotel Occupancy Tax (HOT) collections, though it is entirely speculative

to project expected revenue. Within the South Padre Island ETJ, the hotel/motel tax combined for all jurisdictions cannot exceed 15%. Cameron County has been authorized to collect a Hotel Occupancy Tax at a rate up to 7% by the Texas Tax Code § 352.002(a). The allowed use of such funds are prescribed and controlled by a complex set of statutory provisions found in Chapter 352 of the Tax Code, Subchapter B. While no definitive legal opinion can be offered in this study, it appears Cameron County may not currently have the authority to use HOT revenues for beach nourishment or erosion response projects such as dune creation, enhancement or maintenance projects. Even if clear authorization from the Texas Legislature were obtained to use HOT revenues for beach nourishment and/or erosion response projects, close coordination with current and future hotel owners and operators and other stakeholders in the county would likely be necessary before any HOT revenues could be shifted from their current uses to beach nourishment or erosion response projects.

Such an effort, however, is advisable. Nationally, the use of HOT revenues as a component of a comprehensive funding strategy has proven to be a useful and reliable revenue source to support beach and shoreline management projects.

6.2.3 Special Improvement District

In the ERP, the County indicates that, "A special improvement district will be created to assure private landowners have a stake in the creation and maintenance and funding of the EPDS effort." (Intro, page 7).

Section 2.25 of the County Plan states, "Cameron County will undertake efforts in cooperation with private landowners, General Land Office, TxDOT, the USCE (sic), and all other governmental entities, agencies and programs, to construct a continuous Erosion Protection Dune System along the entire length of South Padre Island within Cameron County's jurisdiction and Boca Chica Beach and *actively seek out funding* for shoreline beach nourishment using high quality compatible materials."

Cameron County also makes clear that it intends to "utilize all reasonable efforts to find and provide funding from private, local, state, and federal sources for the creation of a special district to be called the Cameron County Erosion Protection District to construct, manage and maintain an EPDS and provide for post storm mitigation of the EPDS." The County further specifies in its plan that it intends to pursue funding from a wide variety of federal, state, local and private sources.

Finally, the County Plan states, that the Cameron County Erosion Protection District (District) will be "a special funding district for the area seaward of the Dune Protection Line (DPL) to be located in unincorporated Cameron County for the purpose of funding the construction and maintenance of the Erosion Protection Dune System and provide for post storm mitigation of the EPDS and any other purpose needed in the EPDS effort."

Notably, the County plan fails to project a range or magnitude of project costs or commit any local revenues to beach nourishment, dune creation/maintenance or

shoreline management. Almost without exception, federal and state funding sources require local governments to provide significant cash match to receive public funds.

6.3 State Revenue Sources

There are three principle state revenue sources that could potentially be used to support shoreline management or beach restoration projects, all administered through the General Land Office (GLO): (1) Coastal Management Program (CMP) grants (2) Coastal Erosion Planning and Response Act (CEPRA) funds, and (3) Coastal Impact Assistance (CIAP) funds. As noted below, none of the existing state programs at this time appears to be sufficiently funded to financially support the entire cost of maintaining the existing shoreline position in the study area, should development occur in a manner which would warrant an aggressive beach nourishment program. As shown in Section 6.1.1, the cost to maintain the current shoreline position for five miles of beach in the study area, if re-nourished on a five year cycle and assuming a volume loss rate of 12 CY per year, would be between $31 million and $78 million per project.

These costs are substantially greater than can be funded through CMP or even CEPRA at the present time. With CIAP funds no longer available, the long-term financial risk to Cameron County taxpayers -- if development in the study area were undertaken in an irresponsible manner -- could exceed the financial capacity of the County.

Finally, as discussed in Section 6.4 below, it is not at all clear that County taxpayers can expect substantial federal assistance through the USACE should an aggressive beach management program be required.

The financial risk to county taxpayers of poor planning and/or development practices in the study area cannot be overlooked.

6.3.1 CMP

The Texas Coastal Management Program (CMP), funded by NOAA, helps ensure the long-term environmental and economic health of the Texas coast through management of the state's coastal natural resource areas. CMP construction grants are limited to $100,000.00 per award. These grants can be useful for small-scale dune restoration projects or beach access improvements, including land acquisition.

The GLO awards approximately $2.2 million annually in CMP grants, most of which goes to state and local entities to implement projects and program activities. The Land Office has funded projects in all parts of the coastal zone for a wide variety of purposes. The following project categories have been identified for CMP grants: (1) Coastal Natural Hazards Response, (2) Critical Areas Enhancement, including beach and dune enhancements, (3) Public Access, including beach access, (4) Waterfront Revitalization and Ecotourism Development, (5) Permit Streamlining/Assistance, Governmental Coordination/Local Government Planning Assistance, and (6) Water/ Sediment Quantity and Quality Improvements.

Overall, it is likely some state funds either from CMP or CEPRA could be available to assist Cameron County in future shoreline management needs. However, due to the limited availability and timing of grant funds, CMP funds are not well suited for the substantial and recurrent long-term shoreline management costs likely to be encountered in the study area. In addition, state CMP grants are unlikely in the near term except perhaps for shoreline access improvements until sufficient development occurs to justify state investment in shore protection projects in the study area.

6.3.2 CEPRA

Most of the 367 miles of the Texas gulf coast is eroding. Texas bays and estuaries, with 3,300 miles of shoreline, are suffering retreat and wetland loss due to erosion caused by the creation of navigation channels, commercial vessel and recreational boat traffic, and land subsidence. To address these problems, the Texas Legislature established and funded, in 1999, the Coastal Erosion Planning and Response Act (CEPRA) within the state's General Land Office (GLO).[24] CEPRA funds on-the-ground implementation of erosion control projects, feasibility studies and engineering, permitting, and scientific studies that support erosion response planning in critical erosion areas.

In order to qualify for CEPRA project funding, the state's Land Commissioner, an elected state-wide public official in charge of the state's submerged land and public beaches, must find that, within the project area, there is a threat to:

- Public health, safety, or welfare;
- Public beach use or access;
- General recreation;
- Traffic safety;
- Public property or infrastructure;
- Private commercial or residential property; or
- An area of regional or national importance.[25]

CEPRA projects generally require a "qualified project partner" to provide a local contribution to an on-the-ground project. However, the state's Land Commissioner may undertake one large-scale beach nourishment project without requiring match as long as that project does not exceed one-third of the funds appropriate to the CEPRA program.

