



July 23, 2004

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Mr. Shane Hunt
Planning Branch, CESWG-PE-P
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77551

Re: Greens Bayou Federal Flood Control Project
Results of Recent Site Visit

Dear Mr. Hunt:

Texas Parks and Wildlife Department staff attended a site visit on May 21, 2004 for the Greens Bayou Federal Flood Control Project proposed detention basin and channel improvement. The new channel will have a 60' wide bottom with a meandering pilot channel and side shelves. The 108-acre detention basin will be excavated from a site adjacent to Greens Bayou that currently consists of prairie and forest south of the Bayou, north of Beltway 8 and east of Antoine. ENTRIX, an environmental consulting company, performed an environmental assessment of the project area that indicates that 14.72 acres of wetland occur on the site. A subdivision forms the site's eastern boundary. Greens Road cuts west to east across the detention site. The project is located north of Beltway 8 and east of Antoine in northern Harris County, Texas.

PROJECT AREA DESCRIPTION

TPWD staff visited the site to assess project impacts on State fish and wildlife populations. The site has not been land leveled for agriculture, therefore Pleistocene topographic features including prominent river channel scars and neighboring wind-deflated basins (circular blow-outs in loamy soils) are abundant. The wetlands occur within these depressional features. Infrared, digital, orthoquads from 1995 overflights of this site show the identified wetlands and their boundaries as were generally verified by the site visit with the exception of what appears to be unidentified wetland on the southern end of the site. The remainder of the site consists of upland prairie and young pine/hardwood forest.



Take a kid
hunting or fishing



Visit a state park
or historic site

The site is located near the historic coastal plain boundary of forest and prairie and in the absence of disturbing agents such as fire or mowing, a forest canopy has developed over most of the site's wetlands. The introduction of Chinese tallow (*Sapium sebiferum*), a prairie invader species, has accelerated the growth of this canopy. A prominent channel scar that lies parallel with and partially borders Greens Bayou contains a diverse, young swamp composed of sweet gum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), sugarberry (*Celtis laevigata*), and persimmon (*Diospyros virginiana*). The understory and ground cover consisted of a diverse mix of vines, shrubs and herbs such as rattan vine (*Berchemia scandens*), wax myrtle (*Myrica cerifera*), soft rush (*Juncus effuses*), smartweed (*Polygonum* spp.), arrowhead (*Sagittaria* spp.) and beak rush (*Rhynchospora* spp.). Maximum water depth was approximately 12", though a stock pond excavated out of a portion of the wetland contained permanent water that was several feet deep. Two circular depressions visited were shallower and dominated by grass-like plants such as beak rushes, spike rushes (*Eleocharis* spp.), bushy beard bluestem (*Andropogon glomeratus*), gulf coast cordgrass (*Spartina spartinae*), and young green ash. Chinese tallow was common in all depressional wetland areas. The upland matrix surrounding the wetlands is composed of little bluestem prairie that has been degraded by past overgrazing, but is still dominated by native prairie grasses and herbs.

Greens Bayou has been previously channelized through the project area. The flat-bottomed channel contains a narrow, meandering pilot channel with a higher shelf that is frequently inundated and is a mix of weed-dominated upland and emergent wetland. The Bayou contains permanently flowing water, which during dry periods consists largely of urban effluents. Water quality in Greens Bayou is currently impaired (Section 303d of the Clean Water Act) and does not support its designated aquatic life use category. Problems include the leakage of sewage from sanitary sewers into storm water drainpipes and non-point pollution contained in upland runoff.

Wildlife observed on site included red-shouldered hawk, white-eyed vireo, cardinal, and tufted titmouse. The wetlands and associated upland prairie and forest support habitat for many other species of wildlife. These include waterfowl such as wood ducks and wading birds such as great egrets, great blue herons, white ibis, little blue herons, snowy egrets and green herons. Hawks that commonly occur in the open field habitat found on the site include red-tailed and marsh hawks. Shorebirds such as snipe use the shallower, grass-dominated wetlands found on the site. Mammals that use the site's habitat include white-tailed deer, raccoon, opossum, coyote and others. Turtles of an unknown species were observed in the pond habitat that occupied the deepest wetland. Alligators and nutria may also occupy this habitat. Snakes such as the ribbon snake, cottonmouth, and water snake commonly occur in this type of wetlands and adjacent uplands. The presence of fishing bobbers indicates that the pond likely contains a population of pan fish, catfish and perhaps large-mouth bass.

The wetlands to be affected by this project vary in quality. They include highly disturbed wetlands such as the one lying adjacent to Antoine and Greens Bayou that appears to

have been cleared and modified during construction of Antoine; as well as high quality wetlands such as those occupying the channel scar paralleling Greens Bayou and the circular basin in the northeast quadrant of the future detention area. The project proposes to excavate a majority of the uplands and wetlands currently on the future detention basin site. The remaining wetlands will be filled or otherwise highly disturbed. Approximately 14.5 acres of wetland will be created within the basin to offset these losses by excavating approximately one-foot below the proposed bottom in certain locations. Native trees and shrubs will be sparsely planted within the basin and along the new channel's slopes to compensate for upland habitat losses.

DEPARTMENT COMMENTS AND RECOMMENDATIONS

Texas Parks and Wildlife staff have several concerns with the proposed federal project in regards to uncompensated losses of fish and wildlife habitat and missed opportunities to improve the water quality of Greens Bayou.

1. Wetland losses need to be fully accounted for and compensated by a greater than one for one acreage ratio through restoration or creation of other wetlands in the detention basin and channel bottom including wetlands removed from CWA jurisdiction by 100-year floodplain reduction.
2. The existing poor water quality of Greens Bayou should be improved by incorporating wetlands into the channel bottom where it will be subject to inundation by normal channel flows.
3. Upland habitat losses should be compensated for through the development of an upland habitat creation and maintenance plan that uses native grasses, trees and shrubs for project lands.

FULL ACCOUNTING AND COMPENSATION FOR WETLAND LOSSES

The facilitated loss of wetlands by floodplain reduction and subsequent reclassification of Clean Water Act (CWA) jurisdictional status needs to be considered as a secondary impact. A quick review of aerial photography was used to conservatively estimate that 100-200 acres of wetlands occur within the 100-year floodplain of Greens Bayou. A reduction in the extent of the floodplain will remove some of these wetlands from CWA jurisdiction. Areas removed from jurisdiction are likely to be filled in the foreseeable future given this region's rapid development. The loss of these wetlands will further degrade the water quality of Greens Bayou, eliminate additional fish and wildlife habitat and exacerbate the flooding situation. It is recommended that the USACE determine the acreage of wetlands to be removed from the 100-year floodplain by the project and develop a plan to suitably compensate for their anticipated loss.

There appears to be a shallow but large wetland within the proposed detention basin south of Greens Road that lies in an area not represented by an ENTRIX sample point. It lies just northwest of sample pit 24 as shown in Figure 5 of the ENTRIX report. This area should be revisited to determine if it contains wetland characteristics. A joint

agency site visit is recommended to quickly assess the area and determine if further review by USACE staff or consultants is warranted.

Detailed plans to offset wetland loss with creation have not yet been presented to the Texas Parks and Wildlife Department for review; however, the creation of wetlands in the bottoms of detention basins as proposed is fraught with challenges. Most such wetlands fail to support diverse native wetland plant communities or wildlife populations. Typically, monotypic stands of cattail (*Typha* spp.) or willow (*Salix* spp.) develop and prevent establishment of native vegetation. This occurs because created wetlands are often flooded too long, are subject to heavy sedimentation, and have a bare substrate after construction that facilitates germination of these light-seeded species. These shortcomings can be somewhat remediated by salvaging topsoil from impacted wetlands for use in the created wetlands and by careful design to produce a desirable hydrology. A greater than 1 for 1 ratio of destroyed to created wetlands anticipates the lower function of the created wetlands and partially offsets it. It is recommended that the USACE further coordinate with the Texas Parks and Wildlife Department to ensure wetland creation plans fully compensate for anticipated wetland losses.

WATER QUALITY IMPROVEMENT OF GREENS BAYOU

Project plans should include measures that will significantly improve the water quality of Greens Bayou. The current plan includes wetlands only within the proposed Greens Road detention basin that will receive water from the Bayou during high flow events. The pollutant removal, transformation or sequestration function of the wetlands will be least efficient during high flow events due to the relatively low residence time of the water within the wetland, the large volume of water to be treated, and the dispersed nature of the pollutants during flood events.

