



BAHIA GRANDE PROJECT

OCEAN TRUST: SUSTAINABLE FISHERIES WILDLIFE & THE ENVIRONMENT

Bahia Grande Master Plan Overview March 2009

Goal

Bahia Grande is a federally protected 20,000 acre degraded coastal ecosystem within the Laguna Atascosa National Wildlife Refuge in Cameron County, Texas. The loss of tidal exchange in the 1930's turned a thriving wetland into a 10,000 acre barren dust bowl. The goal of the Bahia Grande Restoration Project is to restore the ecosystem functions of Bahia Grande so that it once again serves as critical wetland habitat for a variety of fish, shellfish and migratory waterfowl along the South Texas Gulf Coast.



History

Bahia Grande is located in south Texas between Brownsville and Port Isabel just north of the Brownsville Ship Channel and south of State Highway 100. It encompasses three basins which include Bahia Grande (6,900 acres), Laguna Larga (1,700 acres) and Little Laguna Madre (1,300 acres) that were once a productive bay system with a regular connection with the Laguna Madre and thus the Gulf of Mexico. Anecdotal reports from elderly residents tell of shrimping with shallow draft sailboats and populations of blue crabs and even flounder. Barnacles and oyster shells still can be found attached to pilings and other objects scattered across the basin and the sandy bottom is dotted with clamshells of several species. Waterfowl (rafts of 15,000 redhead ducks) are reported to have been abundant and the adjacent Redhead Ridge took its name from its being the place to pass-shoot redhead ducks. An island in the Bahia Grande was reported to support 10,000 nesting terns and gulls and in the mid-1920's. Bahia Grande was a naturally functioning wetland with no direct human development.



On July 4, 1872, a 22.5-mile, narrow-gauge "Rio Grande Railroad" was opened. It connected Port Isabel to Brownsville and had a 3-mile (15,550-foot) trestle section crossing the "Badilla Grande". The railroad line was abandoned in 1921. In 1936, the Brownsville Ship Channel was completed. It bisected San Martin Lake and restricted tidal flow into the Bahia Grande. In 1951, the Farm-to-Market Road 1792 was authorized and constructed just north of and parallel to the Brownsville Ship Channel. It effectively isolated Bahia Grande from the Brownsville Ship Channel and the Lower Laguna Madre. FM 1792 was renamed "State Highway 48" in 1990. After the ship channel and Highway 48 construction,

Bahia Grande was filled occasionally by very heavy rains or tropical storm tides, but the basin was essentially dry and barren for almost 70 years due to strong evaporation and lack of regular tidal exchange with the Laguna Madre. Strong coastal winds common to the area have sweep across the basin and raised dense clouds of salty, clay dust that blanketed area towns causing health problems, clogging air conditioners, shorting power lines, lowering land values, and restricting visibility on State Highways 48 or 100.



Environmental Assessments Early Flooding

Biological surveys of the area conducted by the Division of Wildlife Refuges began as early as 1937. A 1953-1959 ecological survey of the Lower Laguna Madre by the Texas Game and Fish Commission was published in 1962. Efforts to restore Bahia Grande began in 1982 when a small channel was dug from the Brownsville Ship Channel to the Bahia Grande by local shrimping interests. The basin was re-flooded, but owners of the basin and adjacent ranchland took legal action to have the channel filled. This was followed by a 1991 proposed flooding evaluation.



Federal Acquisition

In 1999 and 2000, the U.S. Fish and Wildlife Service acquired 21,762 acres of land and water surrounding the Bahia Grande with help from the Natural Resources Conservation Service and The Conservation Fund. The property became a unit of the Laguna Atascosa National Wildlife Refuge. With the Bahia Grande under federal ownership, renewed interest among local communities, governments, conservation organizations, and commercial and recreational fishing groups to restore the wetland complex resulted in plans to re-establish tidal connections and restore the fisheries and wildlife habitat of the Bahia Grande.



TEES Hydrologic Study

Ocean Trust and NOAA's Community-based Restoration Program (CRP) became engaged in the Bahia Grande restoration in 2000 sponsoring an initial hydrologic study for channels needed to restore tidal connections to the Gulf of Mexico. Some of the conclusions from the work conducted by Dianna Van Valkenburg as part of her graduate thesis at Texas A&M Engineering Experiment Station (TEES) were that since the objective of flooding Bahia Grande was to create an ecosystem in which plant and marine life would flourish, salinity should be a consideration for the channel designs, and that a tidal exchange of 2.5% from a proposed pilot channel may not be able to regulate salinity in the basin, leading to a continuous increase in salinity due to evaporation. Subsequent monitoring conducted by University of Texas at Brownsville/Texas Southmost College confirmed this hypothesis. Van Valkenburg's analysis and hydrologic model provided an assessment of several channel dimensions and was used to determine the specifications for a main channel opening (Channel E) between the Brownsville Ship channel and Bahia Grande.