The qualified project partner must pay:

- not less than 25 percent of the shared project cost if the project is a beach nourishment project on a public beach or bay shore (a sandy beach occurring within a bay system); and

[24] Texas Natural Resources Code, Subchapter H - Coastal Erosion, §§33.601-33.663.
[25] Texas Natural Resource Code §33.601(4)

- not less than 40 percent of the shared project cost if the project is any other coastal erosion response study or project, including a marsh restoration project or bay shoreline protection project other than a bay beach nourishment project.[26]

Generally, feasibility studies and engineering, permitting, and scientific studies that support erosion response planning in critical erosion areas are paid for by the GLO, not the local sponsor. However, there have been limited cases in which local partners have undertaken such efforts.

CEPRA lacks a dedicated fund and depends on the Texas Legislature to provide a biennial appropriation. CEPRA's funding source has changed three times to include state general revenue, a transfer of money from a dedicated fund designed to support the state's oil spill response, and, most recently, an agreement with the state's parks and wildlife department to support the program from that agency's dedicated fund derived from sales taxes on sporting goods. However, the program has funded more than 200 projects providing about $65 million in revenue in state funds which have been matched by more than $70 million in partnership funding. Table 6-2 illustrates the number of projects per year, as well as match, and the requested amount of funding.

Table 6-2: CEPRA APPROPRIATIONS BY BIENNIUM[27]

Biennium	State Funding	Matching Funds	Number of Projects Funded	Number of Projects Requested	Funding Requests
2000 - 2001	$15.00 M	$10.03 M	42	63	$129.17 M
2002 - 2003	$15.00 M	$9.38 M	53	64	$108.22 M
2004 - 2006	$7.32 M	$14.46 M	20	77	$36.49 M
2006 – 2007	$ 7.30 M	$8.50 M	49	81	$111.78 M
2008 – 2009	$ 17.30 M	$27.86 M	58	84	$58.57M
Total	$61.92 M	$70.25 M	222	369	$443.72M

State policy makers continue to refine the program and have noted program strengths and shortcomings over the years. Three concerns dominate: (1) funding does not meet demand; (2) funding levels vary by biennium making it difficult to implement

[27] *Coastal Erosion and Response Act: Report to the 81st Texas Legislature*, Texas General Land Office, January 9, 2009

complex multiyear projects; and (3) a lack of a dedicated source of funding increases uncertainty among program supporters and communities implementing projects and providing matching funds.

One of the chief limitations on CEPRA funding generally is that the legislature has not chosen to establish a dedicated funding source to support the program. Under current Texas Law, the state collects 1 1/3 cents per barrel of imported oil for the state's coastal protection fund, which is generally used for oil spill response. Previously, the GLO has sought to increase the per barrel fee to 3.5 cents and allocate the additional funds for erosion response. While the legislation provides the statutory basis for the new dedicated fund, it would have to also appropriate the extra revenue into the fund.

As with CMP funds, access to CEPRA funds to respond to beach erosion or dune losses in the study area will be difficult to obtain until sufficient development has occurred to justify public investment in the beach. Should the County seek to maintain the current shoreline position in an effort to sustain the future commercial viability of seaward lots in the study area, securing state assistance under either CEPRA or the CMP may prove difficult. Finally, in the long run, it is not clear the state CEPRA fund will be sufficient to substantially offset the local costs of maintaining the beach in the study area on an on-going basis.

6.3.3 Coastal Impact Assistance Program (CIAP)

A more recent and significant development in coastal funding availability has been the federal Coastal Impact Assistance Program (CIAP). The program is funded with royalties collected from offshore oil and gas leases in federal waters. Alabama, Mississippi, Louisiana, Texas, California, and Alaska receive funding from the program. By design, Cameron County has been a direct recipient of CIAP funds and is eligible to apply for additional CIAP funds from the state.

CIAP is intended to assist those coastal states and coastal political subdivisions within those states that have either supported or been impacted in some measure, directly or indirectly, from Outer Continental Shelf (OCS) oil and gas exploration and development activities.[28] Many of these impacts are felt onshore through increased need for production and support facilities, potential air and water quality issues, and increasing demand for infrastructure and social systems to an influx of OCS workforce. The program is authorized and funded through statute from federal FY 2007 to FY 2010.

The allocation of CIAP revenues to the eligible states has varied year to year and is driven by a formula based on proximity to leases, oil and gas production facilities, miles of coastline, and population. Texas received $45 million to $48 million per year in CIAP funding between FY 2007 and 2010. Texas coastal counties receive 35 percent of the allocated funds, while the state receives the remaining portion.

[28] Section 384 of the Energy Policy Act of 2005 amended the Outer Continental Shelf Lands Act (43 U.S.C. 1356a)

Cameron County received a combined total of $1,393,313.00 in CIAP funds in the last two years of the program: $700,249 for FY 2009 and $693,064 for FY 2010. The state administers its portion of the CIAP funding in the form of a competitive grant program.

Cameron County has already committed all its CIAP funds under the program and no additional funds are expected to be available at this time.

Advantages: While funding has varied over time and is of limited duration, CEPRA has been a relatively stable source of funding, providing resources for a significant number of projects coast-wide. Additionally, the program has been successful in eliciting local matching funds that have significantly leveraged state and local resources. The state's use of competitive CIAP program grants, often with the counties adding their own CIAP funds and by leveraging other funding sources such as the CMP or FEMA disaster funds, has made possible large erosion response efforts on the upper Texas Coast. In the past, the CIAP program has been flexible, reasonably well funded, and suitable for significant projects, including beach erosion and dune enhancement projects.

Disadvantages: Unfortunately, the CIAP program is set to expire unless new congressional action to reauthorize the program is undertaken. If Congress elected to continue the program in its current form, Cameron County might receive about $700,000.00 per year in County funds, though the level of local funding is dependent on many factors and is therefore difficult to predict. State CIAP funds might also be available if Congress chose to continue the program but, as in the past, competition for state CEPRA funds would likely remain competitive. In short, given the expected expiration of the program and the coast-wide needs that can be funded under the program, CEPRA funds are unlikely to be available in the future to maintain the Gulf beach and dune system in the study area.