Low flows of the Bayou, which maybe entirely comprised of pollutant containing waters such as sewage treatment plant effluent, street runoff and untreated sewage leaking from sanitary sewers into stormwater sewers, are those that are the most efficiently improved by wetlands due to their low volumes and high concentration of pollutants. It is recommended that wetlands be constructed in a location that will allow them to contact and treat normal Bayou flows. They should be constructed on low shelves along the meandering pilot channel and those to be constructed in the detention basin should be designed to receive normal flows of the Bayou.

UPLAND HABITAT MITIGATION

The current project proposes to use native plants in landscaping, but does not provide a comprehensive plan for upland prairie and forest mitigation. Replacement of upland habitats require more than the use of native plants on project lands. The Department recommends that a plan be developed that outlines goals and methods for the creation or restoration and management of upland wildlife habitats.

Mr. Shane Hunt
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Please feel free to contact Andrew Sipocz at the Coastal Conservation office in Dickinson at (281) 534-0136 if you have questions or would like to discuss this further.

Sincerely,



for
Robert Spain
Branch Chief, Coastal Fisheries Habitat Resources

cc: Glenn Laird, HCFCD
Phil Glass, USFWS



REPLY TO
ATTENTION OF

Environmental Section

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

December 27, 2004

Robert Spain
Branch Chief, Coastal Fisheries Habitat Resources
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744-3291

Dear Mr. Spain:

Reference is made to your correspondence dated July 23, 2004 concerning the Greens Bayou Federal Flood Control Project. Your letter documents a field visit by Texas Parks and Wildlife Department (TPWD) on May 21, 2004, and provides observations, information, comments, and recommendations for the project. We will address your comments and recommendations in the order presented in your letter.

PROJECT AREA DESCRIPTION

Your letter describes an area that appears to be a wetland area based on aerial photography from 1995 at the proposed detention basin site that was not delineated as a wetland area during project evaluation. A wetland delineation of the detention site was performed by ENTRIX for the Harris County Flood Control District and was verified by the U.S. Army Corps of Engineers, Galveston District, Compliance Section in January of 2004 (Determination #15045). The delineation and verification showed that there are 14.72 acres of wetlands present, which is the figure we have used to develop mitigation for this project, as described below.

In regard to wildlife use of the site, it should be noted that the detention basin site is located in an unincorporated area of Harris County in close proximity to the city limits of Houston (less than 2 miles) and the North Sam Houston Parkway (less than 1/8th of a mile). Commercial and residential development nearly surrounds the site, severely limiting its habitat value, especially for several of the larger species of wildlife mentioned in your letter including alligators, white-tailed deer, and coyote. In addition, there have been no indications that the ponded area mentioned in your letter contains populations of game fish. The pond is a little over half an acre in size and estimated to be no more than 3 feet deep, which is generally considered too small and shallow to provide habitat for the catfish and large mouth bass mentioned in your letter.

DEPARTMENT COMMENTS AND RECOMMENDATIONS

The current project mitigation plan (see Enclosure) calls for the creation of 12.1 acres of wetlands within the proposed detention basin and 4.2 acres of wetlands within the channelized area of Greens Bayou for a total of 16.3 acres of wetland creation. The creation of 16.3 acres to

replace the 14.72 acres of degraded wetlands that will be impacted by the project provides a mitigation ratio slightly greater than 1:1. The mitigation plan was developed using the Habitat Evaluation Procedures (HEP) for three aquatic species. The models used for the analysis were the U.S. Fish and Wildlife Service (USFWS) Habitat Suitability Index (HSI) models for the bullfrog (*Rana catesbeiana*), snapping turtle (*Chelydra serpentina*), and the great egret (*Casmerodius albus*) feeding model. The HSI values were averaged over the life of the project (50 years) for each species and then multiplied by the appropriate acreages to determine Average Annual Habitat Unit (AAHU) values. These values for the three species were averaged for the existing wetlands (No Action) and the mitigation alternatives to provide overall AAHU values. The analysis showed that the project would impact 10.33 AAHU. The proposed mitigation plan would create 11.21 AAHU to mitigate impacts to the 10.33 AAHU that would continue to exist under the No Action alternative. Some of the existing wetland areas we are mitigating have been previously disturbed by past construction activities, while the majority have also been degraded by the introduction of invasive species and past channelization along the bayou. During past channelization it appears that material was side-cast on the top bank creating a small berm that limits water exchange between the existing wetland areas and the bayou. Given the degraded nature of the impacted wetlands, we believe that this is a reasonable mitigation proposal that satisfies both your request based on acreage replacement and our requirement to base mitigation on biological productivity.

Excavation of the 12.1 acres of wetland areas within the basin will be of varying elevations below the proposed basin bottom, ranging between approximately 6 inches and 2 feet below grade. The current plan calls for planting the following native species in the wetland areas: sweetflag, meadow foxtail, sedge (*Carex* sp.), white-top sedge, spikerush, lovegrass, half-bred-leaf rosemallow, spider lily, soft rush, cardinal flower, maiden-cane, switch grass, beakrush, arrowhead, American bulrush, *Spartina alterniflora*, *Spartina patens*, and bald cypress. By adding 4.2 acres of the wetland mitigation to the channelized area, benefits to water quality are expected for the bayou during normal flows as described below. In addition, water is expected to exchange between the detention basin and the main channel more frequently than the 100 percent annual exceedance probability event (1-year flood).

FULL ACCOUNTING AND COMPENSATION

Accurate, current land use data that could be used to quantify the amount of wetland habitat that would be removed from the 1 percent annual exceedance (100-year) floodplain of Greens Bayou is not available. Using aerial photography from 1995 as a basis, wetland areas in the floodplain are generally downstream of the project footprint. Based on the size of the project and projected water surface profiles calculated for a 1 percent annual exceedance probability event, the average decrease in water surface profiles downstream of the project is 2.15 inches, with a maximum decrease at any one station of 10.08 inches. This decrease in water surface profiles is not expected to be great enough to remove wetland areas from Clean Water Act jurisdiction. As such, so no further mitigation will be developed to compensate for secondary impacts since no secondary impacts to wetlands can be demonstrated for this project.

It is understood that the existing water quality of Greens Bayou is affected by numerous sources as mentioned in your letter that are unrelated to the proposed project. The proposed project is not expected to negatively impact water quality. The current mitigation plan calls a 5-foot wide wetland area created along both sides of the pilot channel for the entire length of the channelization (3.7 miles), creating a total of 4.2 acres of wetlands along the pilot channel. These wetlands are expected to improve the water quality of Greens Bayou during lower flow periods. In this project area, the gentle gradient of the bayou makes it impractical from an engineering standpoint to carry the base flows of the bayou through the detention basin wetland areas. Exchange between the basin and the channel is expected to occur at storm events more frequent than the 100 percent annual exceedance probability event.

No mitigation of upland prairie and forest habitats is proposed for this project. The existing habitat in the proposed detention basin has minimal wildlife habitat value because of its fragmented, highly urbanized setting and the presence of many non-native invasives including Chinese tallow. Although we do not propose to mitigate the existing upland habitats at this site, the proposed project includes environmental features of the previously authorized Greens Bayou project that were carried forward into the current plan. The environmental features of the project include vegetating the upland areas within the basin with native trees and shrubs at a density of approximately 50 trees and 60 shrubs per acre, which are over-planted 20 to 25 percent to compensate for plants that do not survive to maturity. Native tree and shrub species to be planted include: American beautyberry, water hickory, roughleaf dogwood, parsleyleaf hawthorn, yaupon holly, sweetgum, wax myrtle, Mexican plum, water oak, and willow oak. Grasses to be planted on the side slopes of the basin typically include a blend of bermuda grass, side oats grama, and crimson clover. Upland areas within the basin will be planted with native vegetation including little bluestem, brownseed paspalum, switch grass, beaked panicum, Virginia wildrye, green sprangletop, and Florida paspalum. It is our conclusion that through the environmental features described above and maintenance to control the presence of invasives, the habitat value of the basin with the project in place will be an improvement over its existing condition.

Detailed plans for the wetland mitigation areas, the upland plantings, and maintenance of these areas have not been developed. The conceptual plans described here will be refined and finalized during the plans and specifications phase of the project. During the plans and specification phase, comments and recommendations from TPWD and USFWS will be requested to assist us in effective project implementation of these features.

