Chacon Creek, Laredo, Texas

Feasibility Report and Environmental Assessment

April 2024

Prepared by the City of Laredo, Texas,
under Section 203 of WRDA 1986,
as amended by Section 1014(a) of WRRDA 2014
and as amended by Section 1126 of the WIIN Act of 2016

<u>ERRATA SHEET</u>

CHACON CREEK
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
CITY OF LAREDO, TEXAS
for
FLOOD RISK MANAGEMENT AND ECOSYSTEM

RESTORATION SECTION 203 STUDY

August 29, 2018

1. This Errata Sheet includes revisions to the referenced Chacon Creek Feasibility Report and Environmental Assessment Feasibility Study, City of Laredo, Texas, dated August 2018. The Section 203 Study determined economic benefits for Flood Risk Management and Ecosystem Restoration within Chacon Creek in the City of Laredo, Texas. None of the information provided in this Errata Sheet results in a significant change to the environmental conditions, economic justification, or selection of the TSP.

2. Point of contact regarding this Errata Sheet: Mr. John Porter, Director, Environmental Services Department, City of Laredo, Texas.

3. Executive Summary, page 2, previously provided project data that were not updated when similar information in the previous paragraphs and/or later report sections were updated. The following deletions/additions are therefore made to the top of page 2:

   "Average Annual Habitat Units (AAHUs) with an annual cost of approximately $6,300 per unit gained over the No-Action Plan and a total first cost of $26,901,000.

   The total project cost for the TSP is estimated at $51,973,000 and provides total annual net benefits of $378,800 with a benefit-to-cost ratio of 1.35-to-1.00 and 164 AAHUs of aquatic ecosystem restoration benefits.

   The City of Laredo is identified as the non-Federal sponsor for implementation of the recommended plan. Federal participation in the project is estimated at

   $30,887,700 or 59.4% percent of the total project cost. Non-Federal participation in the project is estimated at $21,085,100, or 40.6% percent of the total project cost."

4. Executive Summary, page 2, under "Conclusions," the following deletions/additions are made. (Italicized words are text additions and are not italicized in the actual report.)

   "Based on the results of the investigations conducted for this study, the following conclusions *were reached*."

5. Introduction Section, Page 7, under “Study Collaboration,” the last sentence before the list of agencies has been revised as follows:

> “If Congress authorizes construction of the recommended plan, further coordination with the following agencies would continue.”

6. Section 5, Tentatively Selected Plan, page 179, first paragraph under “Ecosystem Restoration,” and Table 42 (provided below in its corrected version) have modifications due to earlier numbers reflecting information during the alternatives being updated rather than using the refined update of the TSP. These have been corrected as follows. Note that Appendix A, Socioeconomics, and Appendix B, Environmental (Ecosystem), both of which respectively assess the benefits and costs of the NED, NER, and TSP plans, remain accurate and are therefore unchanged. (Italicized words are text additions added for clarity and are not italicized in the actual report.)

> “Figure 44 depicts the location of the aquatic ecosystem restoration (ER) component of the TSP. The ER component would restore three wetland sites totaling 16.75 acres and produce a net increase of 12.3 AAHUs *versus the No Action Alternative*. It includes riparian measures that would restore 401 acres of riparian habitat providing *a net increase of* 151.6 AAHUs *versus the No Action Alternative* by removing buffelgrass and planting native species with temporary irrigation until plants are established.
> Additional riparian measures include the removal and control of salt cedar. The TSP would produce a net increase of 163.9 AAHUs at an annual cost of *approximately* $6,300 per unit *of net output based upon the refined costs shown in the table below*. The TSP would also include the removal of debris as well as a concrete barrier from the streambed.

Table 42. TSP Outputs

Flood-Risk Management	
Estimated First Cost	$14,109,000
Benefits	$594,200
Total Annual Cost	$522,600
Recreation	
Estimated First Cost	$11,662,000
Benefits	$859,700
Total Annual Cost	$552,500
Ecosystem Restoration	
Estimated First Cost	$26,901,000
Output (AAHUs)	164
Total Annual Cost	$1,029,200

7. Section 5, Tentatively Selected Plan, page 181-182, Table 43 is not needed and is therefore deleted. The paragraph is replaced with the following text:

   > "If Congress authorizes construction of the recommended plan, all Environmental Compliance activities will be completed prior to implementation."

8. Section 5, Tentatively Selected Plan, page 185, the following changes are made to the sections on the Fish and Wildlife Coordination Act, and the Endangered Species Act, respectively:

   > "Coordination with the U.S. Fish and Wildlife Service began in July 2006 when the Corps and the Service negotiated a scope of work to perform fish and wildlife studies in relation to the Chacon Creek Feasibility Study. If Congress authorizes construction of the Laredo's recommended plan identified in this report, further coordination will continue following authorization."
   >
   > and
   >
   > "If Congress authorizes the recommended plan, the Corps will complete all environmental compliance activities, including Endangered Species Act, prior to construction."

9. Section 5, Tentatively Selected Plan, page 189, paragraph 1, is corrected as follows:

   > "The TSP would have annual costs allocated to flood risk management and recreation of $1,075,100, total annual economic benefits of $1,453,900 annual net benefits of $378,800, and a BCR of 1.35-to-1.00."

10. Section 5, Tentatively Selected Plan, page 189, paragraph 3, and Table 46 (provided below in its corrected version) are corrected as follows:

    > "Table 46 displays the economic summary of the ecosystem restoration component. The ecosystem restoration would have a first cost of approximately $26,901,000 and total annual charges of about $1,029,000. The proposed plan would result in a gain of about 164 AAHUs over the No-Action Alternative, which would result in an average annual cost of approximately $6,300 per AAHU gained."

Table 43. Economic Summary for Ecosystem Restoration (February 2018 Prices)

Project Cost Items	Cost
First Cost	$26,901,000
Annual Interest Rate	2.75%
Project Life	50 years
Construction Period	24 months
Interest During Construction	$749,900
Investment Cost	$27,650,900
Annual Investment	$1,024,200
Annual O&M	$5,000
Total Annual Charges	$1,029,200
With-Project AAHU	346
No-Action AAHU	182
Plan AAHU Gain	164
With-Project Acres	417.87
Average Annual Cost per AAHU Gain	$6,276
First Cost per Acre	$64,400

11. There were a few instances of reference codes linking text to table or figure locations that were broken during the editing of the report, resulting in "Error! Reference source not found." These have been corrected in the text.

12. Related to the broken links, the table numbering created an incorrect numbering sequence in the Table of Contents. This has been corrected in the text.

TABLE OF CONTENTS

APPENDICES

** Appendices with asterisks in this Table of Contents have been added or updated from the original 2010 USACE report; others remain relevant*

LIST OF FIGURES

LIST OF TABLES

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EXECUTIVE SUMMARY

Chacon Creek is an important natural resource located on the eastern side of Laredo, Texas with a wide range of environmental, economic, recreational, and educational needs and opportunities. Years of neglect including illegal dumping, rapid urbanization, and storm runoff have led to contamination, erosion, and loss of wetland habitats and vegetation. Invasive plant species have seriously degraded the value of riparian and riverine habitats for wildlife, as well as altered soil productivity and increased the potential for fires. Additionally, 438 structures located in the 500-year floodplain are at risk of flooding. In June 2007, the city received five to eight inches of rain in a four-hour period which led to the city's first flooding death. A total of 68 homes were reported to have received varying levels of damage during the storm, with several homes along Chacon Creek being almost entirely inundated.

Recurring flood events have historically flooded low lying homes and businesses along the creek. Flood damages associated with the 2007 flood event alone exceeded a million dollars. The flood events have been exacerbated by the explosive growth within the upper portions of the watershed. The city also has a significant shortage of outdoor recreational facilities, both as identified by residents and based on the standards developed by the National Recreation and Park Association.

This Feasibility Study and Environmental Assessment for Chacon Creek, Laredo, Texas (Study) was originally conducted by the U.S. Army Corps of Engineers (USACE) in cooperation with the City of Laredo, the non-Federal sponsor. Following the development of a draft report that was being finalized for public circulation in 2010, the study was discontinued due to funding availability under an earlier, 2003 Congressional resolution. The current report represents an update of the 2010 report conducted by the City of Laredo. The report updates the earlier report in areas that have changed in the interim, primarily physical and environmental conditions, NEPA documentation including threatened and endangered species, real estate values, recreation features, and the costs and benefits of the alternatives and the Tentatively Selected Plan (TSP).

The Study originally examined an array of alternatives to address each of the challenges to reduce flood threat, restore the aquatic and riparian ecosystems, and provide compatible recreational opportunities. This resulted in the identification of a Tentatively Selected Plan (TSP) that is a combined National Economic Development / National Ecosystem Restoration (NED/NER) Plan.

The NED Plan provides for the permanent relocation of the residents of the 62 residential structures to be demolished, most of which are in the 10-year floodplain, and for using the vacated lands for a local recreation facility. The TSP results in a $594,200 reduction in Expected Annual Damages (EAD), with recreational amenities adding $859,700 in benefits. Total annual benefits for the project are $1,453,900. The total first cost of the NED plan is $25,770,600 including interest during construction. Total annual costs would be $1,075,100 with net benefits of $378,800. The benefit/cost ratio for the NED plan is 1.35-to-1.00.

The NER Plan would restore 401 acres of riparian woodlands by removing buffelgrass, Arundo cane, and salt cedar, and planting native species. Three wetland sites will also be restored and will total approximately 17 acres. The combined NED/NER Plan would result in the overall increase of 164

Average Annual Habitat Units (AAHUs) with an annual cost of $5,975 per unit gained over the No- Action Plan and a total first cost of $25,982,000.

The total project cost for the TSP is estimated at $51,370,000 and provides total annual net benefits of $295,200 with a benefit-to-cost ratio of 1.28-to-1.00 and 164 AAHUs of aquatic ecosystem restoration benefits.