HHR Hydrologic Analysis

In 2004, the Brownsville Navigation District contracted with H&H Resources (HHR) to conduct an engineering study which included a professional hydrologic analysis and design for the main channel updating the work of Van Valkenburg. HHR utilized the EPA-Storm Water Management Model computer program to analyze hydraulic operation of the proposed main channel and to simulate potential time-based changes in water level and velocities as flow exchanges between the Brownsville Ship Channel and Bahia Grande. With the recommended 150-ft bottom width, the main channel will convey a maximum inflow rate (rising tide) to Bahia Grande of 4030 cfs at a velocity of 2.3 ft/sec, and a maximum outflow rate of 3060 cfs at a velocity of 2.0 ft/sec. The calculated water volume exchange between Bahia Grande and the Brownsville Ship Channel is about 32% of the maximum flood volume achieved in Bahia Grande during a normal tidal cycle.

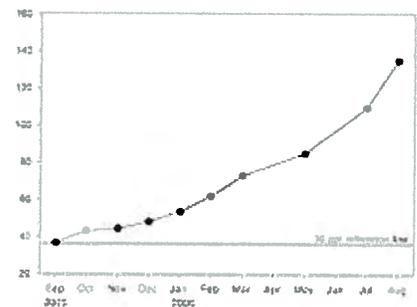
Pilot Channel

In July 2005, a small pilot channel 15 foot wide on the bottom was constructed between the Brownsville Ship Channel and Bahia Grande which flooded Bahia Grande eliminating persistent dust from the main basin, but only provided a 2.5% tidal exchange (approximately 2 million cubic feet of water flow in a 12.5-hour tidal cycle) that has not halted the continuous increases in salinity from evaporation that has not supported estuarine life nor provided sufficient water and nutrient exchange to fully restore the Bahia Grande as an important coastal estuary of the Gulf of Mexico.

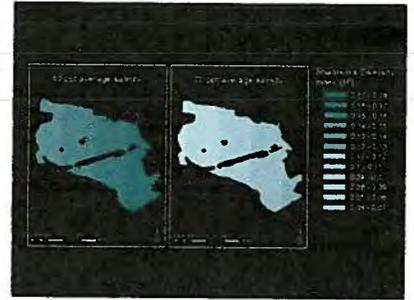


Monitoring Salinity

Data gathered following the July 2005 flooding of Bahia Grande from the pilot channel provided an encouraging glimpse of how rapidly the system could recover given adequate tidal exchange. Conversely, data collected later in the twelve-month monitoring program clearly demonstrate the ecological consequences of not providing adequate circulation. Within six weeks of the initial flooding of Bahia Grande benthic sediments were colonized by lush growths of blue-green algae and pioneering marine worms (surface deposit feeding nereid and spionid polychaetes) at average densities of 23 individuals • m⁻². Brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), blue crab (*Callinectes sapidus*), and six fish species (predominately the omnivorous sheepshead minnow; *Cyprinodon variegatus*) were commonly captured in bag seine samples. Despite increases in average salinity from 36.9 ppt in September to 43.2 ppt in December 2005, both population sizes and diversity of estuarine species were observed to increase over the next three months. However, salinities continued to rise and by early Spring 2006 salinities exceeded 85 ppt; more than twice full-strength seawater (Fig 1). This extreme hypersalinity resulted in a shift in community structure. By the Summer of 2006, the developing estuarine community had completely disappeared, giving way instead to a community similar to that which develops over frequently flooded wind-tidal flats and dominated by salt-tolerant insects (e.g., dipteran larvae).



In the absence of estuarine predators at salinities exceeding 100 ppt, water scavenger beetles (Berosus) have dominated the benthic community at Bahia Grande. Clearly, the restoration of adequate tidal exchange as proposed in this project is paramount to establish the water quality needed to sustain a fishery habitat and fully restore Bahia Grande and its functional estuarine role and contribution to important fish and shellfish species of the Gulf of Mexico. The larger tidal exchange with the Gulf of Mexico will minimize the rise in salinity associated with poor circulation and evaporation and extend favorable salinity conditions beyond the entrance of the pilot channel to support estuarine species in a larger portion of Bahia Grande.