In conclusion, we will develop 16.3 acres of wetlands to mitigate the loss of 14.7 acres of marginal wetlands impacted by detention basin construction. A total of 4.2 acres of the 12.1 acres of created wetlands will be constructed along the pilot channel within Greens Bayou which will improve water quality of the bayou and provide habitat. Upon completion, the detention basin will be revegetated with native plants and grasses and maintained to insure their success. The resulting detention basin will provide a 108-acre island of improved wetlands and wildlife habitat that would otherwise be lost in this highly developed urban setting.

If you have any question regarding this letter please contact Mr. Shane Hunt, Environmental Section, US Army Corps of Engineers, P.O. Box 1229, Galveston, TX 77553.

Sincerely,



for

Carolyn Murphy

Chief, Environmental Section

Enclosures

Copy Furnished:

Phil Glass
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058

Glen Laird
Harris County Flood Control District
9900 Northwest Freeway
Houston, TX 77092

HEP Evaluation and CE/ICA for Project Mitigation

Introduction

A mitigation plan for the proposed Greens Bayou project's impacts to 14.72 acres of wetlands was developed by utilizing Habitat Evaluation Procedures (HEP) for selected aquatic species.

In order to evaluate the impacts to wildlife from the resulting land use changes, it was determined that Habitat Suitability Index (HSI) models would be used in the HEP analysis. The models are based on the assumption that there is a positive relationship between the HSI and habitat carrying capacity and that habitat suitability can be summarized as scale, ranging from 0.0 to 1.0 (U.S. Fish and Wildlife Service, 1981). Due to the frequently qualitative nature of existing data and the amount of available quantitative habitat information, the HSI models vary in generality and precision. The value given by an HSI model serves to improve decision making and increase understanding of habitat relationships.

Multiple mitigation measures were developed and evaluated in the HEP analysis in order to determine which measure or combination of measures would provide full impact mitigation in a cost effective and incrementally justified manner by using IWR-Plan software. Table 1 presents the 8 mitigation measures and costs developed for the analysis.

Table 1. Mitigation measures developed for the HEP analysis.

Measure Symbol	Measure Abbreviation	Measure Description	Cost *
	No Action	The Green Bayou project would not be constructed.	
A	4.2 Ch	4.2 acres of wetland creation 5 feet wide on both sides to the Greens Bayou channel pilot channel for the length of the channel improvements (3.7 miles).	\$67,842.60
B	1.1 Ba	1.1 acres of wetland creation within the detention basin area.	\$17,768.30
C	1.2 Ba	1.2 acres of wetland creation within the detention basin area.	\$19,383.60
D	2.3 Ba	2.3 acres of wetland creation within the detention basin area.	\$37,151.90
E	2.6 Ba	2.6 acres of wetland creation within the detention basin area.	\$41,997.80
F	3.0 Ba	3.0 acres of wetland creation within the detention basin area.	\$48,459.00
G	5.3 Ba	5.3 acres of wetland creation within the detention basin area.	\$85,610.90

* Cost for each measure only includes estimated initial planting costs, and operation and maintenance costs for the 50 year life of the project.

For the analysis each measure is considered as a stand alone mitigation alternative and measures are combined with one another to create numerous other mitigation alternatives with the exception of the No Action measure. Under the No Action measure or

alternative no mitigation would occur. The measures considered for the mitigation plan included the No Action, one wetland creation measure adjacent to the pilot channel of Greens Bayou, and seven measures of various sizes of wetland creation within the detention basin. The channel measure (A) is comprised of 4.2 acres of wetland creation along the sides of the meandering pilot channel for the length of the channel improvements (3.7 miles). Measures B through G are comprised of wetland areas of differing sizes that can be built within the detention basin. The sizes of measures B through G represent acreages that can be built individually or combined with one another based on the proposed detention basin configuration considering engineering and hydrologic concerns.

HEP Methods

The species selected for the HEP analysis were selected as representatives of the range of wildlife that could potentially utilize the existing wetlands and the proposed mitigation wetlands. The criteria used to determine the species selected for the analysis were limited to those with existing Habitat Suitability Index (HSI) models and parameters such as vegetation, climate, and water regime consistent with the study area. Based on site visits by Texas Parks and Wildlife (TPWD), U. S. Army Corps of Engineers (USACE), and PBS&J biologists it was decided that HSI models would be performed on the *Casmerodius albus* (Great Egret), *Rana catesbeiana* (Bullfrog), and *Chelydra serpentine* (Snapping Turtle) as shown in Table 2.

Table 2. FWS documentation for the HSI models used in the HEP analysis.

Title	Reference	Date
Great Egret	FWS/OBS-82/10.78	September 1984
Bullfrog	Biological Report 82(10.138)	June 1987
Snapping Turtle	Biological Report 82(10.141)	June 1987

For the great egret there are separate HSI models for feeding and nesting. Since the habitat being impacted would function as feeding habitat as opposed to nesting habitat, the feeding HSI model was used in the analysis.

The bullfrog and snapping turtle models base habitat values on factors such as water depth and vegetation that are relevant to the habitat being impacted and the mitigation measures ability to provide mitigation for the value of the habitat being impacted. When the outputs from the three models are combined they represent a diverse range of the types of wildlife that are expected to utilize both the existing wetlands and the wetlands created for mitigation.

An Excel spreadsheet was set up for each HSI model. Model parameters and assumptions for the bullfrog, great egret, and snapping turtle models are shown in Tables 3, 4, and 5 respectively. Many factors affect the amount of time required for a created wetland to become fully functional. According to the U.S. Department of Agriculture

Conservation Service, a wetland develops rapidly but is not fully functional the first five years following wetland creation (USDA, 1992). We conservatively assumed that the Greens Bayou wetland mitigation areas would be fully functional by Year 9.

Table 3. Assumptions for the Variables for the Bullfrog HSI Model.

Variable	Assumptions
V1 - mean distance from shore to water >1.5 m (4.9 ft) deep	It was determined that none of the water was > 1.5 m deep, leading to an HSI of 0.5 for all measures.
V2 - percent canopy cover of aquatic vegetation in the littoral zone	Since aquatic vegetation will be planted, it was assumed that there would be 25% cover immediately after project construction. Therefore, Year 1 was assigned a value of 0.25 and increased by one-eighth until Year 9, at which time it was assumed there would be optimal cover. The No Action was assumed to have optimal cover.
V3 - percent shoreline cover	Since trees and shrubs will be planted, it was assumed that V3 would equal 0.5 immediately after project construction. Therefore, Year 1 was assigned a value of 0.5 and increased by one-eighth until Year 9; existing conditions are 100% cover.
V4 - mean water transparency	V4 was assumed to equal 0.7 for all measures.
V5 - winter water depth	V5 was assumed to equal 1 for all measures.
V6 - percent silt substrate	The No Action was estimated to be a 0.9, while measure A was assumed to have an ultimate lower value (0.8), starting at 0.4. Measures B-G were assumed to reach an ultimate value equal to the No Action, starting at 0.45.
V7 - mean current velocity at mid-depth during summer in cm/s (centimeters per second)	V7 was assumed to equal 1 for all measures.
V8 - water pH	V8 was assumed to equal 1 for all measures.
V9 - mean water temperature at mid-depth during summer (°C)	V9 was assumed to equal 1 for all measures.
V10 - frequency of water level fluctuations >2m	V10 was assumed to equal 1 for all measures.
V11 - distance to permanent water (m)	V11 was assumed to have a value of 1 for all measures.

Table 4. Assumptions for the Variables for the Great Egret Feeding HSI Model.

Variable	Assumptions
V1 - percent of area with water 10 -23 cm deep	Estimated to be slightly over 50% for measure A and approximately 33% for measures B-G.
V2 - percentage of submerged or emergent vegetation cover in zone 10 - 23 cm deep	All areas were assumed to be in the optimum range between 40 and 60% so all measures were assessed a 1.0.

Table 5. Assumptions for the Variables for the Snapping Turtle HSI Model.