The City of Laredo is identified as the non-Federal sponsor for implementation of the recommended plan. Federal participation in the project is estimated at $31,517,600 or 61.4 percent of the total project cost. Non-Federal participation in the project is estimated at $19,851,300, or 38.6 percent of the total project cost.

CONCLUSIONS

Based on the results of the investigations conducted for this study, USACE reached the following conclusions.

1. There is a need to provide flood risk management measures and ecosystem restoration features within the Chacon Creek study area. The Tentatively Selected Plan (TSP) offers a combined plan addressing these missions, as well as providing recreation amenities.

2. The combined, multi-objective plan consists of non-structural features (buyouts), ecosystem restoration features, and recreation facilities compatible with a larger, regional recreation master plan. The total TSP has an estimated first cost of approximately $51.4 million, with a Federal cost share of approximately $31.5 million (61.4 percent) and a non-Federal cost share of approximately $19.9 million (38.6 percent).

3. The City of Laredo has agreed to serve as the local sponsor for the construction of the project. Approximately $340,800 of the recreation costs would not be cost shared, and would be 100 percent non-Federally funded due to the type of recreation features included in the Plan.

4. According to the Environmental Assessment, no significant environmental impacts would occur as a result of implementation of the TSP.

5. Additional evaluation, including Value Engineering, will be conducted during the preconstruction, engineering and design phase. The results of these studies could alter the project materials, design, costs, and cost apportionment or the amount of Federal participation in the project.

INTRODUCTION

OVERVIEW

The U.S. Army Corps of Engineers (USACE) was asked by the City of Laredo, Texas, to partner in a Water Resources Feasibility Study in 2004 for Chacon Creek in Laredo, Webb County, Texas (Study). A Project Management Plan, dated 24 September 2004, was prepared and a Feasibility Study was initiated. Following the development of a draft report that was being finalized for public circulation in 2010, the study was discontinued due to funding availability under an earlier, 2003 Congressional resolution. The current report represents an update of the 2010 report and has been prepared by the City of Laredo under the Section 203 authority of the Water Resources Development Act of 1986 (WRDA 1986) which allows non-Federal preparation of feasibility studies for review, comment, and approval by the Secretary of the Army. The report updates the earlier report and associated appendices in areas that have changed in the interim, primarily physical and environmental conditions, NEPA documentation including threatened and endangered species, real estate values, recreation features, and the costs and benefits of the alternatives and the Tentatively Selected Plan (TSP).

This Feasibility Report documents the results of the planning process and findings to date. The integrated Environmental Assessment (EA) has been prepared in compliance with the National Environmental Policy Act, 42 U.S.C. section 4321, et seq., White House Council on Environmental Quality regulations 40 C.F.R. Parts 1500-1508, and Engineer Regulations, 33 C.F.R. Part 230. As a result, this Feasibility Report and integrated EA is prepared in accordance with 33 C.F.R. section 230.10(c).

This Study utilizes the six-step planning process described in the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies issued in 1983, and updated in 2013. These steps identify and respond to problems and opportunities associated with the Federal objective and specific State and local concerns, and culminates in the selection of a recommended plan.[1] This process consists of the following steps:

1. Specification of the water and related land resources problems and opportunities (relevant to the planning setting) associated with the Federal objective and specific State and local concerns.
2. Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities.
3. Formulation of alternative plans.
4. Evaluation of the effects of the alternative plans.

[1] Until the plan is actually recommended by the Chief of Engineers, it is called the “Tentatively Selected Plan,” or “TSP.”

5. Comparison of alternative plans.
6. Selection of a plan for recommendation based upon the comparison of alternative plans.

REPORT SECTIONS

Section 1 describes the Chacon Creek study in terms of the study purpose and scope and the need identified for the study. This section also provides a general description of the study area and concludes with statements regarding governmental authorization for the study and the collaborating Federal, State, and local agencies. The remainder of this report describes the study process and findings, which are presented in the following sections.

Section 2, “Affected Environment,” describes existing conditions in the study area. Section 2 also describes the projected future without-project conditions if no Federal action takes place. This section presents the findings from the second step in the Planning Process.

Section 3, “Plan Formulation and Development of Alternatives,” details the processes used to develop a Tentatively Selected Plan (TSP), including: identification of problems and opportunities; definition of goals, objectives, and constraints; and exploration of alternative measures. This section corresponds to refinement of the first step in the Planning Process and also details the third step.

Section 4, “Environmental Consequences,” provides a discussion of the detailed investigation of alternatives and their impacts. This section demonstrates the fourth and fifth steps in the Planning Process.

Section 5, “Tentatively Selected Plan,” provides further details on the TSP in anticipation of it being approved as the TSP. Section 5 completes step six of the Planning Process.

Section 6, “Coordination,” maintains an ongoing record of coordination and communication with the local sponsor, resource agencies, and the public.

Section 7, “Discussions, Conclusions, and Recommendations,” brings the feasibility study and environmental assessment to closure.

Section 8, “Citation References,” provides full reference information for the citations used in the report.

Separate appendices provide detailed reports on the area resources studied, technical assessments, and study and project collaboration documents.

Study Purpose and Scope

The primary purpose of the Chacon Creek Feasibility Study is to identify the Federal interest in providing implementable measures to reduce the risk of flooding and restore degraded aquatic ecosystems. These measures include but are not limited to:

- Measures that will reduce the risk of flooding along Chacon Creek

- Measures that will restore degraded aquatic and riparian habitat to more natural condition and compliment planned ecosystem restoration measures
- Recreational amenities that will reduce excess demand and complement planned ecosystem restoration measures

To this end, the study scope is to evaluate the existing conditions and future without-project conditions, identify the problems and opportunities, develop alternatives to reduce the risk of flooding, restore degraded ecosystems, and provide increased recreational opportunities, evaluate those alternatives, develop a Tentatively Selected Plan, and ultimately recommend a plan to Congress for authorization that has Federal interest.

Need for the Study

An estimated 438 structures located in the 500-year floodplain are at risk of flooding. Recent floods that occurred in much of the State of Texas in 2007 also impacted the City of Laredo (City) and resulted in extensive property damage and the first flooding death in the City's history. Laredo received five to eight inches of rain in a four-hour period, this, for a city that receives average annual precipitation of 19 inches. Eighteen homes were reported to have received major damage, and an additional 50 homes received varied damages.

Urban growth and resulting increases in impervious surfaces throughout the watershed have altered the hydrologic response of the basin, leading to exacerbated flooding along Chacon Creek. Flood events in 2002 prompted the city to permanently remove three houses along the waterway. Rapid urbanization and associated storm water runoff into Chacon Creek have also caused hydro- geomorphological effects, including erosion and loss of wetland habitats and vegetation.

The drainage area of Chacon Creek is 155 square miles, and the Lower Chacon Creek watershed, defined as the basin south of Lake Casa Blanca and below the dam outfall, is 38 square miles. The discharges at various points in the study area along Chacon Creek are more than 13,000 cubic feet per second (cfs) at the 10% Annual Chance Exceedance (10-year) event. This study area conforms to Code of Federal Regulations subsection 238.7, which specifies that … *problems may be addressed, under flood damage reduction authorities, downstream from the point where the flood discharge is greater than 800 cubic feet per second for the 10-percent flood*.

Additionally, erosion from storm water runoff has led to increased turbidity in aquatic habitats. The introduction of invasive plant species has also increased the potential for fires, threatened to alter soil productivity, and degraded the value of riparian and aquatic habitats for wildlife. Due to all these factors, a valid need exists to identify flood risk management and ecosystem restoration measures that will help solve the water resource problems in the Chacon Creek watershed, specifically downstream of Lake Casa Blanca.

The city also has a sizable deficiency in terms of the number and size of its park facilities particularly for passive recreation amenities such as trails, pavilions and shelters, picnic tables, and playgrounds.

Specific problems and opportunities in the study area are identified in Section Three along with planning objectives and constraints identified as a result of the assessment of existing conditions and forecast of future without-project conditions presented in Section Two.

STUDY AUTHORITY

Authority for the Chacon Creek Feasibility Study is provided in Section 1201(22) of the Water Infrastructure Improvements of the Nation Act (Public Law 114-322) also known as the Water Resources Development Act of 2016, which reads:

SEC. 1201. AUTHORIZATION OF PROPOSED FEASIBILITY STUDIES.
The Secretary is authorized to conduct a feasibility study for the following projects for water resources development and conservation and other purposes, as identified in the reports titled ''Report to Congress on Future Water Resources Development'' submitted to Congress on January 29, 2015, and January 29, 2016, respectively, pursuant to section 7001 of the Water Resources Reform and Development Act of 2014 (33 U.S.C. 2282d) or otherwise reviewed by Congress:
(22) CHACON CREEK, CITY OF LAREDO, TEXAS.—Project for flood damage reduction, ecosystem restoration, and recreation, Chacon Creek, city of Laredo, Texas.