6.4 Federal Shore Protection Program

The U.S. Army Corps of Engineers (USACE or Corps) is the primary federal entity responsible for the restoration and maintenance of sandy beaches in the United States. The Corps' authority to assist local communities with beach erosion projects is provided by the Water Resources Development Act (WRDA), a federal statute reenacted about every four years. Through this law, Congress can grant the Corps the legal and budgetary authority to assist states and local communities combating beach erosion. Federal funds to support projects authorized under WRDA are appropriated annually through the Energy and Water Development Appropriations Act.

Under WRDA, Congressional authorization for a beach erosion project can take two forms. First, Congress can specifically direct the Corps to study, design, and construct a particular project by name and establish a dedicated funding stream for the project. These are often referred to as "individual project authorizations." Second, Congress has granted the USACE general authority to investigate and construct certain kinds of small, one-time projects that fall within specific categories and budget limits. This general authorization program is called the Corps's Continuing Authorities Program (CAP).

There are nine separate and distinct CAP authorizations that empower the Corps to assist communities with a variety of water resource related problems. Each of the nine CAP authorities is described and evaluated below.

Whether pursued under an individual project authorization or under one of the Corps's nine CAP authorities, every project must be authorized and funded by Congress – either directly or indirectly -- before the Corps can assist a local community with a beach erosion problem.

6.4.1 Project Authorizations Under the Water Resources Development Act

Through WRDA, Congress can grant the Corps the direct authority to study, design, and construct a specific shore protection project. The USACE has a long and successful history in the restoration of sandy beaches. Typically, federal assistance provided by the Corps includes the investigation of the beach erosion problem, project design, placement of sand on the beach, and periodic renourishment over the life of the project. In most cases, the federal commitment to maintain a beach is 50 years.

The federal interest in and responsibility for beach restoration projects was clarified when Congress enacted the Shore Protection Act of 1996. Codified in Section 227 of WRDA, this Act emphasizes the Corps's mission to promote the protection, restoration, and enhancement of sandy beaches. Congress also made clear that the USACE should cooperate with states and local communities to develop and implement comprehensive state and regional plans for the restoration and conservation of sandy beaches.

Over the last five years, the federal budget for beach restoration projects has been about $100 to $130 million per year. Federal funding appears to be leveling off or declining and competition for federal beach restoration funds in increasing substantially. Since about 2000, the U.S. Office of Management & Budget (OMB) has sought to place a moratorium on any new federal beach projects. It is unclear at this time whether the Obama administration will follow suit.

Even without a moratorium, however, convincing Congress to include a new individual project authorization in WRDA can be a long and difficult process, taking up to ten years or more. In spite of the difficulties, many communities have found it worthwhile in the long run to seek federal assistance for the restoration of their sandy beaches.

There are three major requirements that must be met to earn an individual beach restoration project authorization from Congress:

1. Each project must have a willing non-federal sponsor (such as a state or local government) able to partner with the Corps and share in the cost of the project.

2. Each project must have a clear public benefit. To be restored at federal expense, a beach must have sufficient public access to justify federal funding

and/or provide substantial storm damage reduction benefits to upland properties and infrastructure. Restoration of private beaches or projects that only benefit private properties are rarely eligible for federal assistance.

3. The project must be economically justifiable and have a positive cost-benefit ratio. Before federal funds are expended to restore a beach, the Corps must find that the benefits to be derived from the project exceed the project costs.

Federal Process and Schedule: There are seven major steps in the planning, design, and construction of a federal beach restoration project if it is pursued as an individual project authorization from Congress. The time required to complete these steps varies from project to project, however, a minimum of five years under favorable circumstances should be expected. The steps are:

1. Problem Perception – Local citizens or local government perceive or experience a shore erosion problem that is beyond the ability or capacity of the local government to solve.

2. Request for Federal Action – Local government officials contact their Congressional delegation to request a "study authorization."

3. Congressional Approval for Reconnaissance Study – If receptive to the problem, Congress can direct the Corps to conduct a preliminary investigation of the beach erosion problem by conducting a "Reconnaissance Study." Usually through the House Committee on Transportation & Infrastructure, Congress provides the local Corps District with $100,000, the usual cost for a Reconnaissance Study. No funds are required from the local sponsor and the results are usually released 12 to 18 months. The Reconnaissance Study results in the issuance of a "Section 905(b) Report," which determines whether there is a "federal interest" in responding to the erosion problem identified by the local community. If no federal interest is found, the community must look elsewhere for assistance; if a federal interest is identified, Congress can, through specific action in the next WRDA bill, direct the USACE to proceed with a full feasibility study.

4. Federal Feasibility Study - In the feasibility study, the Corps will assess the problem in detail and evaluate potential erosion control alternatives and recommend the most cost-effective approach. When completed, the Feasibility Study is submitted to Corps's Chief of Engineers for review, final approval, and possible submission to Congress. Feasibility studies usually require 24 to 48 months to complete and can cost from $2 million to $5 million. Typically, the non-federal sponsor (a state and/or local government) is required to pay 50% of the feasibility study costs.

5. Pre-construction Engineering and Design - If Congress accepts the Chief of Engineers' recommended shoreline response alternative identified in the feasibility study, the Corps will prepare a detailed project design for implementation. This phase is called Pre-construction Engineering and

Design and the local project sponsor again typically pays 50% of the cost of this effort. This phase culminates with the detailed construction drawings and specifications for the project, often referred to as the "plans and specs."

6. Congressional Authorization - Following a successful review and coordination with the Office of Management and Budget, the Assistant Secretary of the Army for Civil Works will transmit the feasibility study and design report to Congress for final consideration. Congress may then choose to authorize the recommended project for construction during consideration of the next Water Resources Development Act authorization, then separately appropriate the funds needed to proceed to construction.

7. Project Implementation – Once the design is complete and Congress has authorized and funded the project, construction of the project may begin. For most projects, the local sponsor will usually pay 50% to 65% of the project construction costs, as defined in the terms and conditions of the Project Cooperation Agreement (PCA) signed by the parties. The PCA describes the responsibilities of the parties and requires the local share to be deposited into an escrow account. Following completion of the project, the local sponsor is usually responsible for routine maintenance of the project, except for storm damage repair.