Variable	Assumptions
V1 - mean water temperature at mid-depth during the summer (°C)	Assumed to be in the optimum range between 25 and 32 °C for all measures and the No Action.
V2 - mean current velocity at mid-depth during summer (cm/s)	Zero for the No Action and measures B-G, assumed 25 cm/s for measure A.
V3 - percent canopy cover of aquatic vegetation in the littoral zone	Assumed 50% cover for No Action and an end result of 50% for measures A-G.
V4 - winter cover component	All measures assigned a 1 based on the assumption that the winter water depth is greater than the maximum ice depth.
V5 - percent silt substrate	The No Action was estimated to be a 0.9, while measure A was assumed to have an ultimate lower value (0.8), starting at 0.4. Measures B-G were assumed to reach an ultimate value equal to existing conditions, starting a 0.45.
V6 - distance to small stream (km)	>5 km for all measures and the No Action.
V7 - Distance to permanent water (km)	Measure A and No Action were assumed to be permanent water. Measures B-G were estimated to be less than 1 km permanent water.

Using the HSI values computed and averaged over the 50 year project life for the existing condition (no action), the proposed mitigation measures were multiplied by their respective area in acres generating Average Annual Habitat Unit (AAHU) values. The AAHU values created a common metric to allow impacts and benefits to be quantified and compared across the measures and alternatives. The AAHU values for the 3 species were averaged for each measure. Table 6 presents the AAHU calculated by species and the overall average for the three species that is referred to as the Community AAHU value.

Table 6. AAHUs for the Potential Mitigation Measures (Three species averaged).

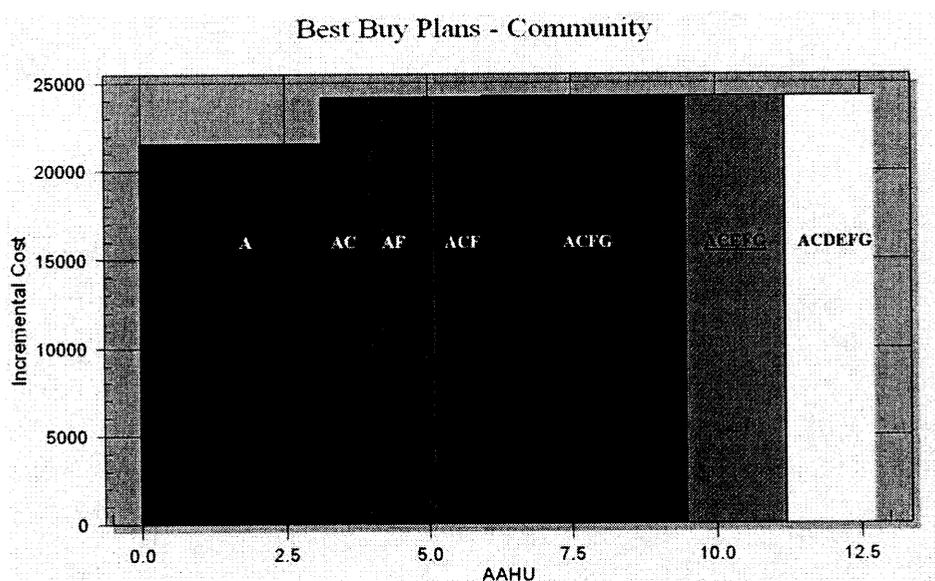
Description	No Action	4.2 Ch	1.1 Ba	1.2 Ba	2.3 Ba	2.6 Ba	3 Ba	5.3 Ba
Measure		A	B	C	D	E	F	G
Bullfrog	10.55	3.52	0.77	0.84	1.6	1.81	2.09	3.7
Snapping Turtle	9.4	2.66	0.7	0.76	1.46	1.65	1.9	3.36
Great Egret	11.04	3.276	0.7315	0.798	1.5295	1.729	1.995	3.5245
Community AAHU	10.33	3.15	0.73	0.80	1.53	1.73	2.00	3.53

Cost Effectiveness/Incremental Cost (CE/ICA) Analysis Methods

A CE/ICA analysis was performed to identify the least cost solution for each possible level of environmental output (AAHU) and to identify large increases in costs relative to outputs using IWR-Plan software version 3.33.

The Community AAHU values from Table 6 and costs from Table 1 for each measure were entered in the IWR-Plan software to generate mitigation alternatives and complete the CE/ICA analysis on the alternatives. The software identifies combinations of mitigation measures that produce alternatives that are cost effective and incrementally justified, known as Best Buy Plans or Best Buy Alternatives.

Figure 1. Cost Effective and Incrementally Justified Mitigation Alternatives Generated Using IWR-Plan Software for Measures A-G.



Incremental costs shown in dollars. The recommended Best Buy Plan is underlined.

Table 7. Costs and Outputs for the Best Buy Plans.

Alternative	Incremental Cost	Incremental Output	Incremental Cost Per Output	Total Output	Total Cost
No Action	\$0.00	0.00	\$0.00	0.00	\$0.00
A	\$67,842.60	3.15	\$21,537.33	3.15	\$67,842.60
AC	\$19,383.60	0.80	\$24,229.50	3.95	\$87,226.20
AF	\$29,075.40	1.20	\$24,229.50	5.15	\$116,301.60
ACF	\$19,383.60	0.80	\$24,229.50	5.95	\$135,685.20
ACFG	\$85,610.90	3.53	\$24,252.38	9.48	\$221,296.10
ACEFG	\$41,997.80	1.73	\$24,276.19	11.21	\$263,293.90
ACDEFG	\$37,151.90	1.53	\$24,282.29	12.74	\$300,445.80

Recommended Best Buy Plan shown in bold lettering.

The recommended mitigation alternative must provide an AAHU value greater than or equal to the 10.33 AAHUs that would exist under the No Action alternative. To allow some flexibility in the combination of measures without generating plans that would be unnecessarily large, a constraint was placed limiting the IWR-Plan software from combining measures that created an AAHU value higher than 13 since a value of 10.33 AAHUs would be sufficient to mitigate project impacts. Given the identified measures and the constraint of a maximum AAHU value of 13, the IWR-Plan software identified 127 different combinations of which 81 were cost effective and 8 were Best Buy Plans as shown in Figure 1. Table 7 shows the incremental cost, incremental output, incremental cost per output, total output, and total cost for each of the Best Buy Plans. Figure 1 and Table 7 both identify the alternatives by the measure or combination of measures that comprise the Best Buy Plans shown in Table 1.

The smallest Best Buy Plan with an AAHU value that met or exceeded the No Action AAHU value of 10.33 is the combination of measures A, C, E, F, and G, which provides 11.21 AAHUs by creating 4.2 acres of wetlands along the sides of the Greens Bayou pilot channel for the length of the channel improvements and 12.1 acres of wetlands within the detention basin at a total cost of \$263,293.30. This combination of measures A, C, E, F, and G is therefore the recommended mitigation alternative since it provides full project mitigation and is both cost effective and incrementally justified. It additionally satisfies the request of TPWD that wetland mitigation be greater than 1:1 based strictly an acre per acre replacement.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882



January 13, 2004

Colonel Leonard D. Waterworth
Attn: Chief, Environmental Branch
US Army Corps of Engineers
PO Box 1229
Galveston, TX 77553-1229

Dear Colonel Waterworth:

This planning aid letter is for the purpose of finalizing U.S. Fish and Wildlife Service (Service) comments and recommendations regarding Greens Bayou, Houston, Texas Flood Damage Reduction Project. The Service has previously submitted a Fish and Wildlife Coordination Act Report (August 1987) for Buffalo Bayou and Tributaries, Texas, Feasibility Report, Flood Damage Prevention Project, the larger project from which Greens Bayou has been separated; and a Planning Aid Letter (November 1998) for the Greens Bayou Project. The present letter addresses changes to the Greens Bayou Project since November 1998. Due to the reduced scope of the current project and the urban nature of the watershed, the Service will not submit a Fish and Wildlife Coordination Act Report on this project.

Primary project features now proposed in the *Draft General Reevaluation Report, Greens Bayou at Houston, Texas, Flood Damage Prevention* (in prep.) are:

- 1) channel modifications of the bayou from just upstream of Veteran's Memorial Drive to downstream of Cutten Road, within existing ROW limits only, to a maximum bottom width of 60 ft,
- 2) three (3) potential disposal sites totaling 430 ac at varying distances from the bayou and entirely within improved pasture or fallow farmland,
- 3) two (2) detention basin cells totaling 138 ac separated by West Green's Road, south of Veteran's Memorial Road bridge, to be developed as a recreational park and planted with (primarily native) bushes, trees, and grasses.