Additionally, the authority for non-Federal preparation of feasibility studies for review, comment, and approval by the Secretary of the Army is contained in Section 203 of the WRDA of 1986, as amended by Section 1014 of the WRRDA of 2014, which reads:

SEC. 1014. STUDY AND CONSTRUCTION OF WATER RESOURCES DEVELOPMENT PROJECTS BY NON-FEDERAL INTERESTS
(a) STUDIES.—Section 203 of the Water Resources Development Act of 1986 (33 U.S.C. 2231) is amended to read as follows:
“SEC. 203. STUDY OF WATER RESOURCES DEVELOPMENT PROJECTS BY NON- FEDERAL INTERESTS.
“(a) SUBMISSION TO SECRETARY.—
‘‘(1) IN GENERAL.—A non-Federal interest may undertake a feasibility study of a proposed water resources development project and submit the study to the Secretary.
“(2) GUIDELINES.—To assist non-Federal interests, the Secretary, as soon as practicable, shall issue guidelines for feasibility studies of water resources development projects to provide sufficient information for the formulation of the studies.
“(b) REVIEW BY SECRETARY.—The Secretary shall review each feasibility study received under subsection (a)(1) for the purpose of determining whether or not the study, and the process under which the study was developed, each comply with Federal laws and regulations applicable to feasibility studies of water resources development projects.
“(c) SUBMISSION TO CONGRESS.—Not later than 180 days after the date of receipt of a feasibility study of a project under subsection (a)(1), the Secretary shall

submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives a report that describes—

"(1) the results of the Secretary's review of the study under subsection (b), including a determination of whether the project is feasible;

"(2) any recommendations the Secretary may have concerning the plan or design of the project; and

"(3) any conditions the Secretary may require for construction of the project. "(d) CREDIT.—If a project for which a feasibility study has been submitted under

subsection (a)(1) is authorized by a law enacted after the date of the submission to Congress under subsection (c), the Secretary shall credit toward the non-Federal share of the cost of construction of the project an amount equal to the portion of the cost of developing the study that would have been the responsibility of the United States if the study had been developed by the Secretary."

Further, Section 203 authorization for non-Federal Interests to prepare feasibility studies was last amended by Section 1126 of the Water Infrastructure Improvements for the Nation Act (Public Law 114-322) to allow for the provision of technical assistance, by addition of part (e), as follows:

SEC. 1126. STUDY OF WATER RESOURCES DEVELOPMENT PROJECTS BY NON- FEDERAL INTERESTS.

Section 203 of the Water Resources Development Act of 1986 (33 U.S.C. 2231) is amended by adding at the end the following:

"(e) TECHNICAL ASSISTANCE.—At the request of a non-Federal interest, the Secretary may provide to the non-Federal interest technical assistance relating to any aspect of a feasibility study if the non-Federal interest contracts with the Secretary to pay all costs of providing such technical assistance."

STUDY COLLABORATION

As mentioned above, USACE conducted the original Feasibility Study and produced a 2010 Draft Report in cooperation with the City of Laredo. USACE had been coordinating with the following Federal and State natural resource and other agencies. Coordination with these agencies would continue when future circulation of the Draft Report takes place.

- Federal Aviation Administration (FAA)
- United States Department of Agriculture (USDA)
- United States Environmental Protection Agency (EPA)
- United States Fish and Wildlife Service (USFWS)
- Texas Commission on Environmental Quality (TCEQ)
- Texas Parks and Wildlife Department (TPWD)
- Texas State Historic Preservation Officer (SHPO)

USFWS and TPWD have played key roles during the original alternative evaluation in assessing the fish and wildlife existing conditions, future without-project conditions, and the impacts to the resources. Collaboration with these agencies will continue as the project proceeds. In the meantime,

these aspects of the project—fish and wildlife existing conditions, future without-project conditions, and the impacts to the resources—have been updated in this report and respective appendices.

The study area lies within the jurisdiction of Texas Congressional District 28, which is represented in the U.S. Congress by the Honorable Henry Cuellar. The U.S. Senators for Texas are the Honorable John Cornyn and Honorable Ted Cruz.

GEOGRAPHIC DESCRIPTION

Rio Grande Basin

The Rio Grande forms the boundary between the State of Texas and the Republic of Mexico. Encompassing an area of approximately 417,000 square miles, portions of the Rio Grande Basin (Basin) are located in Colorado, New Mexico, Texas, and the Republic of Mexico. Approximately 20 percent of the basin (87,000 square miles) is located within the boundaries of Texas. *(Image source: USACE, 2010)*

Figure 1, “Rio Grande Basin,” below, shows the extent of the Basin.

Chacon Creek Basin

Chacon Creek is a tributary of the Rio Grande that has a drainage area of approximately 155 square miles (see Figure 2, below). Chacon Creek originates north of Lake Casa Blanca and flows approximately five miles to the south and west emptying into the Rio Grande. Major tributaries flowing into Chacon Creek include Tios Creek and San Ygnacio Creek located above Lake Casa Blanca, and Tinaja Creek, Tributary 1 (TexMex Creek), Tributary 2, Tributary 3, and Tributary 3A located below Lake Casa Blanca.

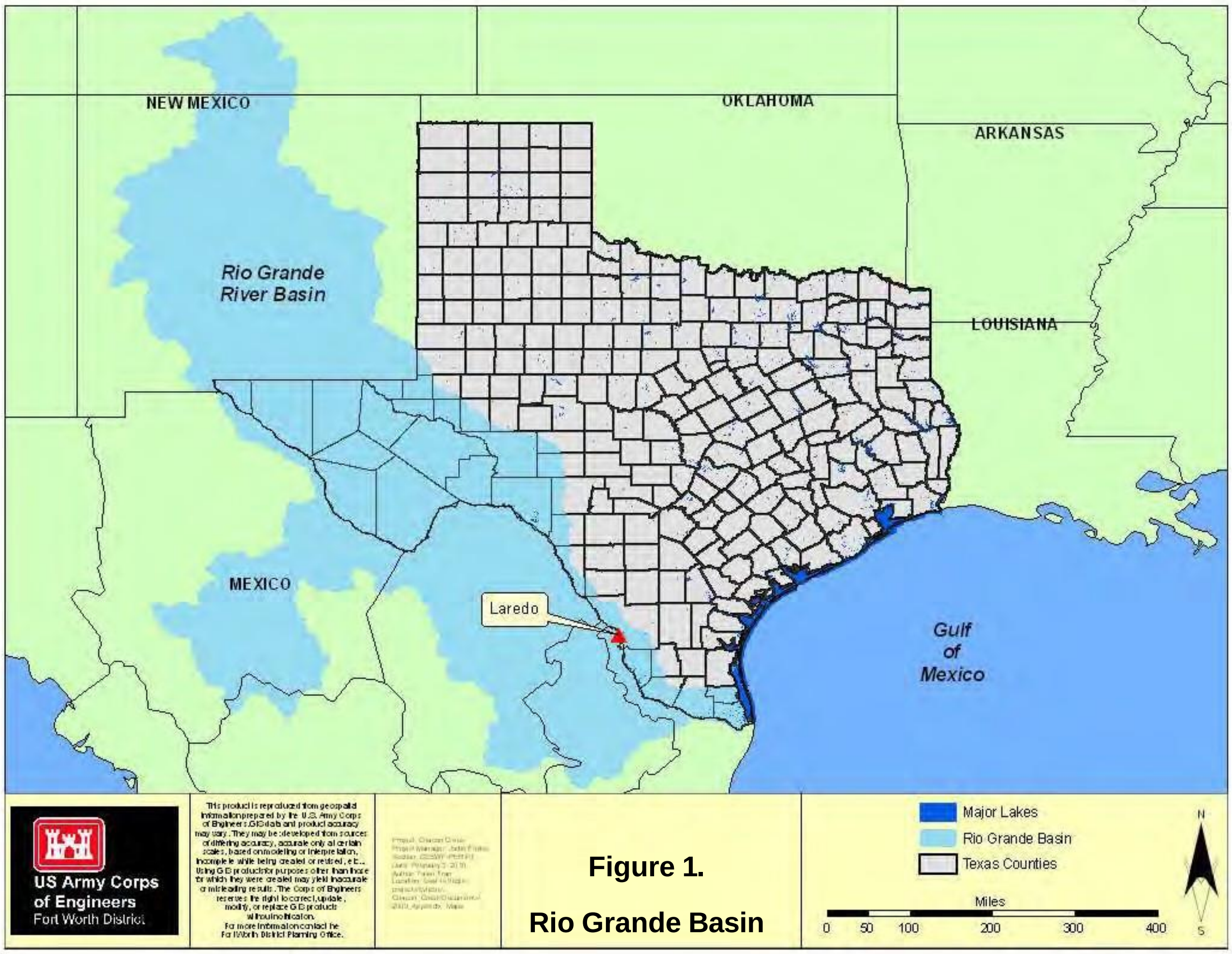
Study Area Description

The study area is in the City of Laredo (City), Webb County, Texas, at the northern border of the Rio Grande (Figure 3). Located in the eastern half of the city, Chacon Creek originates north of Lake Casa Blanca and flows about five miles to the southwest where it forms a confluence with the Rio Grande. Lake Casa Blanca and Chacon Creek are located along what used to be the eastern and southern edges of development associated with the City. In recent years, urban development east of Chacon Creek and along the eastern tributaries has filled in much of the watershed. The Laredo International Airport is located immediately west of Lake Casa Blanca in the northern part of the lower Chacon Creek watershed.