Potential Revenue: Currently, the federal government is expected to pay 50% of the project cost on *new* beach restoration projects; historically the federal share has typically been 65%. In certain cases, the federal share can be higher than 50% if, for example, a federal navigation project is found to contribute to the shoreline erosion problem. The state and local communities should continue to seek individual project authorizations from Congress for any beach restoration project whenever possible. If secured, authorization for a federal project will provide a significant measure of long-term financial stability for the restoration and maintenance of Cameron County beaches.

Advantages: Securing additional individual federal project authorization to restore beaches in Cameron County would be advantageous for several reasons:

- May save the state and its local partners money;
- Provide long-term financial stability with a 50-year federal funding commitment;
- Bring federal resources, experience and expertise to the table; and,
- Provide federal funds to rebuild or repair the beach to the original design following a storm event.

If Congress were to authorize federal assistance for the beach projects in Cameron County, the state and local cost of the project could be substantially reduced. Federal shore protection projects are cooperative efforts. Absent special circumstances, the Corps has in the past typically paid up to 65% of the cost of reconstructing a beach, with the non-federal sponsor paying the remaining balance. More recently the federal share has been lowered to 50% and since 1999, Congress has attempted to change the law to limit federal assistance to 35% of the cost of a new federal beach project. So

far, congressional efforts to limit federal assistance to 35% have not been successful. Given current budget limitations, it is possible the federal cost share contribution will be no more than 50% in the future for new starts.

Once a federal project is secured, however, the local sponsor can expect to be eligible for federal assistance for the next 50 years. This federal commitment provides exceptional financial stability for the state and its local partners and enhances the potential for effective long-term financial planning. The local sponsor would also receive the benefit of the expertise and experience of the Corps of Engineers in beach restoration projects.

Disadvantages: There are several disadvantages that must be considered when seeking an individual authorization for Federal beach restoration assistance:

- Securing federal assistance can take as long as 10 years and requires careful attention to Congress and the bi-annual reauthorization of WRDA.

- The federal project planning process is cumbersome and can be difficult. Attention to detail is important to ensure that local priorities and objectives are fully recognized and served in the Corps's planning process. Local communities would need to commit the resources necessary to move through the project authorization process and be prepared to pay 50% of the cost of the federal feasibility study.

- While no definitive conclusions can be drawn, on-going budget pressure at the federal level make new federal beach projects exceptional and very difficult to secure.

- Because the Cameron County shoreline in the study area is undeveloped at this time, there is no reasonable likelihood that the project analysis would generate a positive benefit – cost ratio.

At the present time, it would not be prudent for Cameron County to incorporate a federal beach project into its future shoreline erosion response strategy for the study area or to develop a shoreline management funding strategy that relies on an individual project authorization under the federal shore under the federal shore protection program.

6.4.2 USACE Continuing Authorities Program (CAP)

Within limits established by Congress, the Corps is authorized to plan, design, and construct certain types of water resource improvement projects (including beach nourishment projects) without first obtaining an individual project authorization in WRDA. Known as the "Continuing Authorities Program" or CAP, this small projects program allows the Corps, in partnership with local communities, to move relatively quickly to address flooding, erosion, or navigation problems. In general, CAP projects are small scale, one-time projects that constitute a complete solution to the problem.

Each of the nine CAP authorities has specific eligibility requirements and funding limits. For all CAP projects, the local project partner (typically a local governmental entity) must share in the cost of the project from 20% to 35% depending on the CAP authority. The nine CAP authorities are:

1. *Small Flood Control Projects*. Under this section, small flood control projects may be constructed if the USACE Chief of Engineers determines that the work is advisable and the project cost does not exceed $5 million. Local flood control projects may include the construction or improvement of levees, channels, or dams. Non-structural alternatives may also be considered and include installation of flood warning systems, raising and/or flood-proofing structures, and relocating flood-prone structures.

2. *Small Navigation Projects.* The USACE may construct small river and harbor improvement projects not specifically authorized by Congress when they will result in substantial benefits to navigation. The federal share in such projects may not exceed $4 million. The work must be intended to improve navigation and can include dredging channels, widening turning basins, and installing navigation aids.

3. *Emergency Streambank and Shoreline Protection Projects.* The Corps may spend up to $1 million in one locality during any fiscal year for the construction, repair, restoration and modification of emergency streambank and shoreline protection works. Typically, work under this section is intended to prevent erosion damage to highways, bridge approaches, public works, as well as churches, hospitals, schools, and other non-profit services endangered by erosion.

4. *Snagging and Clearing for Flood Control*. For purposes of flood control, the Corps is authorized under this provision to spend up to $500,000 on a single tributary during any fiscal year for the removal of accumulated snags and other debris and for the clearing and straightening of stream channels.

5. *Project Modifications for the Improvement of the Environment.* Under this provision, the Corps is authorized to investigate study, modify, and construct projects for the restoration of fish and wildlife habitat where the degradation is attributable to an existing federal water resource project constructed by the USACE. Projects are limited to $5 million.

6. *Small Beach Erosion Control Projects.* Under this authority, the Corps can spend up to $3 million for projects to protect or restore a public shoreline or beach. Typical projects include construction of revetments, groins, and jetties, or periodic sand replenishment. Large-scale beach restoration projects requiring frequent renourishment are not eligible under this section.

7. *Shore Damage Attributable to Federal Navigation Works.* Limited to $5 million per project, work under this authority is intended to prevent or mitigate erosion damage to public or private shorelines when the damage is

the result of a federal navigation project. This authority cannot be used for shoreline damage caused by riverbank erosion or vessel-generated waves. Projects are not intended to restore shorelines to their natural or historic configuration, but only to reduce the erosion damage to a level that would have existed without the federal navigation project.

8. *Ecosystem Restoration in Connection with Dredging.* Under this authority, the Corps is authorized to undertake projects to protect, restore, or create aquatic and wetland habitats in connection with the construction or maintenance dredging of an authorized project. Congress has not established as specific cost limit for Section 204 projects, but the local share is 25% of the project cost.