Buyout plans for streamside developments from the Green's Bayou mouth to Garner Bayou were considered but benefits were determined to not exceed buyout costs. The Service is disappointed that this buyout feature was not justified. Numerous recent studies have shown that urban buyout plans in flood-prone areas within metropolitan areas have produced great benefits in terms of water quality protection, flood damage reduction, and urban recreation; in addition to provide islands of native fish and wildlife habitat for city-dwellers to enjoy. The Service would like to participate in analyses of urban wildlife habitat benefits for future Galveston District flood control projects.

**TAKE PRIDE[®]
IN AMERICA** 

Colonel Leonard D. Waterworth
Attn: Chief, Environmental Branch
January 13, 2004
Page 2

The Service endorses the plan to plant predominantly native trees, shrubs, and grasses within the detention sites and would like to participate in species and site selection.

Presently, native fish and wildlife values within the two proposed detention basin cells and three potential disposal sites are limited due to the cleared, urban nature of the project area. Providing channel widening operations are confined to a 60-ft bottom width or less and are entirely within the currently cleared right-of-way, losses to resident native fisheries and riparian habitat should also be minimal.

Federally-listed threatened and endangered species which may occur in Harris County at the project site and which the Service furnished the Galveston District by letter dated September 17, 2003 are the Texas prairie dawn-flower *Hymenoxys texana* and the bald eagle *Haliaeetus leucocephalus*. The Galveston District should provide information on the potential impacts of the proposed project on these listed species to the Service concurrent with publication of the Re-evaluation Report and prior to irreversible commitment of resources.

Thank you for the opportunity to participate in the planning process for this urban flood control project. The rate of urban development in the Houston Metropolitan area has covered many thousands of acres of native prairie, wetlands, and bottomland forest, all productive and declining native wildlife habitat types, within the past 20 years. It is important that flood control projects such as Green's Bayou Flood Damage Reduction Project maximize opportunities to reverse this trend whenever possible.

Please inform me or Phil Glass at 281-286-8282 should there be any significant change in project plans.

Sincerely,



Carlos H. Mendoza
Field Supervisor, Clear Lake ES Field Office

Advisory
Council On
Historic
Preservation

1522 K Street NW.
Washington D.C.
20005

April 15, 1980

Colonel James M. Sigler
District Engineer
Corps of Engineers, Galveston District
Department of the Army
P. O. Box 1229
Galveston, Texas 77553

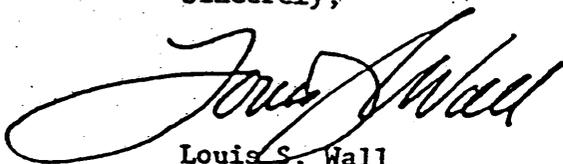
Dear Colonel Sigler:

The Memorandum of Agreement for the six on-going construction projects in the State of Texas (Mouth of Colorado, Freeport Harbor (45-Foot Project), Taylors Bayou, Highland Bayou, Buffalo Bayou and Tributaries and the Corpus Christi Ship Channel (45-Foot Project)) with the potential of affecting Fort Valasco-Quintana Historic District and other cultural properties has been ratified by the Chairman of the Council. This document constitutes the comments of the Council required by Section 106 of the National Historic Preservation Act, Section 2(b) of Executive Order 11593, "Protection and Enhancement of the Cultural Environment", and completes compliance with the Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800). A copy of the Agreement is enclosed.

In accordance with Section 800.6(c)(2) and 800.9(e) of the regulations, a copy of this Memorandum of Agreement should be included in any environmental assessment or statement prepared for this undertaking to meet requirements of the National Environmental Policy Act and should be retained in your records as evidence of compliance with Section 106 of the National Historic Preservation Act, and Section 2(b) of Executive Order 11593.

The Council appreciates your cooperation in reaching a satisfactory resolution of this matter.

Sincerely,



Louis S. Wall
Chief, Western Division
of Project Review

Enclosures

Advisory
Council On
Historic
Preservation

1522 K Street NW.
Washington D.C.
20005

MEMORANDUM OF AGREEMENT

WHEREAS, the Galveston District, Corps of Engineers, proposes to implement the following ongoing construction projects: Mouth of Colorado River, Freeport Harbor, Taylors Bayou, Highland Bayou, Buffalo Bayou and Tributaries, Corpus Christi Ship Channel, Texas; and,

WHEREAS, the Galveston District, in consultation with the Texas State Historic Preservation Officer (SHPO), has determined that this undertaking as proposed may have an adverse effect upon cultural properties which may be eligible for the National Register of Historic Places; and,

WHEREAS, pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) and Section 800.4(d) of the regulations of the Advisory Council on Historic Preservation (Council), "Protection of Historic and Cultural Properties" (36 CFR Part 800), the Galveston District has requested the comments of the Council; and,

WHEREAS, pursuant to Section 800.6 of the Council's regulations, representatives of the Council, the Galveston District, and the Texas SHPO have consulted and reviewed the undertaking to consider feasible and prudent alternatives to avoid or satisfactorily mitigate the adverse effect;

NOW, THEREFORE, it is mutually agreed that the undertaking will be implemented in accordance with the following stipulations:

Stipulations

The Galveston District will comply with the following procedures in implementing further actions on the below listed six authorized, ongoing construction projects:

Mouth of Colorado River, Texas;
Freeport Harbor, Texas (45-Foot Navigation Project)
Taylors Bayou, Texas;
Highland Bayou, Texas;
Buffalo Bayou and Tributaries, Texas;
Corpus Christi Ship Channel, Texas (45-Foot Navigation Project);

1. Prior to any land disturbing activities the Galveston District will complete a cultural resources survey designed in accordance with guidelines established in consultation with the SHPO to identify historic and cultural properties included in or eligible for inclusion in the National Register of Historic Places that may be affected by the undertaking. The Galveston District shall provide the Council with a copy of the guidelines established.
 - A. Cultural resource surveys will be administered by the Galveston District staff archeologist.
 - B. Copies of survey reports will be provided to the Texas SHPO.
 - C. All historic and cultural properties identified by the surveys will be evaluated in consultation with the Texas SEPO to identify those properties that appear to meet National Register criteria. For those properties that appear to meet the criteria, the Galveston District will seek determinations of eligibility from the Secretary of the Interior in accordance with National Register procedures (36 CFR Sec. 63.3).
 - D. For those sites included in or found to be eligible for inclusion in the National Register, the Galveston District will evaluate, in consultation with the Texas SHPO, the proposed undertaking to determine effect pursuant to 36 CFR Sec. 800.4(b). If "no effect" is found through such consultation, the undertaking may proceed.
 - E. Upon finding that the undertaking will affect a property included in or eligible for the National Register, the Galveston District will develop a set of alternatives that would result in avoidance, or mitigation of adverse effects. In consultation with the Texas SEPO, the most prudent and feasible alternative will be selected.
 1. If the selected alternative results in avoidance, the Galveston District will document a determination of no effect and retain it in its files; the project may proceed.
 2. If the selected alternative would result in preservation of the cultural property and not create an adverse effect, the Galveston District will document this finding and forward a copy of the documentation to the Council and afford the

Council the opportunity to object pursuant to 36 CFR Sec. 800.6(a), before proceeding with the project.

2. Where it is not prudent and feasible to avoid or to preserve historic and cultural properties included in or eligible for inclusion in the National Register, the Galveston District will consult with the Texas SHPO and,
 - A. If it is determined that the affected historic or cultural property is included in or eligible for inclusion in the National Register primarily because it may be likely to yield information important in prehistory or history, and meets the criteria detailed in Part I of the "Guidelines for Making 'Adverse Effect' and 'No Adverse Effect' Determinations for Archeological Resources in Accordance with 36 CFR Part 800" (Guidelines), the Galveston District will institute a data recovery program in consultation with the Texas SHPO, in accordance with Part 2 of the Guidelines and the Department of the Interior's "Recovery of Scientific, Prehistoric, Historic, and Archeological Data: Methods, Standards, and Reporting Requirements" (36 CFR Part 66). (Copies of the Guidelines and 36 CFR Part 66 are attached.)
 - B. If it is determined that the affected historic or cultural property is listed in or eligible for inclusion in the National Register primarily for criteria other than the criterion that it is likely to yield information important in the prehistory or history of the area, but is not a National Historic Landmark or National Historic Site, and it is not known to have historic or cultural significance to any community or social or ethnic group, the Galveston District will develop measures acceptable to the Texas SHPO to mitigate the impact of the proposed action.
 - C. The Galveston District shall provide the Council with documentation supporting the agreements reached with the Texas SHPO under the provisions of A and B of this section and shall afford the Council an opportunity to object within 30 days after receipt of adequate documentation before undertaking data recovery program or proposed mitigative measures.
 - D. If it is determined that the affected historic or cultural property is a National Historic Landmark, National Historic Site, or is known to have significance to any community or social or ethnic group, or agreement cannot be reached between the Galveston

District and the Texas SEPO on satisfactory mitigation measures, or if the Council objects to the measures agreed upon, the comments of the Council will be requested in accordance with 35 CFR Part 800.