The study area encompasses the lands along Chacon Creek within the 500-year floodplain and contains approximately 1,006 acres along the main stem and Tributary 2. The drainage areas, lengths, and gradients of Chacon Creek and associated tributaries are presented in

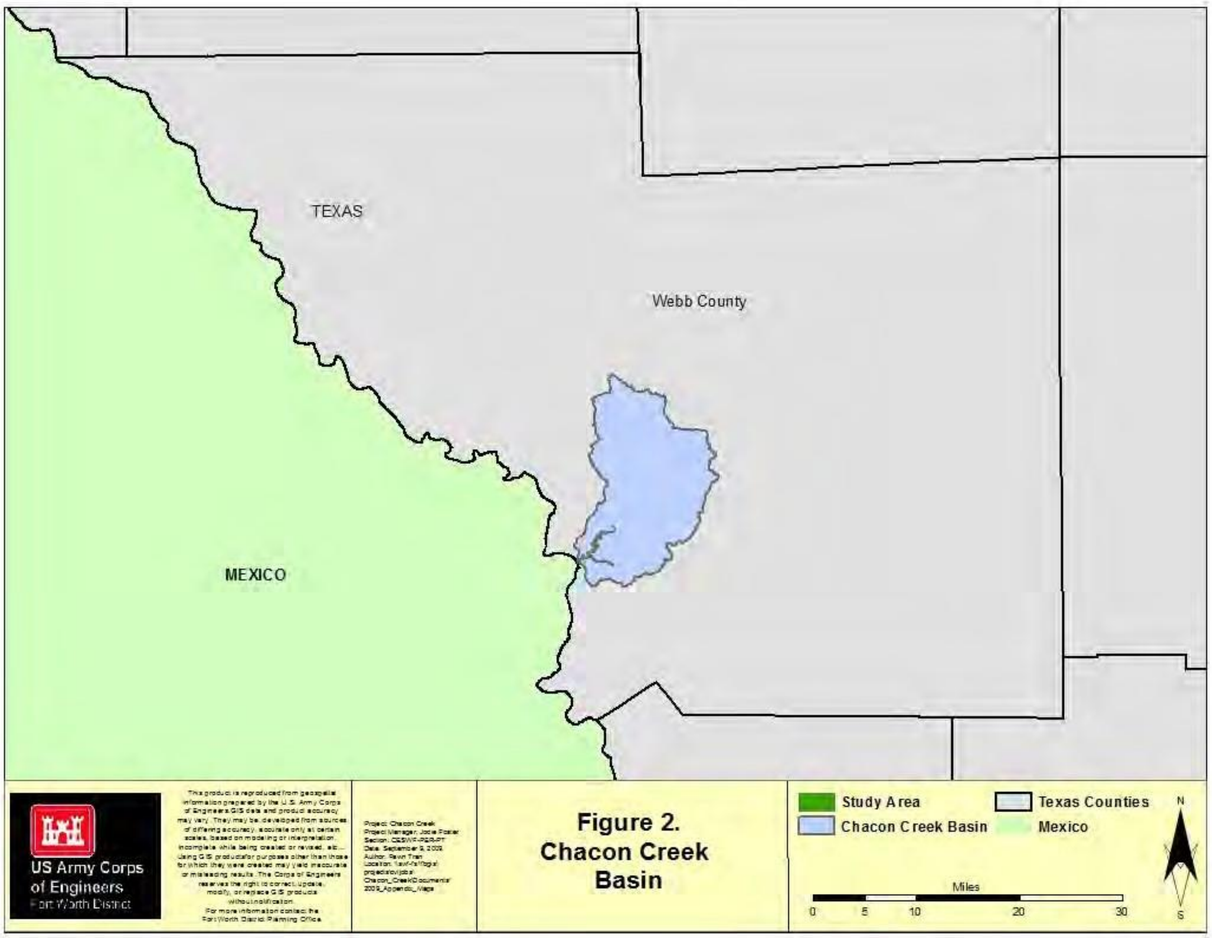
Table 1. Tinaja and TexMex Creeks were not included because no structures exist in the 500-year floodplain. Tributary 3, though

outside the city limits when the floodplain was originally delineated, has not been an area that has historically had flooding problems. The City has Conditional Letters of Map Revisions (CLOMRs) on file, issued by the Federal Emergency Management Agency (FEMA) for modification of existing regulatory floodways for this area.



(Image source: USACE, 2010)

Figure 1. Rio Grande Basin

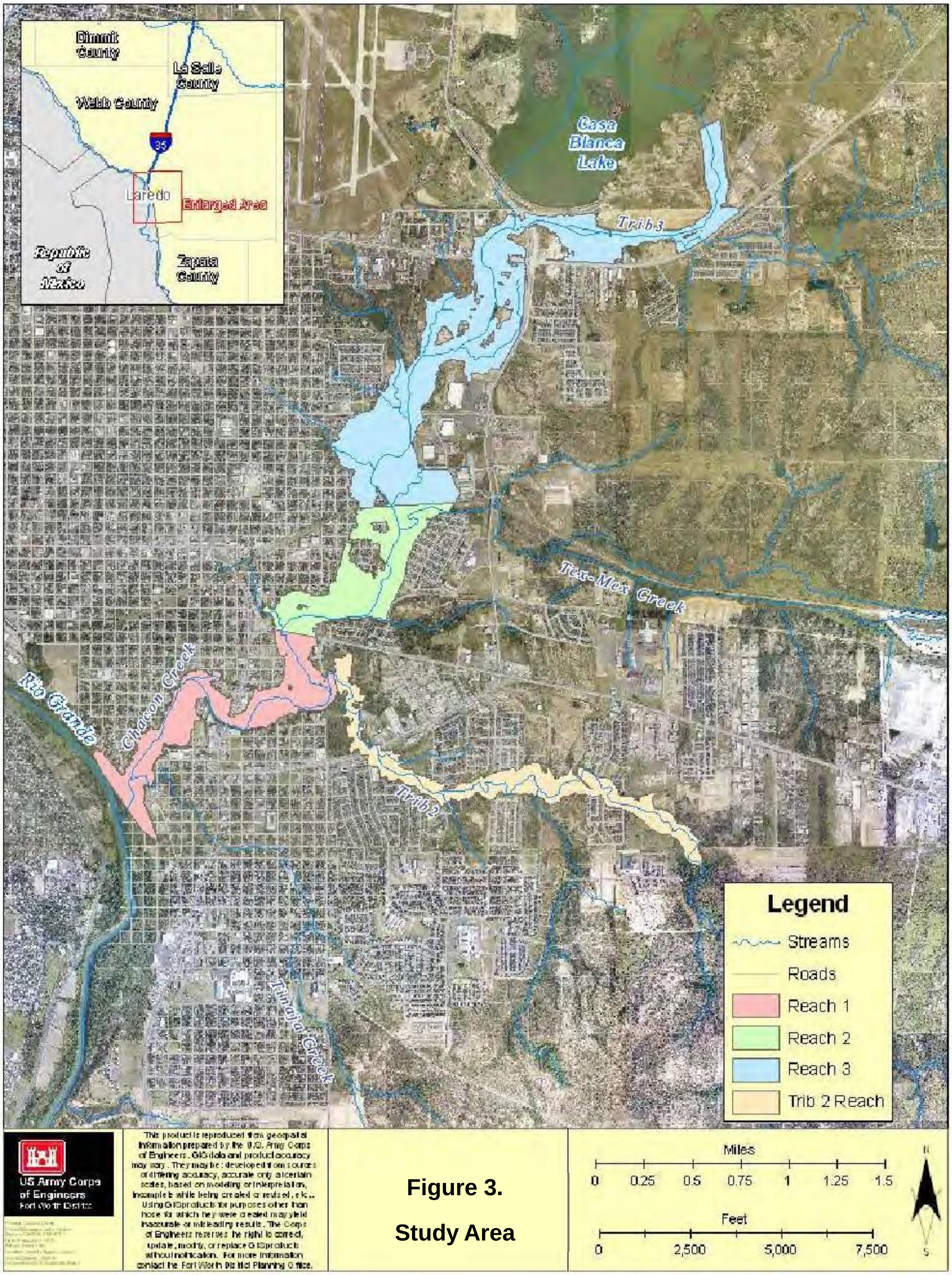


(Image source: USACE, 2010)

Figure 2. Chacon Creek Basin

Table 1. Chacon Creek and Tributaries

Waterway	**Drainage Area** (sq mi)	**Length** (feet)	**Gradient** (percent)
Chacon Creek	155.0	35,000	0.2
Tinaja Creek	2.5	8,000	0.8
Tributary 1 (TexMex Creek)	6.2	7,000	0.3
Tributary 2	16.0	16,300	0.5
Tributary 3, 3A	6.0	4,000	0.4



(Image source: USACE, 2010)

Figure 3. Study Area

Much of the watershed west of Chacon Creek and a substantial portion of lands adjacent to the study area within the 100-year floodplain have been developed. A large portion of the upper watershed east of the creek remains relatively undeveloped. Four major bridges cross the creek within the study area: State Highway 359, U.S. Highways 83 and 59, and the Texas Mexican International Railway Bridge.

The creek, below Lake Casa Blanca, is an intermittent stream with low flow, approximately less than 5 cfs, much of the time. Flows to Chacon Creek downstream of Lake Casa Blanca are primarily a result of dam seepage. The stream provides flood conveyance, but it also serves as a local natural resource with recreational, educational, and economic potential. In prior years Chacon Creek has been adversely impacted by illegal dumping and other detrimental activities including a confined animal feeding operation (CAFO).

Aesthetic resources in the study area consist of man-made and natural landscape features that are indigenous to the area and give the environment its visual characteristics. In general, the project corridor is highly disturbed. However, it is an important ecosystem resource within an urban setting. The project corridor is predominately riparian vegetation flanking a small stream and occasional open- water wetland. The lush vegetation, although composed of mainly invasive species, contrasts the urban environment and semi-arid desert countryside.

Lake Casa Blanca

Lake Casa Blanca was created by the impoundment of Chacon Creek in 1951 by Webb County to provide recreational opportunities for residents of Webb County. Webb County continues to operate and maintain the lake. The dam impounds approximately 1,680 surface acres to form Lake Casa Blanca. The lake’s dam is a curved earth fill structure and is classified as large in size (impoundment capacity of 77,838 acre-feet at the top of dam elevation). An earth cut service spillway is located approximately 3,500 feet northeast of the left abutment, and an emergency spillway is located near the right abutment. The dam provides flood protection to downstream residents.

EXISTING PROJECTS

A number of existing water resource projects in the study area are relevant to the formulation of any proposed actions in this study. This section provides a summary of the projects currently underway and their potential impacts on this study.

Detention Ponds

To mitigate flooding the City constructed three small detention ponds within the Chacon Creek basin. One pond is in the Los Presidentes area and is designed to accommodate a peak discharge of 239 cfs. The second pond is located south of Chacota Street, adjacent to the Zachery Elementary School. The third pond is located east of Ejido Street and includes approximately 1,600 linear feet of a concrete channel between Louisiana Street and Pine Street to improve the hydraulic capacity and channel conveyance. The latter two detention basins have reduced the 100-year peak discharge for the Tinaja watershed by 638 cfs. The existence of these detention ponds did not directly influence what flood risk management alternatives would be formulated in this study, but they should be considered when addressing cumulative effects of any TSP.