9. *Aquatic Ecosystem Restoration* Under this section, the Corps has the authority to spend up to $5 million per project to restore and protect aquatic ecosystems, if the project will improve the environment and is in the public interest.

Table 6-3: CONTINUING AUTHORITIES PROGRAM

Continuing Authorities Program (CAP Authority)	WRDA Section	Federal Dollar Limit	Cost Share Federal/Local Percentages
Flood Damage Reduction	§205	$7,000,000	65/35
Snagging & Clearing for Navigation	§107	$4,000,000	80/20
Emergency Streambank & Shoreline	§14	$1,000,000	75/25
Snagging and Clearing for Flood	§208	$500,000	65/35
Project Modification for Environmental	§1135	$5,000,000	75/25
Shore Protection/Beach Erosion	§103	$3,000,000	65/35
Mitigation for Shoreline Damage	§111	$5,000,000	65/35
Ecosystem Restoration - Dredging	§204	N/A	75/25
Aquatic Ecosystem Restoration	§206	$5,000,000	65/35

Continuing Authorities Program Process and Schedule

Regardless of the CAP authority used, there are three general steps that must be completed to secure federal CAP assistance: (1) Local request for assistance; (2) Corps study and acceptance of the project; and (3) Project design and construction.

A Corps district may undertake a feasibility study (Step 2) for a CAP project upon the written request of state or local government official and the approval of the Corps Division Office. Studies are initiated subject to the availability of funds and staff. For studies under sections 103, 107, 111, and 205, the objectives of the feasibility study are the same as those for congressionally authorized studies. The first $100,000 is a federal expense. Any study cost over $100,000 is shared 50-50 with the non-federal sponsor.

If the Corps accepts the project and agrees to proceed, the local sponsor and the federal government will sign a Project Cooperation Agreement. Planning and Design Analysis (PDA) for Section 14 and Section 208 projects are accomplished in a single phase. Other CAP projects typically go through a two-step planning and design process. PDA costs are federally financed up to $40,000; costs in excess of $40,000 are shared equally with the local sponsor and are usually paid during the construction phase. Once the design is complete, the Corps will solicit proposals for project construction, select a contractor, and manage construction of the project.

Potential Revenues: Few if any of the beach restoration projects under consideration in Cameron County appear to fall within only one of the nine CAP authorities. Potential federal revenues under Section 103 (small beach erosion projects) are limited to $3 million per project and the local sponsor must contribute 35% of the total cost.

Advantages: Speed and convenience are the key advantages to the CAP program. The CAP program is clearly much faster than addressing water resource problems through individual project authorizations from Congress.

Disadvantages: Funding under the CAP program is limited, projects must still meet specific eligibility requirements, and, although quicker than other federal programs, the CAP process still requires 12-18 months before a project is accepted for funding. In general, CAP projects must meet the following criteria:

- The project must standalone. The project must be complete and not commit the Corps to further construction. This means that the project must solve a specific problem and not require a subsequent work. Beach restoration projects typically require renourishment and fail to meet this criteria.

- The project must be economically justified. That is, the benefits from the project must exceed the annual cost of project maintenance, usually expressed on an average annual basis.

- The project must be environmentally acceptable. Environmental considerations are integral part of the planning of a CAP project. In all cases,

the Corps will prepare an Environmental Assessment that must be coordinated with federal, state and local agencies, and the public. For some, more controversial projects, the Corps may be required to prepare a full Environmental Impact Statement, a process that may require two to three years to complete.

The local sponsor for the project must be financially able to assist with the project. For example, the sponsor is required to share in the cost of the feasibility study, and provide lands, easements, and relocations as may be necessary for construction. In addition, most projects, once constructed, must be operated and maintained by the local sponsor.

Conclusion: The nature and scope of projects that the Corps can pursue under the Continuing Authorities Program is limited. At first blush, Section 103, Small Beach Erosion Projects and Section 1135, environmental project modifications, might appear to be appropriate to address shoreline management needs the study area. However, a fair analysis of the programs is not encouraging. At the present time, because of the restrictions on CAP projects and the very limited CAP funds historically available in the Galveston Corps District, it would not be prudent for Cameron County to incorporate a Corps CAP project into its future shoreline erosion response strategy for the study area.

7.0 Policy Implications of Shoreline Change

7.1 Consequences of Seaward-Most Development

Development at the landward edge of the active beach as it exists today will have predictable results in the near future (years to decades) including the following:

- Creates short term economic benefits based on proximity to the beach
- Maximizes the area available for development in the near term
- Creates risk of beach loss of use to both property owners and the public
- Negatively impacts or limits public access
- Causes natural resource damage and impacts sea turtle nesting
- Increases damage risk to landward property and infrastructure
- Increases public cost of shoreline management
- Causes long term conflict and economic harm

The benefit to adopting a seaward-most development strategy is the maximization of developable acreage, locating development close to the water's edge, which is economically positive in the short term. The maximization of the developable acreage similarly increases the tax base that can be used to support intervention methods. However, the positives are eventually outweighed as more investment in protection is required and the point at which intervention (beach nourishment, etc.) becomes necessary is moved forward in time.

Further, the costs are likely to be imposed on a different group than those enjoying the initial benefits.

Given the long term trend of landward shoreline migration the seaward-most development option will result in almost immediate stakeholder conflict among property owners, public beachgoers, and advocates for the beach-dune system as a natural resource and protective buffer. The data shows that despite short-term relative stability observed in some places, the shoreline will in the aggregate continue its landward progression. As sediment is moved out of the system and sea level rises, the entire profile—not just the shoreline— will shift landward until the seaward-most developments become part of the active beach profile.

Consequences of the ongoing shoreline retreat include degradation of the natural resource, a reduction in the protection for the landward infrastructure, diminished beach use and access, and an increased risk and severity of storm damages.

South Padre Island is consistently ranked one of the top 25 beaches in the United States, and the quality of the Gulf of Mexico beach visitation experience is one of the main attractors to developers, potential homeowners, and tourists alike. As developments start to become part of the active beach, the quantity and quality of the beach access declines, reducing further demand for investment in property and impacting tourism.

Degraded dunes expose landward infrastructure (not limited to the seaward most developments) to damage from storms that previously would have left them untouched.