Internal Channels

In order to restore circulation within the Bahia Grande system channel connections between Bahia Grande, Laguna Larga and Little Laguna Madre were constructed by Ocean Trust in 2006-2007 with funding support from private families, local municipalities and power companies, corporate contributions, and federal partners which included NOAA CRP, FWS Texas Coastal Program, and National Fish and Wildlife Foundation. Approximately 50,000 cubic yards of material was removed in creating Channels B2, C1, C2, and D. Channel banks were stabilized with bales of native vegetation.



Main Channel E

The next step in the restoration process is to enlarge and stabilize the pilot channel increasing its top width from 60' to a 225-foot wide "Main Channel" into the Bahia Grande basin from the Brownsville Ship Channel. The channel will be 2,400 feet long built to a depth of -9 feet below MSL with sloping 4:1 banks (H:V) and 150 wide bottom width as illustrated. It will serve as the main channel for tidal exchange between the Laguna Madre via the Brownsville Ship Channel and Bahia Grande. The existing pilot channel only provides a tidal exchange of 2.5% and is not able to mitigate salinity increases from evaporation, a key objective for the survival of plant and animal life. The main channel construction will involve the removal and stabilization of 160,000 cubic yards of material with gradated channel bottom connections to Brownsville Ship Channel and fanned gradation into Bahia Grande. The Main Channel is expected to provide a tidal exchange of 32% of the total water volume into Bahia Grande that will restore its ecosystem functions as a major fish, wildlife and waterfowl nursery and habitat for the South Texas Coast.



"PILOT" CHANNEL
15-FOOT BOTTOM WIDTH, -3 FEET BELOW MEAN SEA LEVEL)
APPROXIMATE COST: \$90,000.00



"MAIN" CHANNEL
150-FOOT BOTTOM WIDTH, -9 FEET BELOW MEAN SEA LEVEL)
APPROXIMATE COST: \$700,000 TO \$1.4 MILLION

Vadia Anche

Vadia Anche is a historic channel in the northeast corner of Little Laguna Madre that will improve tidal circulation into the Bahia Grande system. The existing 3.5 mile channel from the Brownsville Ship Channel to Little Laguna Madre only transports water during storm events. Past storm flood waters carried fish into Little Laguna Madre through the Vadia Anche channel which resulted in massive fish kills

with evaporation and high salinity in this section of Bahia Grande. In 2003, 19,000 red drum were killed with an estimated replacement value of \$800,000 in the Bahia Grande basin, and 500,000 mullet and redfish were lost in the Little Laguna Madre basin as these basins dried up. While the original Vadia Anche channel proposal called for a 30-ft wide channel, trenching to re-establish the original narrow 2-3 foot wide channel at a depth of -2 ft MSL would be consistent with the depth of culverts leading into Little Laguna Madre under SH 48 which are also at -2 ft MSL.



PROPOSED CONNECTING CHANNEL
BROWNSVILLE SHIP CHANNEL TO VADIA ANCHA



Channel F

The construction of Channel F, on the northern end of Bahia Grande will establish fresh water runoff flow into Laguna Larga and help stabilize the extreme salinity conditions in Bahia Grande's Laguna Larga basin to support a wetland community of fish and waterfowl. It involves construction and stabilization of an 8,256' channel and two dikes (3,800' and 5,200') to carry freshwater runoff and control Hwy 100 floodwaters. A Nationwide Corps permit is under review.



Channel Stabilization

In order to support channel stabilization, Ocean Trust and University of Texas at Brownsville (UTB) have an active native plant program. Ocean Trust constructed a field nursery within Bahia Grande, an initial nursery at UTB, and supported the relocation and expansion of the UTB nursery with other sponsors. Activities include propagation and restocking of native grasses and wetland plants in the nurseries for the Bahia Grande restoration. Much of this work is done by volunteers and involves seed collection, propagation in the nurseries, monitoring of nursery plants. Ocean Trust stabilizes channel banks by planting native grasses and plants from the Bahia Grande nurseries. A successful technique used in the internal channel bank stabilization has been the use of chord grass bales cut from local stands within the Laguna Atascosa National Wildlife Refuge. These tasks have been conducted by both contractors and volunteers to help roll out and stake the bales to the channel banks. Natural seed within the bales have been augmented with plants like disticles. Native plant propagation and channel bank stabilization is an ongoing task as new channels are cut and eroded areas are repaired on existing channels.