Stream Stabilization

Completed December 2005, Phase I of the EPA Chacon Creek Restoration Project consisted of removal of invasive species, as well as trash and solid waste removal from the mouth of Chacon Creek one-half mile upstream. Revegetation of the area with over 15,000 native trees and shrubs improved the diversity and habitat value to wildlife in the same area.

Completed December 2007, Phase 2 of the same EPA project consisted of a bioengineered stream bank stabilization project in an area with high erosion near the mouth of the creek. Phase 2 also included a revegetation component that covers a stream reach of one mile starting upstream from where the Phase 1 revegetation ended.

The EPA has not issued an assessment of this project, but the City believes that it has been successful given that erosion problems have been resolved in the area. This project did not have a direct impact on what potential features would be formulated in this study, but it should be considered when addressing cumulative effects of any TSP.

Brownfield Remediation

The City of Laredo received a $100,000 hazardous substances grant to clean up the 18-acre Killam Lake site in the Chacon Creek watershed from the EPA Brownfield Grant program. The site was contaminated with hazardous substances from years of illegal dumping activities. Grant funds were also used for cleanup planning and community outreach activities.

The City was selected as a Brownfield Sustainability Pilot. A new recreation center will be constructed adjacent to the Brownfield cleanup site, with EPA funds assisting with the design of energy and resource conservation building features, an innovative storm water management system to reduce impervious surface areas and improve site conditions, including the use of native vegetation to conserve water resources. The site was considered for reforestation as part of the ecosystem restoration component of this Chacon Creek project, but the City’s intent for the area takes priority.

Section 206 Aquatic Ecosystem Restoration Project

USACE, with the City of Laredo as the non-Federal sponsor, conducted a feasibility study on a proposed 130-acre aquatic ecosystem restoration area adjacent to the Rio Grande, along a 90-degree bend in the southwest portion of the city (USACE 2013). This study was initiated about the same time as the original Chacon Creek Feasibility Study; however, it was studied under Section 206 (Aquatic Ecosystem Restoration) of the USACE Continuing Authorities Program. The study was completed in 2013, the design was completed in 2015, and construction began in 2016.

The study area contains seven derelict gravel pits and large spoil mounds remaining from sand and gravel operations that ceased around 1954. The pits are supplied lateral subsurface percolating water from the Rio Grande, and the property has problematic non-native invasive plant species. Because it is located in the southwest corner of the City, this project does not have any direct relationship with the Chacon Creek study, but has been considered when addressing cumulative effects of any TSP.

PRIOR STUDIES AND REPORTS

A number of previously published studies and reports, prepared by USACE (Fort Worth District) and other entities, were consulted in developing this feasibility report. This section lists the reports and describes their relevance to the water resources feasibility study for Chacon Creek.

U.S. Army Corps of Engineers

***Section 905(b) Report, Rio Grande Basin,* U.S. Army Corps of Engineers, Fort Worth District, 20 April 2004**. The report identified a number of flood risk management and ecosystem restoration problems and opportunities in the Rio Grande Basin including Chacon Creek in Laredo. The report concluded that further feasibility studies were warranted. The report was approved on 20 May 2004 by the U.S. Army Corps of Engineers, Southwestern Division.

Other Entities

***City of Laredo, Chacon Creek - A Master Plan,* Carter Burgess, August 2001**. The Chacon Creek Master Plan analyzed the existing conditions of the creek corridor, developed a vision for the creek, and identified a collection of improvements that work together to satisfy many requirements of the Chacon Creek corridor. The preliminary plan consists of two components. The first is a channel modification beginning at the Highway 359 bridge and extending upstream about 3,000 feet. The second is a modification to the Texas Mexican International Railway (Tex Mex) Bridge. This plan would raise the bridge by two feet and widen the opening by approximately 300 feet, subject to constraints involving the Tex Mex bridge.

***City of Laredo Parks and Open Space Master Plan*, 2008**. This master plan addresses the need to provide quality park and recreation infrastructure and services, especially in developing parts of the city. Part of the preparation of the master plan included a bilingual community needs assessment for each of the city’s eight council districts, including not only the present city limits but also the city’s extra territorial jurisdiction (ETJ). Phase 1 encompassed the needs assessment while Phases 2 and 3 covered the goals and objectives for the Parks and Recreation Service, recommendations for Indoor and Outdoor Recreation Priorities, and Action Plan and Implementation Strategies.

AFFECTED ENVIRONMENT

Section Two establishes a baseline for each of the following resources within the study area: land use; air quality; geology, soils, and topography; prime farmlands; groundwater; hydrology and hydraulics; terrestrial resources; aquatic resources; threatened and endangered species; cultural resources; hazardous, toxic, and radioactive waste; recreational resources; and other social concerns.

Based on the environment as assessed in this study, “future without-project” conditions were projected for the study period of analysis (50 years). Section Two concludes with descriptions of these future without-project conditions, which will be used as a baseline for measuring the impacts and benefits of alternative flood risk management and ecosystem restoration plans, during the subsequent alternative impact assessment.

Section Two and the related Section Four (Environmental Consequences) address National Environmental Policy Act (NEPA) requirements for the project. Any changes to the proposed project, existing resources, listed species within the project area, regulations or any other components that should be updated or analyzed would be conducted at that time per NEPA and Council on Environmental Quality (CEQ) guidelines.

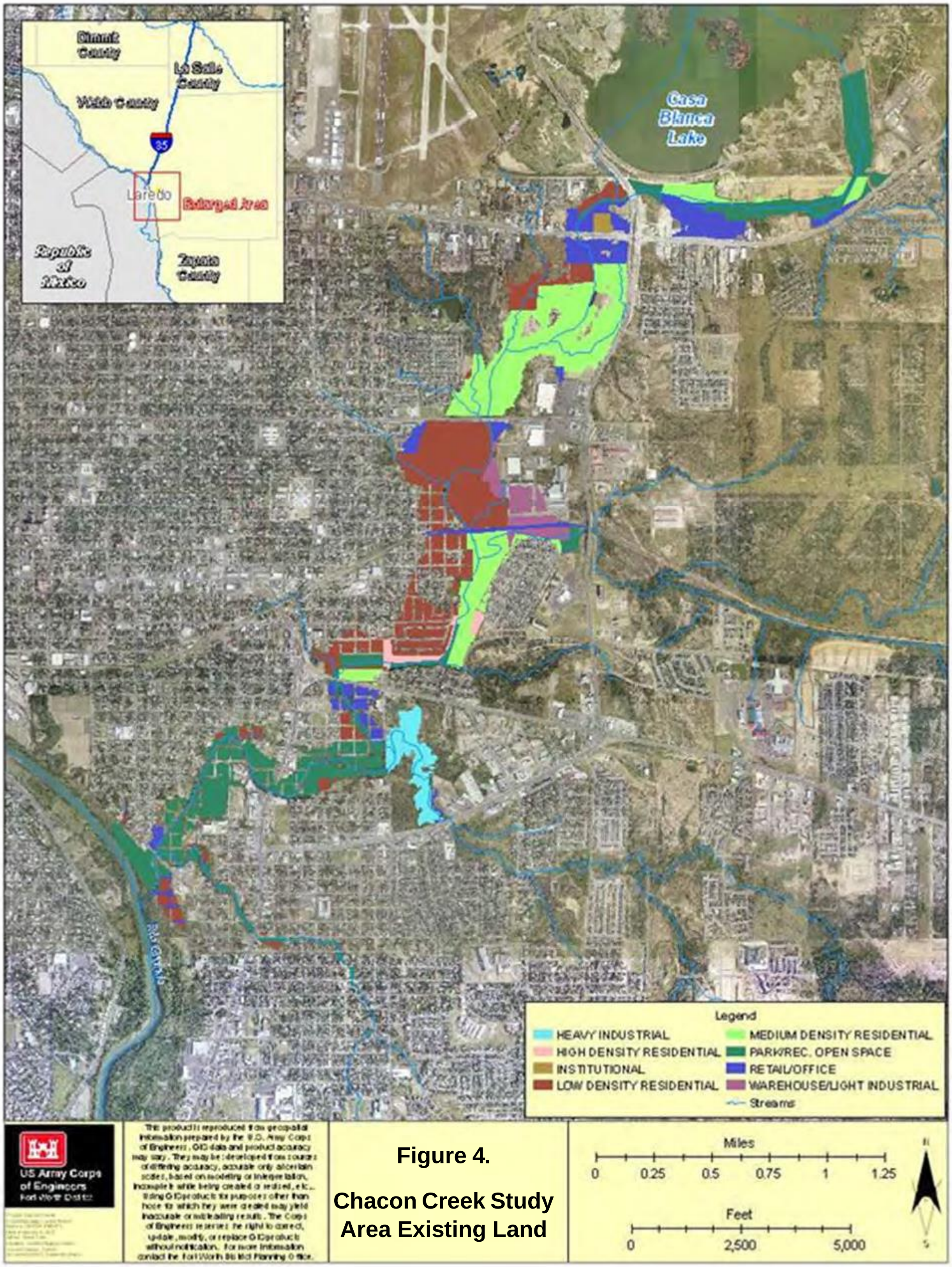
LAND USE

Table 2 displays a summary of the existing land use within the study area.

Table 2. Chacon Creek Existing Land Use

Classification	Acres	Percent of Total
Highway Commercial	38.32	4.6%
Light Manufacturing	115.56	13.8%
Mixed Residential	103.83	12.4%
Single Family Residential	193.65	23.2%
Community Business	200.47	24.0%
Limited Business	6.92	0.8%
Multi-Family Residential	28.82	3.5%
Agricultural	64.38	7.7%
Single Family Reduced Area	78.58	9.4%
Heavy Manufacturing	1.47	0.2%
Highway Commercial	38.32	4.6%
Total	**835.02**	**100%**

Source: City of Laredo GIS Division, 2017



(Image source: USACE, 2010)

Figure 4. Study Area Existing Land Use

AIR QUALITY

The EPA established National Ambient Air Quality Standards (NAAQS) for specific pollutants determined to be of concern with respect to the health and welfare of the general public. The major pollutants of concern, or criteria pollutants, are carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, lead, and suspended particulate matter of less than 10 microns. Texas is in the EPA Air Quality Region 6.