Currently the dunes act similar to a seawall, where waves and water must reach significant height to penetrate beyond the dune ridge. Once that protection is gone, more minor storms will be capable of producing surge and wave action sufficient to affect the lower elevations behind the dune and the associated infrastructure. This potential for severe damage only increases in the case of a major storm event.

To succeed, a seaward-most development strategy must presume that a revenue stream is available to maintain a static shoreline location over the long term by counteracting the natural retreat rate/sand deficit. There is no basis for state or federal funding participation until there is sufficient development worthy of protection. In the subject area, such an economic base is probably at least a decade away. Further, federal and state revenue streams of the required magnitude are highly unlikely to materialize in the coming years given existing fiscal constraints.

Thus, local funding to maintain a static shoreline should be presumed necessary, or conflict and economic harm are assured during subsequent years and decades.

7.2 Consequences of Maximum Retreat Strategy

Implementation of a maximum retreat strategy would reduce the significant financial risk taxpayers at the state and local levels will assume for future shoreline retreat response costs. In this context, maximum retreat means locating land uses landward of the projected location of the active beach-dune system at the end of the life cycle of that land use. Such a strategy could be appropriate if active intervention to address shoreline retreat is not desired or funding mechanisms are not identified. The local regulatory process would have to account for the retreating beach-dune system at the development planning stage.

A maximum retreat strategy would also minimize or reduce the impact of future development on coastal natural resources, particularly the dune system, which is an essential protective feature for future development. Similarly, by allowing sufficient area for dunes to form and be maintained – meaning an area greater than the 75-foot wide Dune Conservation Area now contemplated -- the dune volume can be substantially greater which will serve as a sand supply to the beach in storm conditions. Overall, a maximum retreat strategy is likely to result in a wider, more stable beach over time. This outcome would help protect landward property and infrastructure, maintain quality beach access and use opportunities (for occupants of beachfront property and the public), and maintain or enhance sea turtle nesting success.

At its extreme, maximum retreat could mean implementation of a setback distance representing the total shoreline retreat over a long term period matching the life cycle of the most “permanent” features of development, e.g., high rise buildings. Shorter-lived land uses and land uses that are more dependent upon proximity to the sandy beach or Gulf waters could suffer from this approach.

A more adaptive maximum retreat approach could mean providing for shorter-lived land uses to be located closer to the beach than longer-lived uses. For example, a high rise building would be located beyond reach of the projected beach location 50 or more years

hence (the life cycle of the building) while the the shorter-lived amenities associated with the high rise (boardwalk, deck, swimming pool, smaller buildings, cabanas, etc.) could be seaward of the high rise. These amenities could be moved, eliminated, or otherwise adapted as actual future conditions dictated.

As suggested in Figure 5-1 and discussed in Section 7.4 below, managing future development along this highly eroding and vulnerable shoreline will involve a complex interplay of factors, including the nature and type of development, its proximity to the beach, and the scale and cost of future erosion response projects. Developing an approach that both respects property rights and investor expectations and reduces the financial risks to all taxpayers will be challenging. However, the challenge should be no worse than that of mitigating the inevitable costs and conflict that will arise from poorer planning alternatives.

If, for example, the county had sufficient funds and a long-term beach compatible sand supply, the County could theoretically maintain the current shoreline position in the study area over time and allow more permanent structures to be located closer to the beach.

On the other hand, if the County fails to fully account for the future shoreline retreat when considering future development proposals or fails to secure long-term funds and sand sources sufficient to counteract the on-going erosion problem, prudence would dictate that more permanent structures be located substantially more landward than contemplated now. As discussed in Section 6.1.1, the cost of counteracting shoreline erosion in the study area may be on the order of $600,000 per mile per year, assuming a per cubic yard cost of beach nourishment at $10. If beach nourishment costs were $15 per cubic yard, the annual cost to Cameron County to maintain the current shoreline position would be $900,000 per mile per year. For five miles of developed shoreline, where permanent structures are located in close proximity to the beach, the cost of shoreline management could be $3 million to $4.5 million per year.

Public pressure to undertake costly and recurrent beach nourishment projects and programs will arise once sufficient development value exists in the study area and once the development is placed at risk by shoreline retreat. Without an aggressive shoreline management program, the county should fully expect that future development, if located in close proximity to the current beach, would generate substantial demand from property owners for expensive beach nourishment and dune restoration projects, likely at public expense.

By employing a maximum retreat strategy or one that requires permanent structures to be located more landward, the County could substantially limit or reduce the risk of storm damage to future development and reduce future public expenditures for shoreline management projects.

7.3 Potential Management Principles and Benchmarks

The following discussion seeks to identify primary and secondary principles and benchmarks that could be useful at the local level to frame the important issues that will

promote progress toward a goal of successful economic development of the north end with buy-in from all stakeholders.

If this list of principles, or a similar list developed among stakeholders, can be agreed upon as guideposts for creation of an acceptable approach, then associated benchmarks can be used to measure the degree of success, compare and contrast competing alternatives to achieve the goal, and trigger expirations or other course corrections.

Once agreed upon, each principle should ultimately be addressed in the local regulatory regime, whether in the local platting and zoning process, beachfront construction/dune protection plan, special district, building permit program, or other appropriate mechanism.

Principles

- Explicitly acknowledge and plan for shoreline retreat
- Facilitate and plan for a wide, healthy dune field
- Facilitate and plan for a realistic program to maintain the existing shoreline position, a future position some number of years hence, or a gradually migrating position
- Relocate existing PR 100 more landward
- Locate more landward any new extension of PR 100
- Expect and plan for future conflict between development and retreat when actual conditions vary from estimates
- Address treatment of the large, historical dunes that will be affected by development considering the following: (a) the existing dunes are a source of material; (b) unless/until waves reach them, the dunes are not a dynamic part of the beach-dune system (do not affect shoreline positions); (c) dune sand could be placed seaward, used as construction fill, or transported off site, depending on policies enacted; (d) the sand dunes are a massive sand supply but a one time source.
- Ensure that land uses match the time scale of any shoreline management strategies
- Ensure that the financing mechanisms are correlated in time to the shoreline retreat prospects
- Link "development styles" with their appropriate positions on the beach profile. Longer-lived structures – such as high rises and condos – should be more landward; amenities and lower impact improvements can be more seaward. The temporal life of the structure should be tied to the temporal location of the shoreline.
- Promote feasible relocation in the design stage of smaller structures.
- Identify the spring/summer Mean High Tide Line as the reference line for measurement of cross-shore distances