3. During construction activities covered by the Agreement and after the cultural resource surveys required by Stipulation 1 have been completed, should previously unknown historic or cultural properties be discovered, the Galveston District will cause potentially damaging activities to be delayed until it has had an opportunity to consult with the Texas SHPO and has complied with 36 CFR Sec. 800.7 of the Council's regulations.
4. The Galveston District may request that this Agreement be amended at any time to cover additional authorized construction projects by submitting a formal request to the Council with a preliminary case report concurred in by the Texas SEPO. The Council will review the documentation provided and advise the Galveston District of its concurrence or objection. If the Council objects, consultation with the Galveston District will continue until an amendment acceptable to all parties is agreed upon.
5. Failure to carry out the terms of this Agreement requires that the Galveston District again request the Council's comments in accordance with 36 CFR Part 800. If the Galveston District cannot carry out the terms of the Agreement, it shall not take or sanction any action or make any irreversible commitment that would result in an adverse effect with respect to National Register or eligible properties covered by the Agreement or would foreclose the Council's consideration of modifications or alternatives to the ongoing construction projects that could avoid or mitigate the adverse effect until the commenting process as been completed.
6. If any of the signatories to this Agreement determine that the terms of the Agreement cannot be met or believes a change is necessary, that signatory shall immediately request the consulting parties to consider an amendment or addendum to the Agreement. Such an amendment or addendum shall be executed in the same manner as the original Agreement.

Deputy Robert G. Little 1/30/80
Executive Director (date)
Advisory Council on Historic Preservation

AMENDMENT
TO
MEMORANDUM OF AGREEMENT

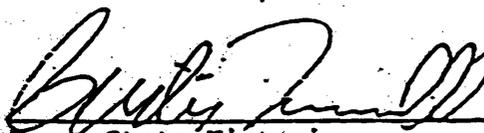
WHEREAS, the Galveston District, Corps of Engineers (COE), the Texas State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (Council), executed a Memorandum of Agreement on April 7, 1980, for several ongoing construction projects in the district in Texas; and

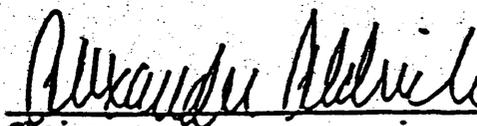
WHEREAS, the Clear Creek, Texas Flood Control Project will have similar effects on historic properties; and

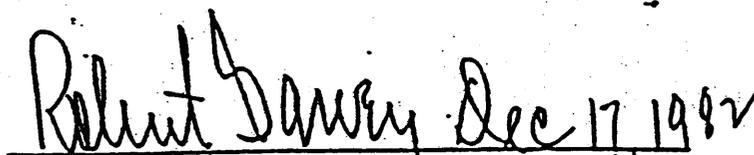
WHEREAS, pursuant to 36 CFR Sec. 800.6(c)(4) of the Council's regulations, the Corps of Engineers has now requested an amendment to the Memorandum of Agreement to include the Clear Creek, Texas Flood Control Project.

NOW THEREFORE, it is mutually agreed that the Clear Creek, Texas Flood Control Project will be implemented in accordance with the Memorandum of Agreement ratified on April 7, 1980.

 25 Oct 8
District Engineer (date)
Corps of Engineers, Galveston District

 3 Nov. 1981
Texas State Historic (date)
Preservation Officer

 12/2
Chairman (date)
Advisory Council on Historic Preservation

 Dec 17 1982
Executive Director (date)
Advisory Council on Historic Preservation

**Council On
Historic
Preservation**

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

Reply to: 730 Simms Street, #401
Golden, Colorado 80401

July 8, 1991

Brink P. Miller
Colonel, Corps of Engineers
District Engineer, Galveston District
P.O. Box 1229
Galveston, TX 77553-1229

REF: Amendment to the Memorandum of Agreement regarding the ongoing construction projects at the Mouth of Colorado River; Freeport Harbor; Taylors Bayou; Highland Bayou; Buffalo Bayou and Tributaries; and Corpus Christi Ship Channel, TX

Dear Colonel Miller:

The enclosed Amendment to the Memorandum of Agreement regarding the ongoing construction projects at the Mouth of Colorado River; Freeport Harbor; Taylors Bayou; Highland Bayou; Buffalo Bayou and Tributaries; and Corpus Christi Ship Channel has been executed by the Council. This action constitutes the comments of the Council required by Section 106 of the National Historic Preservation Act and the Council's regulations. Please send copies of the signed Amendment to Texas State Historic Preservation Officer and your Federal Preservation Officer.

The Council appreciates your cooperation in reaching a satisfactory resolution of this matter.

Sincerely,



Claudia Nissley
Director, Western Office
of Project Review

Enclosure

AMENDMENT
TO
MEMORANDUM OF AGREEMENT

WHEREAS, the Galveston District, Corps of Engineers (COE), the Texas State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (Council) executed a Memorandum of Agreement on April 7, 1980 for several ongoing construction projects in the District in Texas; and

WHEREAS, the Council regulations 36 CFR 800 were revised September 2, 1986; and

WHEREAS, pursuant to Stipulation 6 of the Agreement, the COE now requests an amendment to Stipulation 1.C of the Agreement;

NOW THEREFORE, it is mutually agreed that Stipulation 1.C is amended to be carried out in accordance with 36 CFR 800.4(c) of the 1986 regulations.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: Robert D. Bush Date: 7-2-91

TEXAS STATE HISTORIC PRESERVATION OFFICER

By: Carlis J. [Signature] Date: 31 May 91

U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT

By: Brink P. Miller Date: 8 MAY 91
Brink P. Miller
Colonel, Corps of Engineers
District Engineer



DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF:

January 7, 1998

RECEIVED
RECEIVED
JAN 08 1998
TEXAS HISTORICAL COMMISSION
TEXAS HISTORICAL COMMISSION

Environmental
Resources Branch

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
Department of Antiquities Protection
P.O. Box 12276
Austin, Texas 78711

CONCUR	
Department of Antiquities Protection Texas State Historic Preservation Office	
By	<u><i>William A. Trout</i></u> for James E. Bruseth, Ph.D
Date	<u>1/12/98</u>

Dear Dr. Bruseth:

The purpose of this letter is to coordinate a draft Scope of Work for an historic properties survey in conjunction with the Greens Bayou Flood Control Project, Harris County, Texas. Galveston District and the project's local sponsor, Harris County Flood Control District (HCFCD), are conducting preliminary environmental studies for a proposed channel enlargement and detention pond project on 3.7 miles of upper Greens Bayou between Veterans Memorial Drive and Cutten Road (Enclosure 1).

Specifics of the channel improvement plan are still to be determined; however, the survey is designed to cover all areas which may be impacted by the project with the exception of still undefined placement areas. A draft Scope of Work for "Intensive Historic Properties Survey of Greens Bayou and Proposed Detention Basin, Veterans Memorial to Cutten Road" is enclosed for your review (Enclosure 2). We hope to begin field work in February 1998. If you would like to visit the work in progress, we will be happy to arrange a visit at your convenience. Questions should be directed to Ms. Janelle Stokes at 409/766-3039.