The Texas Commission on Environmental Quality (TCEQ) is the state agency responsible for permitting, remediation, and registration. Because Texas does not have state ambient air quality standards, TCEQ uses the NAAQS. Webb County is currently in attainment for all criteria pollutants (EPA 2010).

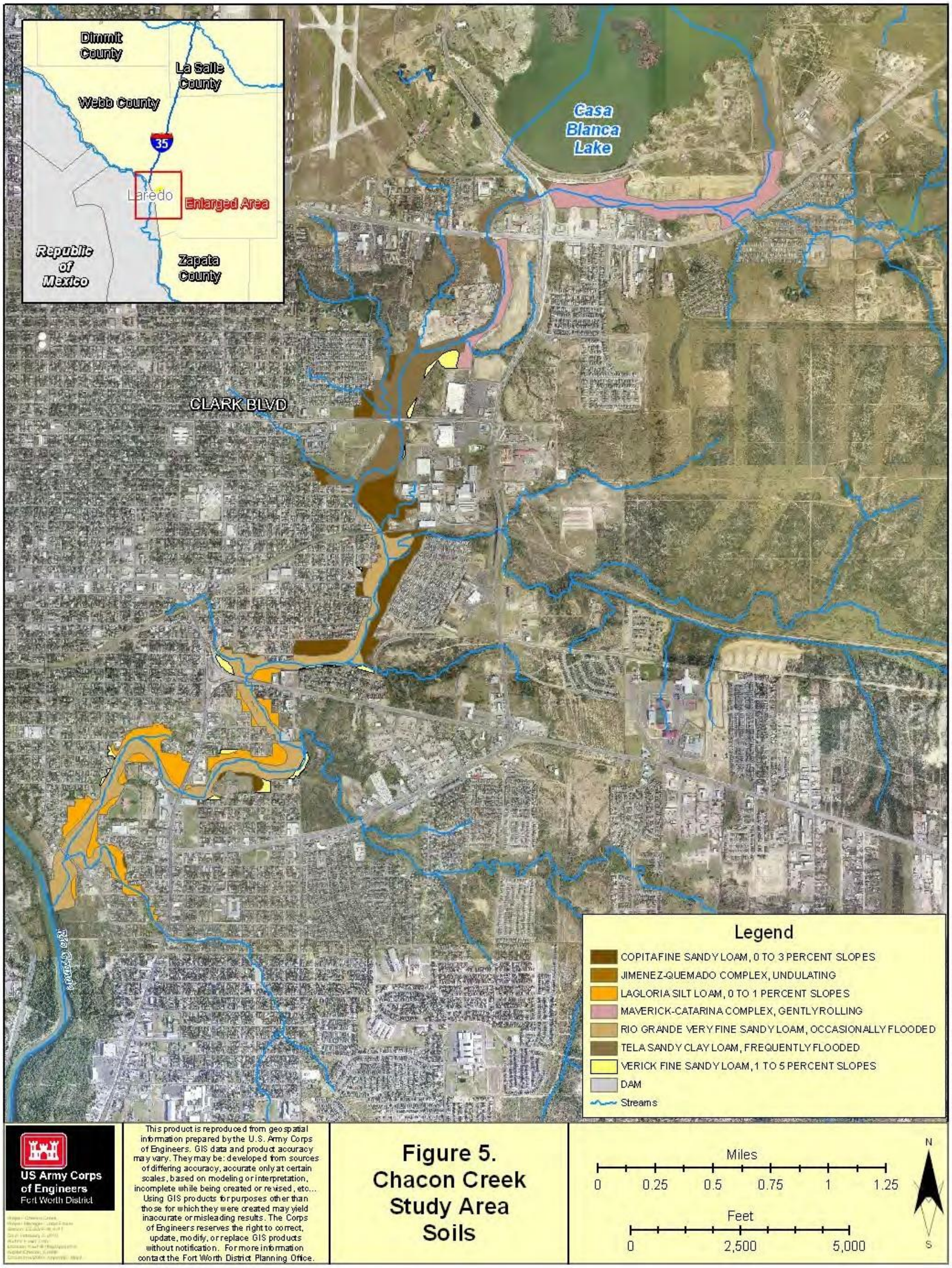
GEOLOGY, SOILS, AND TOPOGRAPHY

The study area is located within the Western Gulf Coastal Plains of the United States, which is an elevated sea bottom with low topographic relief. Topography in the region ranges from a rolling, undulating relief in the northwestern portion to the progressively flatter relief near the Gulf Coast. The lower portion of the region consists of broad, flat plain that rises gently from sea level at the Gulf of Mexico in the east to an elevation of approximately 960 feet in the northern part of Maverick County at the upper end of the region. Geologic formations exposed in the region include Cretaceous, Tertiary, and Quaternary-aged deposits. In general, the region's geologic strata decrease in age from west to east across the area. The oldest strata (Cretaceous age) outcrop in northwestern Maverick County consists of chalky limestone and marl. The youngest, or most recent, sediments are in Cameron County. In general, soils in the Rio Grande Region are of calcareous to neutral clays, clay loams, and sandy loams.

Soils

The soils within Chacon Creek consist primarily of two soil types: Tela Sandy Clay Loam and Rio Grande Very Fine Sandy Loam. The dividing line between the two types is located almost coincident with the Texas Mexican International Railway crossing. Both soil types are well-drained and very permeable. The banks and surrounding land consist of four soil types: Copita Fine Sandy Loam, Jimenez-Quemado Complex, Lagloria Silt Loam, and Maverick-Catarina Complex.

The Copita Fine Sandy Loam, Jimenez-Quemado Complex, and Maverick-Catarina Complex are all low-water capacity, medium to rapid runoff soils. Erosion is a moderate hazard if the soil is left exposed to concentrated water flows. The Jimenez-Quemado Complex and Maverick-Catarina Complex are also dense soils, not easily penetrated by plant roots. A total of eight soil types are found in the study area, as shown in Figure 5 and described as follows (USGS 1985).



(Image source: USACE, 2010)

Figure 5. Study Area Soils

- **Copita Fine Sandy Loam** [CpB], 0 to 3 percent slopes. Copita fine sandy loam is a moderately deep soil (37 inches) with an underlying layer of cemented sandstone. This soil represents approximately 71 acres, or 16 percent, of the soil in the study area. The soil is found at high elevations in the middle portion of the study area and a majority of these areas have been recently cleared for development. Although water capacity is low, the deep rooting zone supports a variety of xeric plant species that provide adequate food and cover for wildlife.
- **Jimenez-Quemado Complex** [JQD], undulating. The Jimenez-Quemado complex is an intricate mixture of the Jimenez and Quemado soils. This soil represents approximately half an acre, or less than one percent, of the soil in the study area. The complex is composed of shallow to very shallow soil (6 to 13 inches) on the summits and side slopes of hills and ridges. The very low water capacity and shallow to very shallow rooting zone limits the availability of vegetation and thus, provides little forage and cover for wildlife.
- **Lagloria Silt Loam** [LgA], 0 to 1 percent slopes. The Lagloria silt loam is a deep (63 inches), nearly level soil on smooth terraces parallel to the Rio Grande. This soil represents approximately 59 acres, or 13 percent, of the soil in the study area. This soil is found at high elevations in the lower portion of the study area near the Rio Grande. The available water capacity is medium, and the deep rooting zone is easily penetrated by plant roots. These soils are capable of supporting a diverse flora, which often includes trees and species that provide adequate forage and cover for a large variety of wildlife species including birds.
- **Maverick-Catarina Complex** [MCE], gently rolling. The Maverick-Catarina complex is composed of Maverick and Catarina soils and is located in the upper portion of the study area including the area below Lake Casa Blanca dam. This soil represents approximately 79 acres, or 18 percent, of the soil in the study area. The shallow surface soil (6 to 10 inches) is clay, and the subsurface soils (to 60 inches) are saline clays. The available water capacity is low, and plant roots do not easily penetrate the deep to moderately deep rooting zone. The wildlife carrying capacity of these soils is lower than surrounding soils.
- **Rio Grande Very Fine Sandy Loam** [Rg], occasionally flooded. The Rio Grande very fine sandy loam is a deep (63 inches), nearly level soil in the floodplain of the Rio Grande and adjacent tributaries. This soil represents approximately 134 acres, 30 percent, of the soil in the study area. This soil is well drained with slow runoff and moderately rapid permeability. Available water capacity is high, and the deep root zone is easily penetrated by plant roots. Less than once every two years, this soil is flooded for brief periods by release of water from Lake Amistad and increased flows of tributaries of the Rio Grande below Lake Amistad during and after high rainfall events. These soils generally provide high quality wildlife habitat and provide sufficient moisture for the development of riparian woodlands and forests.
- **Tela Sandy Clay Loam** [Te], frequently flooded. The Tela sandy clay loam is a deep (63 inches), nearly level soil and is found at low elevations in the upper portion of the study area. This soil represents approximately 81 acres, or 19 percent, of the soil in the study area. The soil is well drained. However, surface runoff is slow and permeability is moderate resulting in a high water capacity. Heavy rainfall events result in brief periods of flooding at an interval greater than once every two years. The availability of water and deep soils of the Tela sandy clay loam typically provides higher quality wildlife habitat than surrounding soils.
- **Verrick Fine Sandy Loam** [VkC], 1 to 5 percent slopes. Verrick fine sandy loam is a shallow (15 inches), gently sloping soil and found in the central portion of the study area. This soil represents approximately 14 acres, three percent, of the soil in the study area.