Benchmarks

- Shoreline location (annual/seasonal)
- Dune volume/width/integrity

- Vegetation cover
- Distance landward of shoreline
- Relative sea level
- Maintenance account balance
- Spatial distribution of assessed valuation
- Economic activity statistics
- Financial assurances
- Structure life cycle
- Building materials/debris potential
- Duration of development rights
- Impervious cover
- Intervention project cost
- Allocation of risk
- Disaster recovery qualification
- Flood insurance qualification
- Beach user statistics/revenue
- Turtle statistics

7.4 Tradeoffs with Emphasis on Local Authority and Decision Making Processes

Discussions of past and future changes must be framed in terms of time intervals or time scales. With the goal of informing decision makers on issues relating to coastal development, the time scale of interest extends for years, decades, and the better part of the coming century. These are the time scales of anticipated coastal development ranging from simple beach access amenities to high rise commercial and residential buildings built tomorrow or several decades from now.

Considering these time scales and the associated cumulative retreat, Cameron County decision makers should consider the likelihood of hundreds of feet of shoreline retreat over the development life cycle of the county's Gulf of Mexico frontage. In the alternative, allowance should be made for the cost of intervention into the long-term coastal processes leading to shoreline retreat, likely meaning projects to deliver very large quantities of imported sand to the beach system.

Equilibrium can be reached between increased development and increased commitment to intervention. The costs associated with intervention measures can be offset by the increase in the tax base and increased economic activity, so that the shoreline management policies result in a net economic benefit. Situations where the effort of maintaining the shoreline outstrips the economic benefits, like maintaining the 2012 shoreline position in perpetuity, should be avoided.

Financial modeling of the intervention costs can be used to develop a plan for finding and maintaining this equilibrium point. As development is pressed closer to the shoreline, long term costs are incurred that may have no offsetting benefit. These

costs should be recognized and allocated as appropriate to make the development limit sustainable.

There will be no impetus to implement a project on the scale of beach nourishment until there is a critical mass of development and infrastructure to be protected. Any proposed management policy needs to assume that the next 10-20 years will see retreat regardless of any long term plan to stabilize the shoreline or reduce the retreat rate.

Intervention options should be scaled appropriately to the developments they are designed to protect. It is unnecessary to protect a boardwalk with a massive beach nourishment and impractical to try to protect a high rise condo with a sand fence. The scope of intervention options ranges from dune stabilization measures such as sand fences and irrigation to substantial protection structures like seawalls.

Between the two extremes of intervention efforts are a number of gradations. For protecting beach amenities and beach access, an intervention program consisting of improved debris and seaweed management or dune stabilization can be sufficient. A residential development requires a more significant commitment such as smaller scale beach nourishment. As the level of development increases into mid-rise and high rise condos and hotels, the level of protection that should be considered goes up accordingly. A large scale offshore dredging operation placing hundreds of millions of cubic yards on the beach becomes more appropriate. Another option is the concept of managed retreat, where the shoreline retreat is slowed such that enough development can take place and enough revenues collected to make the process self sufficient. Land uses would still be located in relationship to their respective life spans, but more acreage becomes available for development with a slowed retreat rate.

A single dune enhancement or restoration episode affects coastal processes operating on a scale of months to a few years at most. While appropriate for protecting nearby development in the short term, it does little to affect processes acting on a scale of years to decades. Dune enhancement should not be expected to overcome long-term, regional shoreline retreat.

At the level of residential homes and up, the option of arresting or slowing shoreline retreat has to be seriously considered given the twelve feet per year retreat rates observed on South Padre Island. For a sense of the magnitude of the shoreline retreat problem, consider a hypothetical development occurring at the end of the existing Park Road 100. The centerline of the road at that point is located 700 feet landward of the 2012 shoreline. Without active intervention, a structure built on the pavement will be located on the back edge of the beach, without any dune for protection, in 50 years. Cameron County is proposing a development setback of 280 feet from MLW. Any house built today at that building limit will be seaward of MLW within 23 years, less than the duration of a typical residential mortgage. There is an easement 100' each side of the road centerline which leaves 320 feet of developable land between the setback line and the easement. In 27 years, there will be no buildable land between the shoreline and the road, only the dune zone.

The costs of increased levels of effort are logarithmic rather than linear, which necessitates the determination of success criteria that can be used to evaluate the associated costs and benefits of different options. The primary success criteria are likely to be economic in nature, considering both the cost of the intervention method proposed and the economic advantage gained with the implemented measure. Each of the options listed above has a base cost associated with it, from thousands of dollars to perform a small scale dune construction to hundreds of millions of dollars to stabilize 18 miles of shoreline for a decade.

Evaluation of risk and uncertainty and storm resilience also should be taken into account when designing an intervention effort. As discussed above, the retreat of the shoreline is episodic, sometimes tripling the average. Tolerances of a project should not be so tight that the project becomes unsustainable in the event of a short-term increase in storms and shoreline retreat. At the same time, not every eventuality can be accommodated when balancing against cost, so the acceptable level of risk must be determined and allocated during the planning process. Storm resilience factors into the selection of an appropriate protection measure. Sand fences do not provide a good method for restoring the shoreline if there is no beach left in front of a development. Nourishing the beach to increase the amount of dry beach provides some cushion for weathering the storm and allowing the beach to naturally recover.

All projects must be evaluated for potential disaster recovery assistance, and if there are requirements such as monitoring or maintenance that must be completed for recovery assistance eligibility then that cost should be evaluated during planning. For smaller scale projects, the cost of meeting these requirements may not be worth the cost of the project. For large scale nourishments, the monitoring and maintenance costs are dwarfed by the potential assistance in the event of a disaster. In all cases, any local match requirements must be computed and taken into account in the financial mode.