Shoreline Loma Stabilization

Several additional sites within Bahia Grande need shoreline and upland stabilization with native grasses and wetland plants. These include Heron Island (10 acres, 2,500' shoreline), Bird Island (7 acres, 2,000' shoreline), Bahia Grande Park (2 acres, 1,000' shoreline), and internal channel bank sites washed out from hurricane damage. Native plants will be cultured and planted with shoreline support to restore the most critical areas within these multiple sites. Several sites in Bahia Grande contain barren lomas made up of high salinity soils which are sources of dust that continues to blanket the region. Remediation techniques have been developed to reduce the high salinity profile and allow native vegetation to grow and stabilize the lomas reducing dust and providing new habitat for birds and wildlife. At the Pilot Channel a delta has formed restricting tidal exchange at the entrance of Bahia Grande and severe erosion at the Bahia Grande Hwy 48 interface requires stabilization. Delta spoil needs to be dredged and used to create a wetland along Hwy 48.



Bahia Grande Native Plant Field Nursery

The construction of the main channel will require significant use of native vegetation to stabilize channel banks. Site preparation will also require removal of large sections of wetland plants which could be maintained for site restoration and channel bank stabilization. A field nursery and staging facility may be needed on BND property to maintain plants removed from the main channel construction site and to propagate plants for use in restoration. Ocean Trust will construct and maintain the field nursery during the construction of the main channel between Bahia Grande and the Brownsville Ship Channel.

Channel Crossings

The construction of single span crossings at channel B2 and C1 are needed to maintain access within the Laguna Atascosa refuge and allow unobstructed water exchange between the three main basins within Bahia Grande. The Paso Corvinas channel culverts were displaced by recent storm events. A permanent low water crossing with articulated concrete mats is needed for access into the refuge and to maintain tidal exchange in the basins.



Environmental Monitoring

The monitoring and assessment program carried out by a consortium of South Texas Universities will gauge the biological response to physical restorations allowing for adaptive management of the restoration project. Objectives include 1) monitoring the physiochemical parameters of water column habitats; 2) documenting the redevelopment of the biological community; 3) monitoring sediment dynamics (biogeochemical cycling); and 4) organizing the physical and biological assessments into GIS layers for analysis of spatial and temporal dynamics,



thereby elucidating trophic linkages and ecological processes that contribute to system productivity. System-level function will be further assessed through measures of community metabolism. Equipment needs include three water/environmental quality monitoring stations, acoustic Doppler velocity meter, and consumables associated with field equipment, maintenance parts, and small equipment items.

Channel Maintenance

One of the tasks to be conducted under this proposal is to address channel monitoring and maintenance. Channel design will incorporate features of the San Martine channel between the Brownsville Ship Channel and San Martin Lake. The San Martin channel was constructed fifty years ago and has not required any maintenance due to its hydrologic characteristics and the presence of mangrove plants which stabilize the banks. The 2004 hydrologic study conducted by H&H Resources concluded the maximum flow rates associated with the proposed Bahia Grande main channel will be below 4030 cfs with velocities below 2.3 ft/sec based on normal tidal cycles and are not expected to cause erosion of the main channel banks. Native plants will be planted during at least two planting cycles and add additional stability to the channel. The channel will be monitored with flow meters. Any required maintenance will be conducted through a partnership established as a part of this project with local, state and federal entities.

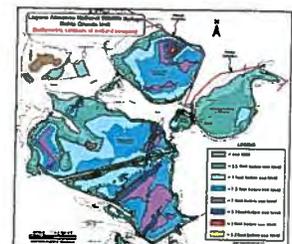
Public Access Park & CCP

Since Bahia Grande is part of the Laguna Atascosa National Wildlife Refuge, the US Fish & Wildlife Service is formulating a Comprehensive Conservation Plan (CCP) that will serve as a management tool to be used by refuge in the overall conservation, development, and restoration of the ecosystem's natural resources. In accordance with the National Wildlife Refuge System Improvement Act of 1997, wildlife has first priority in the management of refuges. In terms of public access, wildlife-dependent recreation involving compatible hunting, fishing, wildlife observation and photography, environmental education and interpretation are also designated as priority public uses. To enhance public education on Bahia Grande and provide an educational venue on the importance of coastal natural resources, Texas Department of Transportation also constructed a parking and pull off area for the Bahia Grande Education and Recreation Access Park along Highway 48 just north of the main channel site. The park still needs expanded parking for school buses and planned educational facilities such as a covered wildlife observation deck, educational kiosks, kayak launch, and trail connecting the two acre track of land. Extensive shoreline stabilization is needed to protect the site from further erosion.