The calcareous, moderately alkaline, fine sandy loams have a very low water capacity and the root zone is shallow. However, these soils are capable of supporting dense brush cover.

In addition to these soil types, there could be small areas of saline soil that would be difficult to detect. Salt-tolerant species indicate where salt and/or alkaline minerals have accumulated at the surface, or are present in soil strata near the surface. Where these species dominate, it is difficult or impossible to establish less salt-tolerant species. The native plants of wet saline soils include big sacaton (*Sporobolus wrightii*), sea ox-eye daisy (*Borrichia frutescens*), seaside heliotrope (*Heliotropium curassavicum*), and seepweeds (*Suaeda* spp.). Dry saline soils support native herbaceous plants, including four-wing saltbush (*Atriplex canescens*), tubercled saltbush (*Atriplex acanthocarpa*), dog cholla (*Opuntia schottii*), and whorled dropseed (*Sporobolus pyramidatus*). Russian thistle (*Salsola tragus*) is a common invasive plant in dry saline soils and is present in disturbed portions of the study area. Stunted mesquite (*Prosopis* spp.), prickly pear (*Opuntia* spp.), common goldenweed (*Isocoma coronopifolia*), whiplash pappusgrass (*Pappophorum vaginatum*), and other native grasses could indicate where a saline stratum is near the surface (just below the rooting zone of grasses).The principal invasive species in the study area are salt cedar (*Tamarix* spp.), Arundo cane (*Arundo donax*), and buffelgrass (*Pennisetum ciliare*).

Prime Farmland Soils

While the Rio Grande basin contains soils that are potentially considered prime or unique farmland, no prime farmland exists within the Chacon Creek study area.

GROUNDWATER

The only significant aquifer in Webb County is the Carrizo Formation, which outcrops in the extreme northwestern portion of the county (Klemt *et al*. 1976; Ryder, 1996). The Laredo Formation is another water-bearing formation near the City of Laredo and yields small quantities of water for irrigation and livestock use.

CLIMATE

The climate within the Lower Rio Grande Region varies from a humid subtropical regime in the eastern portion of the region to a tropical and subtropical regime in the rest of the region. Prevailing winds are southeasterly throughout the year, and the warm tropical air from the Gulf of Mexico produces hot and humid summers and relatively mild and dry winters. The number of frost-free days (growing season) varies from 320 days for coastal areas to 230 days for the northwestern portions.
Rainfall varies across the Lower Rio Grande Region with an average of 28 inches at the coast to 18 inches in the northwestern portion. The City of Laredo average spring/summer temperatures range from 54 to 98 °F, and the fall/winter temperatures range from 46 to 95 °F. For Laredo, on average, 179 days of the year exceed 90 °F and 14 days fall below 32 °F. Average annual precipitation is 19 inches, and average annual humidity is 62 percent. Annual rainfall can be expected to occur in a few heavy events, and the region is susceptible

to widespread, heavy rainfall events associated with tropical storms moving inland from the Gulf of Mexico.

HYDROLOGY AND HYDRAULICS

This report presents an overall systematic approach based on the simulation of some extreme event conditions, using an hydrologic model to generate the resulting river flows, and then using the hydraulic modeling program HEC-RAS to develop the resulting floodplain in the study area. This section describes the hydrologic and hydraulic characteristics of the Chacon Creek study area (Appendix G.1-1).

Existing Conditions Hydrology

The hydrologic analysis was completed using the Hydrologic Engineering Center-1 (HEC-1) program. The watershed was divided into eight subbasins ranging from one to 117 square miles. Peak discharges (Q) for Chacon Creek and its tributaries were calculated using the methodology developed by the Natural Resource Conservation Service (NRCS).

The hydrologic parameters used to determine peak flows included rainfall data, watershed data, and soil properties.

- Soils in the Chacon Creek study area were grouped based on the minimum rate of infiltration and classified based on the Soil Survey of Webb County, Texas, published by the Department of Agriculture in October 1985.
- Each hydrologic basin in the watershed was divided based on the percentage of contributing soil group classification and land use cover. A composite NRCS curve number was derived to describe the physical parameters of each hydrologic subbasin for the existing development conditions in January 1994.
- Rainfall depths used in the computation of runoff from each subbasin were modified using depth- to-area curves developed by the Soil Conservation Service (SCS), and a precipitation hyetograph was used as input in the HEC-1 model for all runoff calculations.
- Additional parameters were determined from the available aerial photographs and the digital terrain model (DTM) of the drainage basins.

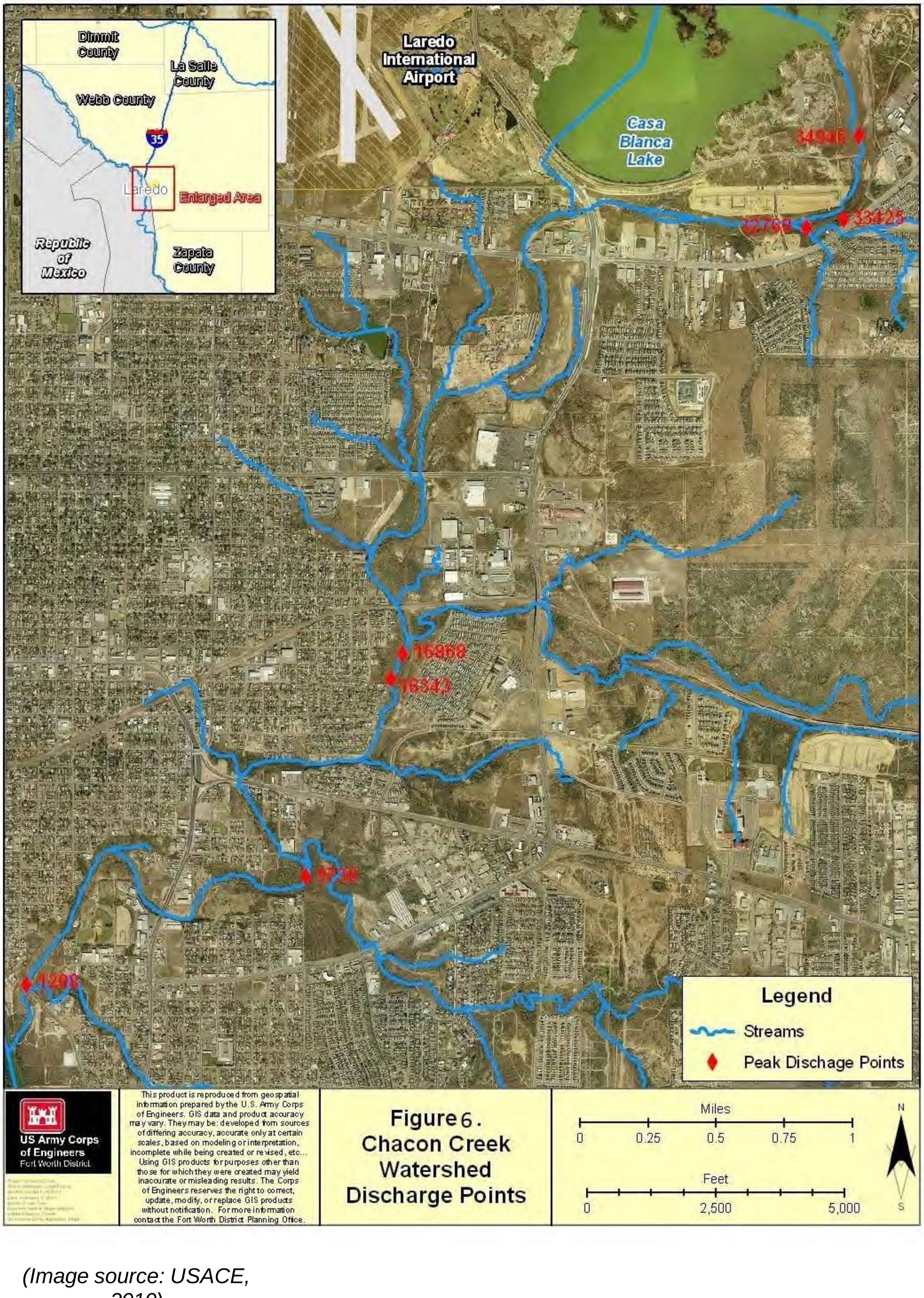
Table 3, “Chacon Creek Fully Developed Basin, Existing Peak Flows,” lists the completed Chacon Creek peak discharges for the 50, 20, 10, 4, 2, 1, 0.4, and 0.2% annual chance exceedance (ACE) events.

Figure 6, “Chacon Creek Watershed Discharge Points,” pinpoints the stream stations where the peak discharges were recorded.

Flows from Chacon Creek stay approximately the same from the lake to the confluence with the Rio Grande despite side-flow urban runoff and tributary flow. This is due to the size of the overall Chacon Creek watershed and the relatively small contributing area of the tributaries. Storage in the basin is more than enough to handle any peak flows from the tributaries, and this allows the main stem flows to dominate the overall flow. For this reason, as well as only minor changes in development downstream of Lake Casa Blanca since 2010, the hydrology identified during the plan formulation phase of this study still represents current conditions. Since the hydrology and resulting floodplain have remained consistent with previous analyses, no structural inventory changes are anticipated beyond the removal of structures as part of the non-structural floodplain management effort conducted by the City since 2010.