Sincerely,

Richard Medina
Chief, Environmental
Resources Branch

Enclosures



TEXAS
HISTORICAL
COMMISSION

George W. Bush • Governor

John L. Nau, III • Chairman

Curtis Tunnell • Executive Director

The State Agency for Historic Preservation

June 9, 1998

Dolan Dunn, Chief
Policy Analysis Section
Department of the Army, Galveston District
Corps of Engineers
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Draft Report: *Cultural Resources Survey of Eight Channel Segments and a Proposed Detention Basin on Upper Greens Bayou, Harris County, Texas (COE-VD, F2, F19)*

Dear Mr. Dunn:

Thank you for the opportunity to review the draft archeological survey report for the project referenced above. We have reviewed the report and find that it is acceptable. The Archeology Division (AD) concurs that: (1) because the investigations indicated that they contain no features and have only very low densities of artifacts, prehistoric sites 41HR708, 41HR710, 41HR716, and 41HR799 are probably ineligible for listing in the National Register of Historic Places; (2) historic sites 41HR798, 41HR824, and 41HR825 apparently contain no subsurface structural remnants or archeological features possessing significant integrity or historical associations for National Register eligibility; and (3) the Hargrave-Hilton Cemetery (41HR709) is potentially eligible for listing in the National Register under Criterion D and should be protected by coverage with clean fill and enclosure by fencing. The History Programs Division (HPD) has separately reviewed the standing structures within the project area and determined that they are not eligible for listing in the National Register of Historic Places. The AD and the HPD conclude that none of these sites warrant additional work, and provided that the COE concurs with these recommendations without additional comments, the project may proceed without further consultation with this office.

If any cultural materials are encountered during construction, work should cease in the immediate area; work may continue in the project area where no cultural materials are present. The Advisory Council on Historic Preservation should be contacted in accordance with 36 CFR 800.11 (b) (2). Please also notify the State Historic Preservation Officer at 512/463-5866.

We look forward to receiving 20 copies of the final report along with completed *Abstracts in Texas Contract Archeology* and curation forms. If we may be of further assistance, please call either Mr. Herb Uecker in the AD at 512/463-5866, or Mr. Greg Smith in the HPD at 512/463-6013.

Sincerely,

James E. Bruseth, Ph.D.
Deputy State Historic Preservation Officer
Director, Archeology Division

JEB/hgu

cc: Ross C. Fields, Principal Investigator

DIVISION OF ANTIQUITIES PROTECTION

P. O. Box 12276 • Austin, TX 78711-2276 • 512/463-6096 • Fax 512/463-8027 • TDD 1-800-725-0000



REPLY TO
ATTENTION OF:

**DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229**

December 9, 1999

Environmental Branch

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
Department of Antiquities Protection
P.O. Box 12276
Austin, Texas 78711

RECEIVED

DEC 13 1999

TEXAS HISTORICAL COMMISSION

Dear Dr. Bruseth:

The purpose of this letter is to coordinate cultural resource investigations conducted in conjunction with a proposed flood control project along upper Greens Bayou in Harris County, Texas. Galveston District and the project's local sponsor, Harris County Flood Control District (HCFCD), are finalizing a General Reevaluation Report and Environmental Assessment which recommend channel enlargement and a detention basin on 3.7 miles of upper Greens Bayou between Veterans Memorial Drive and Cutten Road (Enclosure 1).

The channel widening will be accomplished entirely within HCFCD's existing maintained right-of-way, except for a short reach downstream of Bammel-Mount Houston Road where right-of-way for a 2000-foot long section will extend approximately 10 feet beyond the current right-of-way. The recommended plan consists of an earth-lined channel with a bottom width of approximately 60 feet. The final configuration of the Greens Bayou detention basin has not been determined as yet, but it will be approximately 95 acres in size and will be located adjacent to West Greens Road. A side weir structure will be constructed along the bayou bank. Excavated materials from channel widening and detention basin construction will be placed in five upland placement areas in the Greens Bayou area (Enclosure 2). The project's area of potential effects has been thoroughly investigated as described below.

Historical research and an historic properties survey of all areas to be affected by channel widening and detention pond excavation were conducted in 1998. The requirements for this survey were coordinated with your office by letter dated January 7, 1998 (Enclosure 3) and the results were coordinated by letter dated May 19, 1998.

Your agency responded to the survey results in a letter dated June 9, 1999 (Enclosure 4). A report of this survey, entitled "Cultural Resources Survey of Eight Channel Segments and a Proposed Detention Basin on Upper Greens Bayou, Harris County, Texas," was furnished to your office at that time. Seven sites were recorded in the general area, but only 41HR709 (the Hargrave-Hilton cemetery) was recommended as potentially eligible for the National Register (Enclosure 5). This site will not be affected by channel widening or detention activities proposed by the Corps of Engineers. It is located in a proposed detention basin owned by HCFCD; however, this basin is not a feature of the Corps project and no treatment for this site is proposed. No sites were found in the detention basin proposed by the Corps and no potentially eligible sites were located in channel enlargement impact areas.

A reconnaissance survey of the five proposed PA's was conducted by staff archeologist Janelle Stokes in November 1998. A report of this survey is Enclosure 6. All of the surveyed areas are located well away from the Greens Bayou floodplain in areas with very little potential for prehistoric sites. Historical research has shown that historic settlers bypassed this area until the early 20th century, resulting in low potential for historic-era resources as well. The reconnaissance survey and historic map research found no indication of any cultural resource in the proposed PA's, indicating that use of these areas for placement of dredged materials will have no impact on cultural resources.

Based upon the results of the research and surveys discussed above, we request your concurrence that no historic properties are likely to be affected within the area of potential effects for the proposed Upper Greens Bayou flood control project, Harris County, Texas. If you have any questions, please don't hesitate to call Ms. Janelle Stokes at 409/766-3039.

Sincerely,

James M. Barrows

for Carolyn Murphy
Chief, Environmental Branch

Enclosures

CONCUR
by <u><i>William A. Smith</i></u>
for F. Lawrence Oaks State Historic Preservation Officer
Date <u>1/6/02</u>

NO EFFECT
On National Register-eligible properties or State Archeological Landmarks
PROJECT MAY PROCEED
by <u><i>William A. Smith</i></u>
for F. Lawrence Oaks State Historic Preservation Officer
Date <u>1/6/02</u>



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
17629 El Camino Real, Suite 211
Houston, Texas 77058

November 23, 1998

Colonel Nicholas J. Buechler, District Engineer
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553
ATTN: Dolan Dunn, Chief Environmental Branch

Dear Colonel Buechler:

The purpose of this letter is to aid in planning for the study by Harris County Flood Control District and the Galveston District to update and reevaluate flood control improvement measures along Greens Bayou, Harris County, Texas. This bayou was part of the larger Buffalo Bayou and Tributaries, Texas feasibility study which was completed by the Galveston District in May 1988, resulting in Congressional authorization.

The Service submitted a Fish and Wildlife Coordination Act Report for the Greens Bayou project in August 1987 as part of a flood damage prevention study of the Buffalo Bayou and Tributaries watershed. The plan currently under consideration is entirely in the upper reach of Greens Bayou and has been reduced in scope from the 1987 plan.

As we understand it, the primary project features now being considered consist of:

- 1) channel modifications of the bayou itself from just below Green's Road Bridge to Cutten Road, within existing ROW limits only, to a maximum bottom width of 90 feet;
- 2) six potential disposal sites at varying distances from the bayou and entirely within improved pastureland or fallow farmland;
- 3) two detention basin sites totaling 148 acres separated by Green's Road, south of Veteran's Memorial Road bridge, to be developed as a recreational park and planted with (primarily native) bushes and trees. There would be a possible buffer zone of native trees around the basin and possible wetland creation within the basin. Another, smaller 25-acre detention basin in a previously cleared site in the vicinity of Cutten Road is being considered. The final decision on these detention areas will be made in December 1998.

In addition, selected flood-prone developments along the lower reaches of Green's Bayou from its mouth up to Garner Bayou are being considered for buyout. Please inform me or Phil Glass if the above project summary is not correct or is incomplete.

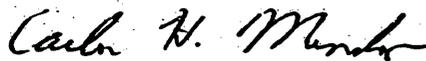
A Service biologist was given the opportunity to tour the project area this past August with Environmental Branch personnel. Findings of this one-day field trip were that the native fish, wildlife, and wetland values of the proposed detention basin site and the six potential disposal sites were limited due to their cleared, urban nature. Provided channel widening operations are confined to 90-ft. bottom width or less and are entirely within the currently cleared right-of-way, losses to resident native fisheries and riparian habitat should also be minimal.

Therefore, we do not plan to provide a coordination act report on this project. We would appreciate the opportunity to review the draft re-evaluation study report, scheduled for February 1999, as well as any environmental studies you are planning to contract for the report.

Federally listed threatened and endangered species which may occur in Harris County include the Texas prairie dawn-flower *Hymenoxys texana* and bald eagle *Haliaeetus leucocphalus*. A review of Service files and on-site investigations indicates that the detention ponds and disposal sites will have no adverse effect on any federally listed or proposed threatened or endangered species.