8.0 Summary of Stakeholder Discussion

The Erosion Response Plan submitted by Cameron County for consideration by the state will affect all stakeholders including the local public, visitors, private property owners, commercial interests, and taxpayers at the local and state level, as well as coastal natural resources. Successful plan implementation will depend, in part, on the extent to which plan elements incorporate realistic forecasts of future physical and fiscal circumstances.

The Texas General Land Office authorized and funded this Cameron County Erosion Analysis to gather and summarize available information, collect new information, and provide independent expert analysis with the goal of equipping local and state decision makers with the best, most up-to-date findings on two primary issues: (1) the likely physical evolution of the beachfront in coming years and decades assuming varying levels of intervention, and (2) the cost implications of a range of land uses, intervention strategies and regulatory choices.

As the report (dated January 31, 2013) was being completed, two information exchange sessions were scheduled with local decision makers. The report was then made available to Cameron County and City of South Padre Island officials. A discussion item was placed on the February 14, 2013 Cameron County Commissioner's Court agenda. Study principals Bill Worsham and Peter Ravella addressed the court, presented the study background and findings, and participated in an open discussion with the commissioners. The following day, the same presentation was made at a meeting of the City of South Padre Island City Council followed by additional discussion.

Given that the audience consisted of the groups potentially responsible for regulating land use and funding public costs of managing the beachfront, the discussion focused on those issues as summarized below. Clarification based on the discussions is also provided below to further highlight some of the key findings.

8.1 Land Use Regulation

Commissioners expressed concern that the report seemed to focus on the shortcomings of the Erosion Response Plan (Plan) adopted by the court in 2012 and submitted to the state. The authors wish to clarify that the study intent was not to critique the county's adopted plan, but rather to evaluate an envelope of potential land use scenarios ranging from a seaward-most building construction approach to a maximum-setback approach and draw conclusions about the costs and benefits of the two extremes as well as one or more balanced approaches in between.

As we began to describe and evaluate the seaward-most construction approach, it became apparent that the Plan approach was essentially equivalent to the seaward-most approach. As a result, our evaluation of the seaward-most approach was unavoidably an evaluation of the Plan in terms of the development style that it incentivizes. In part, we explored specifics of the Plan rather than a similar hypothetical case.

The Key Findings presented at the beginning of the report highlighted a number of Plan elements that the report authors noted would increase the need for intervention in

physical beach processes and incur significant costs. However, the authors wish to reiterate that the first and most significant key finding is that desirable, profitable, and sustainable development can be accomplished by recognizing the size and time scales of potential land uses and ensuring that they are matched with achievable strategies for physical intervention (e.g., beach nourishment and dune restoration) and for financing the foreseeable costs of such intervention.

In contrast to the Plan approach of establishing the present shoreline location as the line to be defended in coming years and decades, the authors suggest that there will be little impetus or financial means to defend any line until a significant amount of development actually occurs. This strongly suggests that a shoreline location of perhaps ten to twenty years in the future would be the appropriate line to defend.

Such an approach does not require absolute retreat or large setbacks from the shoreline, but it does imply that land uses in close proximity to the beach should be compatible with a landward-retreating beach system. In practice, this could mean shorter-lived or easily-relocated structures and uses are allowed near the beach while longer-lived, permanent construction is located farther back. Appropriate setback distances for various uses are directly tied to the scale, timing, and financing of intervention desired by the community to ensure that the natural resource driving the development economy remains in place.

Future adaptation of this approach can be made as actual data on shoreline retreat and the performance of intervention measures emerges.

8.2 Public Costs

During the discussion with the commissioners, questions regarding future costs and funding for beach nourishment were addressed. The report authors believe that if the county pursues an aggressive seaward-most development strategy, beach and shoreline management costs in the study area may eventually exceed $1 million per mile, per year or several million dollars per mile for a recurring beach nourishment program on a 5-7 year cycle.

The county's plan suggests that revenues to sustain the current shoreline position will be pursued from various federal programs, state programs, and possible imposition of a local special district tax, though no details are provided. As explained in the report, reliance on future federal and state funds for a recurrent capital cost of beach and shoreline management that may exceed $30 million per project cycle is questionable. Instead, as a direct beneficiary of increased property tax revenues from beachfront development, Cameron County may well be expected to contribute to the cost of maintaining the beach dune system. It is noteworthy that Cameron County may collect about twice as much in property taxes from future island development when compared to City of South Padre Island tax receipts. The county, as the entity presently having direct authority to determine future development patterns, is in a position to significantly impact future public expenditures for shoreline management and beach nourishment.

The report authors suggested that the county consider implementing a modest but dedicated countywide property tax in preparation for the substantial future capital cost

expected for beach nourishment and dune restoration in the study area. The county would be one key partner in funding shoreline management, along with the City, state and potentially federal government.

Comments during the commissioner's court presentation indicated that such a commitment of future county tax revenues would be highly unlikely and politically difficult. The authors of the report recognize the political difficulty of increasing county taxes to subsidize beachfront development in the unincorporated areas of South Padre Island. Nonetheless, if the county elects to pursue or permit an aggressive seaward development pattern, we believe continued shoreline retreat will necessarily and unavoidably demand substantial local financial commitments to maintain the current shoreline position. Because project costs are likely to exceed the capacity of the city to manage alone, and due to limited state and federal funds for recurrent beach management capital costs, Cameron County will likely be a critical financial partner in paying for future beach nourishment and dune protection projects.

The city presently finds itself in the unenviable position of having no control over the style and pattern of future island development outside the ETJ while at the same time facing potentially significant local beach management costs if and when it annexes newly developed areas approved for construction by the County. In fact, it was suggested during the commissioners' meeting that Cameron County could avoid future beach management cost liabilities simply by waiting for the areas to be annexed by the city, in hopes of shifting the cost to the municipality. Such a result may well be unacceptable to current and future city leaders and taxpayers.

The end result is that in recognition of the potentially substantial beach and shoreline management costs, the county would benefit if it were to take a prudent and conservative approach when considering future development on South Padre Island. The more landward the substantial structures are located, such as hotels or high rises, the less financial risk may be incurred by the county, city and state, and their respective taxpayers. Such an approach would not preclude shorter-lived or more adaptable land uses closer to the shoreline.

The authors hope that this report will continue to provide a basis for framing further stakeholder discussions and decision making as development of the study area proceeds.