Bathymetry & Navigability

While activities such as kayaking and canoeing are envisioned, the average water depth in Bahia Grande is between 1-2 feet and will restrict boating activities. No motorized boating is envisioned for the shallow-water estuary. Furthermore, in August 1989 the Texas Legislature passed Senate Bill 28 which prevents Bahia Grande from becoming a public waterway and a state navigable water.

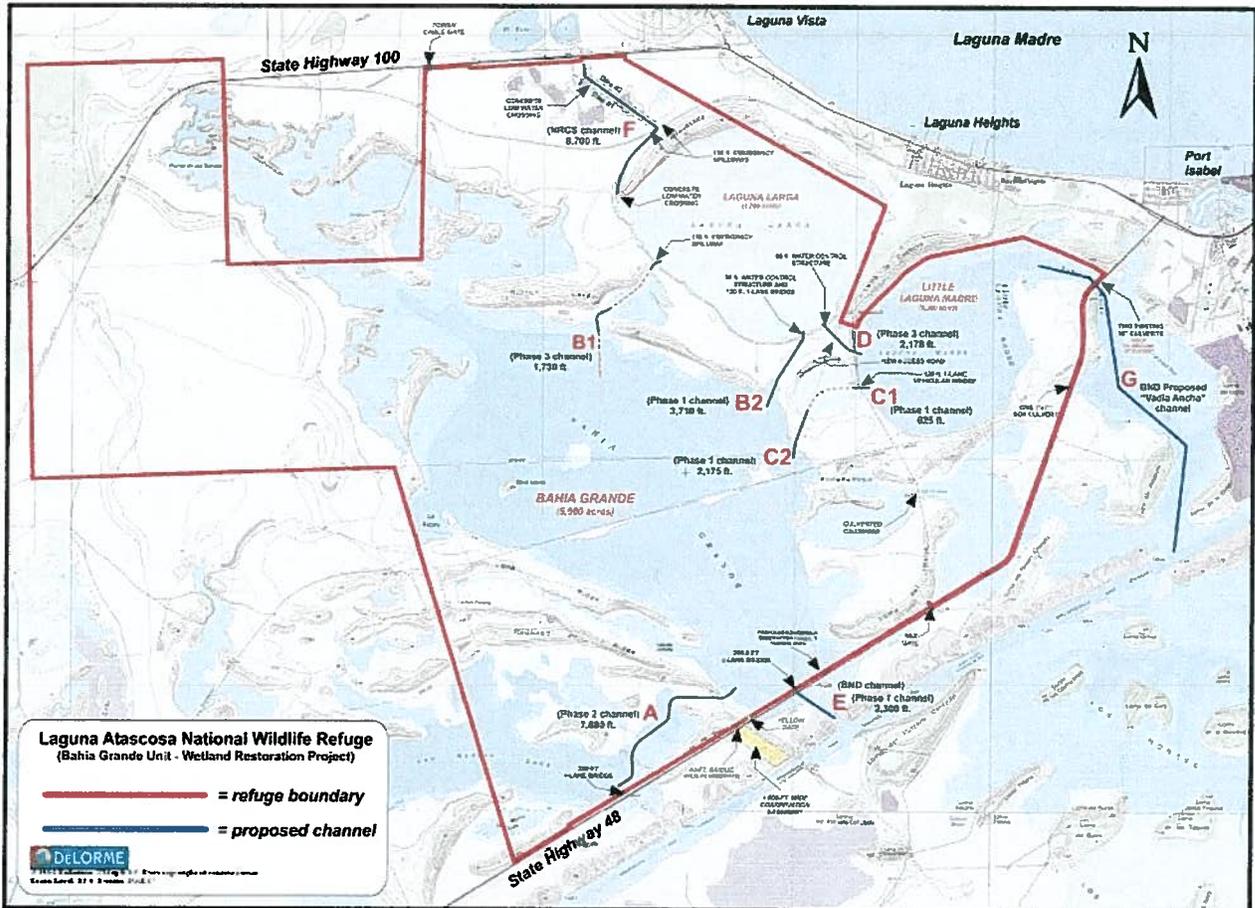


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Bahia Grande Project Map



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