Thank you for the opportunity to participate in the planning process for this flood control project. Please inform me should there be any significant change in your project plans.

Sincerely,



Carlos H. Mendoza
Project Leader, Clear Lake ES Field Office



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
17629 El Camino Real, Suite #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882



September 17, 2003

Carolyn Murphy
Environmental Section
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553

Dear Ms. Murphy:

This responds to your August 15, 2003 letter which requested threatened and endangered species information for your project area. The COE and the Harris County Flood Control District are re-evaluating flooding problems along Greens Bayou and have identified a proposed project plan which involves channel modifications and detention between Veterans Memorial Drive and Cutten Road in the upper reaches of the bayou.

Federally listed species known to occur in Harris County are the endangered Texas prairie dawn-flower *Hymenoxys texana* and the threatened bald eagle *Haliaeetus leucocephalus*. Neither species is currently known to occur along the upper reaches of Greens Bayou and thus wouldn't be impacted by proposed channel modifications that are located within the existing right-of-way. However, it is not known whether or not suitable habitat for Texas prairie dawn may occur at the proposed detention sites. Therefore, we recommend that any project impact areas that contain suitable Texas prairie dawn habitat, be surveyed by a qualified individual to determine whether or not Texas prairie dawn occurs at that site.

Prairie dawn is a small annual reaching a height of up to 4 inches that is traditionally found in poorly drained depressions or saline swales around the periphery of low natural pimple (mima) mounds in open grasslands. However, many of the prairie dawn sites around rapidly developing urban areas have been disturbed by the leveling of the mounds. Often brush and other woody vegetation have invaded the area surrounding the small, mostly barren areas where prairie dawn occurs. Normally, these small areas are sparsely vegetated and the soil is covered with a blue-green alga but prairie dawn has also been found in the mowed areas of public parks.

General information on the plant has been enclosed. If you need additional information or if we can be of further assistance, please contact Edith Erfling at 281/286-8282.

Sincerely,


Frederick T. Werner

Assistant Field Supervisor, Clear Lake ES Field Office

Enclosure

**TAKE PRIDE
IN AMERICA** 

STATUS: Endangered (51 FR 8683-March 13, 1986) without critical habitat. Recovery Plan approved in 1989.

DESCRIPTION: This member of the sunflower family (Asteraceae) is a small, single-stemmed or branching annual reaching a height of up to 6 inches. Leaves clustered at the plant base are spoon-shaped, with entire or toothed margins. Stem leaves are alternate, narrow with parallel sides, and no or few teeth on the margin. The small heads (a cluster of flowers) are 0.15 to 0.23 inch long with small yellowish disk flowers and minute ray flowers that appear to be missing. Seeds are cone-shaped, obscurely 4-angled, and hairy.

HABITAT: Occurs in sparsely vegetated areas of fine-sandy compacted soil. Specifically, the species occurs in the northern part of the Gulf Coastal Prairie, where it is found in poorly drained depressions or saline swales around the periphery of low, natural pimple mounds (mima mounds) in open grasslands. These mostly barren areas are sparsely vegetated and the soil is often covered with a blue-green alga (*Nostoc sp.*). It can also occur on disturbed soils such as rice fields, vacant lots, and pastures if the soil structure remains relatively intact.

DISTRIBUTION:

Present: In Texas: Fort Bend and Harris Counties.

Historic: In Texas: Harris County (and possibly La Salle).

THREATS AND REASONS FOR DECLINE: Habitat destruction and alteration due to residential development and road construction. Many of the sites around rapidly developing urban areas have been disturbed, with leveling of the pimple mounds and invasion by brush and other woody species.

OTHER INFORMATION: This species flowers from March to early April and seeds mature from April to May. Composite thrips (*Microcephalothrips abdominalis*) are suspected pollinators. Recovery Plan approved in 1989. First collected in 1889, the species was considered extinct by many until it was rediscovered in 1981.

REFERENCES:

- Correll, D.S., and M.C. Johnston. 1970. *Manual of the Vascular Plants of Texas*. Texas Research Foundation, Renner, Texas. 1,881pp.
- Mahler, W.F. 1982. *Status Report on Hymenoxys texana*. U.S. Fish and Wildlife Service, Endangered Species Office, Albuquerque, NM. 10pp.
- Poole, J.M., and D.H. Riskind. 1987. *Endangered, Threatened, or Protected Native Plants of Texas*. Texas Parks and Wildlife Department, Austin, Texas.
- U.S. Fish and Wildlife Service. 1989. *Hymenoxys texana* Recovery Plan. Endangered Species Office, Albuquerque, NM. 53pp.





United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882



January 13, 2004

Colonel Leonard D. Waterworth
Attn: Chief, Environmental Branch
US Army Corps of Engineers
PO Box 1229
Galveston, TX 77553-1229

Dear Colonel Waterworth:

This planning aid letter is for the purpose of finalizing U.S. Fish and Wildlife Service (Service) comments and recommendations regarding Greens Bayou, Houston, Texas Flood Damage Reduction Project. The Service has previously submitted a Fish and Wildlife Coordination Act Report (August 1987) for Buffalo Bayou and Tributaries, Texas, Feasibility Report, Flood Damage Prevention Project, the larger project from which Greens Bayou has been separated; and a Planning Aid Letter (November 1998) for the Greens Bayou Project. The present letter addresses changes to the Greens Bayou Project since November 1998. Due to the reduced scope of the current project and the urban nature of the watershed, the Service will not submit a Fish and Wildlife Coordination Act Report on this project.

Primary project features now proposed in the *Draft General Reevaluation Report, Greens Bayou at Houston, Texas, Flood Damage Prevention* (in prep.) are:

- 1) channel modifications of the bayou from just upstream of Veteran's Memorial Drive to downstream of Cutten Road, within existing ROW limits only, to a maximum bottom width of 60 ft,
- 2) three (3) potential disposal sites totaling 430 ac at varying distances from the bayou and entirely within improved pasture or fallow farmland,
- 3) two (2) detention basin cells totaling 138 ac separated by West Green's Road, south of Veteran's Memorial Road bridge, to be developed as a recreational park and planted with (primarily native) bushes, trees, and grasses.

Buyout plans for streamside developments from the Green's Bayou mouth to Garner Bayou were considered but benefits were determined to not exceed buyout costs. The Service is disappointed that this buyout feature was not justified. Numerous recent studies have shown that urban buyout plans in flood-prone areas within metropolitan areas have produced great benefits in terms of water quality protection, flood damage reduction, and urban recreation; in addition to provide islands of native fish and wildlife habitat for city-dwellers to enjoy. The Service would like to participate in analyses of urban wildlife habitat benefits for future Galveston District flood control projects.

**TAKE PRIDE
IN AMERICA** 

Colonel Leonard D. Waterworth
Attn: Chief, Environmental Branch
January 13, 2004
Page 2

The Service endorses the plan to plant predominantly native trees, shrubs, and grasses within the detention sites and would like to participate in species and site selection.

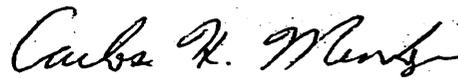
Presently, native fish and wildlife values within the two proposed detention basin cells and three potential disposal sites are limited due to the cleared, urban nature of the project area. Providing channel widening operations are confined to a 60-ft bottom width or less and are entirely within the currently cleared right-of-way, losses to resident native fisheries and riparian habitat should also be minimal.

Federally-listed threatened and endangered species which may occur in Harris County at the project site and which the Service furnished the Galveston District by letter dated September 17, 2003 are the Texas prairie dawn-flower *Hymenoxys texana* and the bald eagle *Haliaeetus leucocephalus*. The Galveston District should provide information on the potential impacts of the proposed project on these listed species to the Service concurrent with publication of the Re-evaluation Report and prior to irreversible commitment of resources.

Thank you for the opportunity to participate in the planning process for this urban flood control project. The rate of urban development in the Houston Metropolitan area has covered many thousands of acres of native prairie, wetlands, and bottomland forest, all productive and declining native wildlife habitat types, within the past 20 years. It is important that flood control projects such as Green's Bayou Flood Damage Reduction Project maximize opportunities to reverse this trend whenever possible.

Please inform me or Phil Glass at 281-286-8282 should there be any significant change in project plans.

Sincerely,



Carlos H. Mendoza
Field Supervisor, Clear Lake ES Field Office