Table 3. Chacon Creek Fully Developed Basin, Existing Peak Flows (cfs)

Discharge Point/Location	Station	Drainage Area (sq mi)	Flow by Annual Chance Exceedance							
			50%	20%	10%	4%	2%	1%	0.4%	0.2%
Lake Casa Blanca Spillway	34946	116.9	8,540	10,994	13,309	17,133	20,741	25,610	31,598	37,041
South of Lake Casa Blanca Spillway	33425	122.9	8,540	10,994	13,309	17,133	20,741	25,610	31,598	37,041
South of Lake Casa Blanca Spillway	32760	126.9	8,539	10,992	13,305	17,127	20,731	25,596	31,582	37,023
South of Tex Mex Railway Bridge	16868	142.9	8,357	10,990	13,304	17,126	20,732	25,597	31,586	37,030
South of Tex Mex Railway Bridge	16343	144.8	8,538	10,991	13,304	17,126	20,730	25,594	31,582	37,025
South of SH 359	9730	151.0	8,538	10,991	13,304	17,126	20,730	25,594	31,582	37,025
Tinaja Creek at Meadow Avenue	1208	154.5	8,538	10,990	13,303	17,124	20,728	25,592	31,579	37,022



(Image source: USACE, 2010)

Figure 6. Watershed Discharge Points

Existing Conditions Hydraulics

Flood frequency data was developed using the rainfall data from TP-40 (Technical Paper No. 40 Rainfall Frequency Atlas of the United States) published by the National Weather Service. Peak discharge-frequency relationships were determined by performing hydrologic analyses for floods of the selected recurrence intervals for each subbasin studied in the watershed using the Hydrologic Engineering Center - River Analysis System (HEC-RAS) version 4.0 computer model to simulate the precipitation-runoff process and compute flood hydrographs at appropriate locations in the watershed. Water surface elevations. and profiles were computed and plotted for the 50, 20, 10, 4, 2, 1, 0.4, and 0.2% annual chance exceedance events. Table 4 displays the water surface elevations (WSE) for the index points at each of the study reaches.

Table 4. Flood Water Surface Elevations (feet) by ACE

Index Point	Depth by Annual Chance Exceedance							
	50%	20%	10%	4%	2%	1%	0.4%	0.2%
6065	376.00	377.36	378.50	380.09	381.39	383.00	384.76	386.21
15230	392.28	393.55	394.59	396.01	396.86	397.86	398.93	399.84
26537	408.61	409.74	410.66	412.08	413.24	414.08	414.97	415.76
8294	423.30	423.74	424.11	424.64	425.03	425.42	425.81	426.81

Flows were estimated for the main stem of Chacon Creek and for Tributary 2. Table 5 displays the estimated flows at the index points in the study area.

Table 5. Flows (cfs) by ACE

Index Point	Velocity by Annual Chance Exceedance							
	50%	20%	10%	4%	2%	1%	0.4%	0.2%
6065	8,538	10,991	13,304	17,126	20,730	25,594	31,582	37,025
15230	8,538	10,991	13,304	17,126	20,730	25,594	31,582	37,025
26537	8,539	10,992	13,305	17,127	20,731	25,596	31,582	37,023
8294	2,910	3,622	4,275	5,322	6,281	7,440	8,761	9,913

Storm Water Erosion

The increase of impervious surfaces in the lower Chacon Creek watershed contributes to the rapid flooding and high flow volumes characteristic of Chacon Creek after high rainfall events. While there is always some balance in the amount of sediment transport in any river system, Chacon Creek does not have any issues concerning head cutting or gully formation.

Existing Conditions Flood Damage Analysis

This section summarizes the socioeconomic characteristics of the study area and the potential impact on the formulation and evaluation of any proposed action. For this analysis, the study area was divided into four economic reaches, defined as follows:

- Reach 1 is the area of Chacon Creek between the confluence with the Rio Grande and State Highway 359
- Reach 2 is between State Highway 359 and the Tex Mex Railway
- Reach 3 is between Tex Mex Railway and Lake Casa Blanca
- Tributary 2 originates north of Merida Drive and has its confluence with Chacon Creek at S. Ejido Street.

Historic Floods

- **2002**. Flood events in 2002 impacted the City of Laredo resulting in significant property damage and prompted the city to permanently remove three houses along Chacon Creek.
- **2007**. Floods that impacted much of the State of Texas in June of 2007 also impacted the City of Laredo resulting in significant property damage and the first flooding death in the city’s history. The city received five to eight inches of rain in a four-hour period in an area that normally receives 19 inches of precipitation annually. A total of 18 homes were reported to have received major damage and 50 more received minor damage. Several homes along Chacon Creek were almost entirely inundated. The city estimates that over one million dollars of damages occurred in the city in this flood event alone. Historically, Chacon Creek has flooded homes and businesses that lie along the creek. This has been exacerbated by the explosive growth within the upper portions of the watershed.
- **1998, 2010, 2012, 2014, and 2017.** These years also saw heavy rains and flooding in the study area and resulted in significant property damage within the City of Laredo.

Study Area Inundation

On the following pages, Figures 7a–10a depict graphically the depth of flooding that would occur in each of the four economic reaches during the 1% ACE or 100-year event. The depths, from the water surface of the 1% ACE to the ground, are depicted in shades of blue.

- The lightest blue indicates the shallowest depths, which range from roughly 0.5 to 3.2 feet.
- The darkest blue indicates the deepest depths, which range from 36 to 40 feet.

Preceding each of the four figures, corresponding Figures 7–10 illustrate projections of the actual structures that would be potentially impacted by inundation within these areas. The structures within individual reach are color-coded by the flood event in which they sustain damages.

Climate Change

A qualitative climate change analysis was conducted according to Engineering and Construction Bulletin (EBC) No. 2016-25 (USACE 2016). The detailed analysis may be found in Appendix G-1a.

Per the guidance in the EBS, climate change trends were excerpted from various sources that discussed regional trends in temperature, precipitation, and hydrology. Further, both the USACE Climate Hydrology Assessment Tool and the Nonstationarity Detection Tool were then used to examine observed and projected trends in watershed hydrology to support the qualitative assessment.

The literature results support either no distinguishable trend or a declining trend in precipitation or frequency of extreme events, based on historical data. The assessment tools' respective results also indicate that the observed changes in the current data period exhibit a declining trend in annual peak instantaneous streamflow. These tools' projected changes in *future* periods exhibit an increasing trend in annual peak instantaneous streamflow. However, both the existing data and future projection trends are not statistically significant because they are based on trend lines plotted through data points that have high variance ("p-values).

Figure 7. Chacon Creek Reach 1 with 1% ACE Inundation

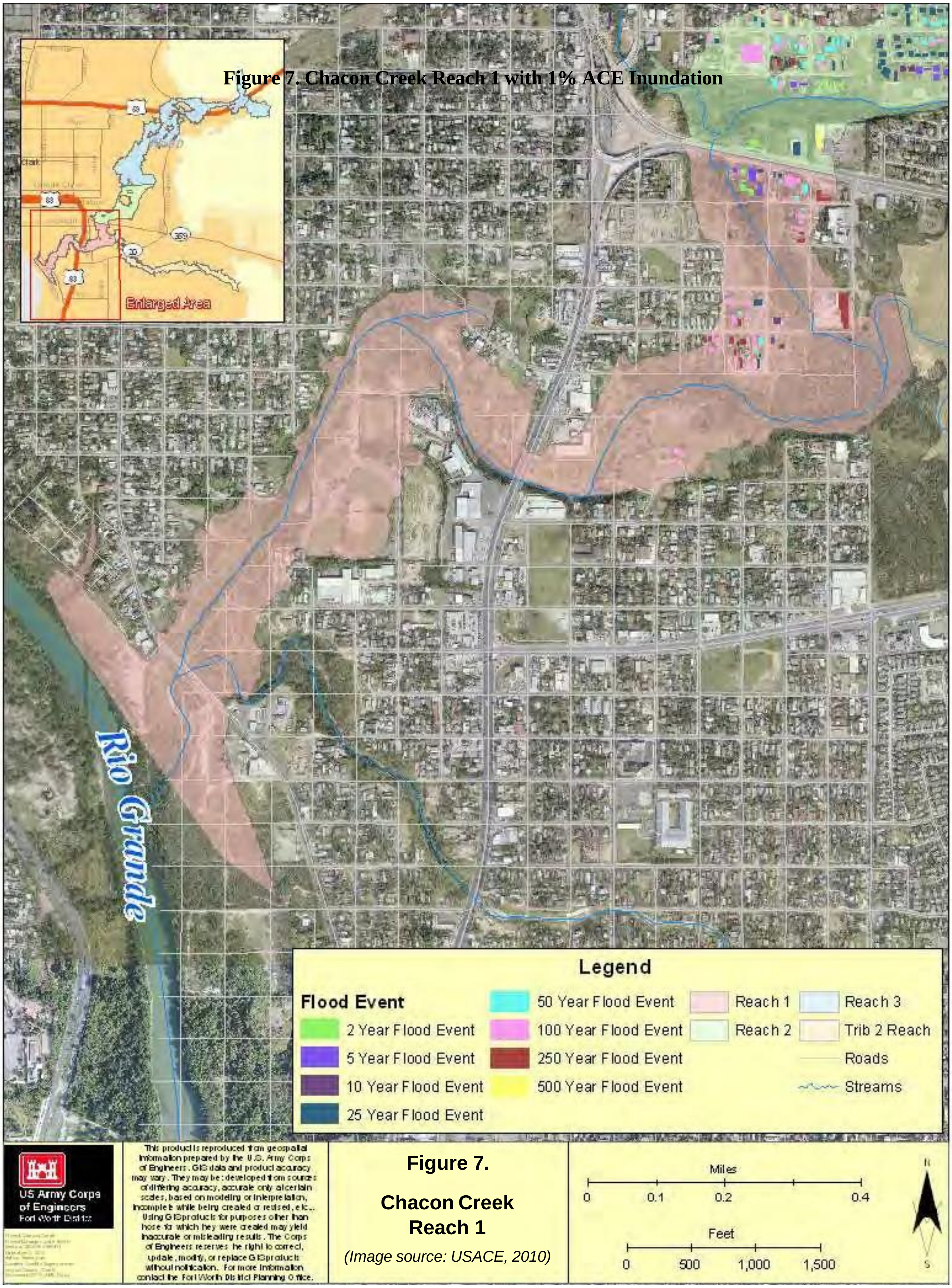
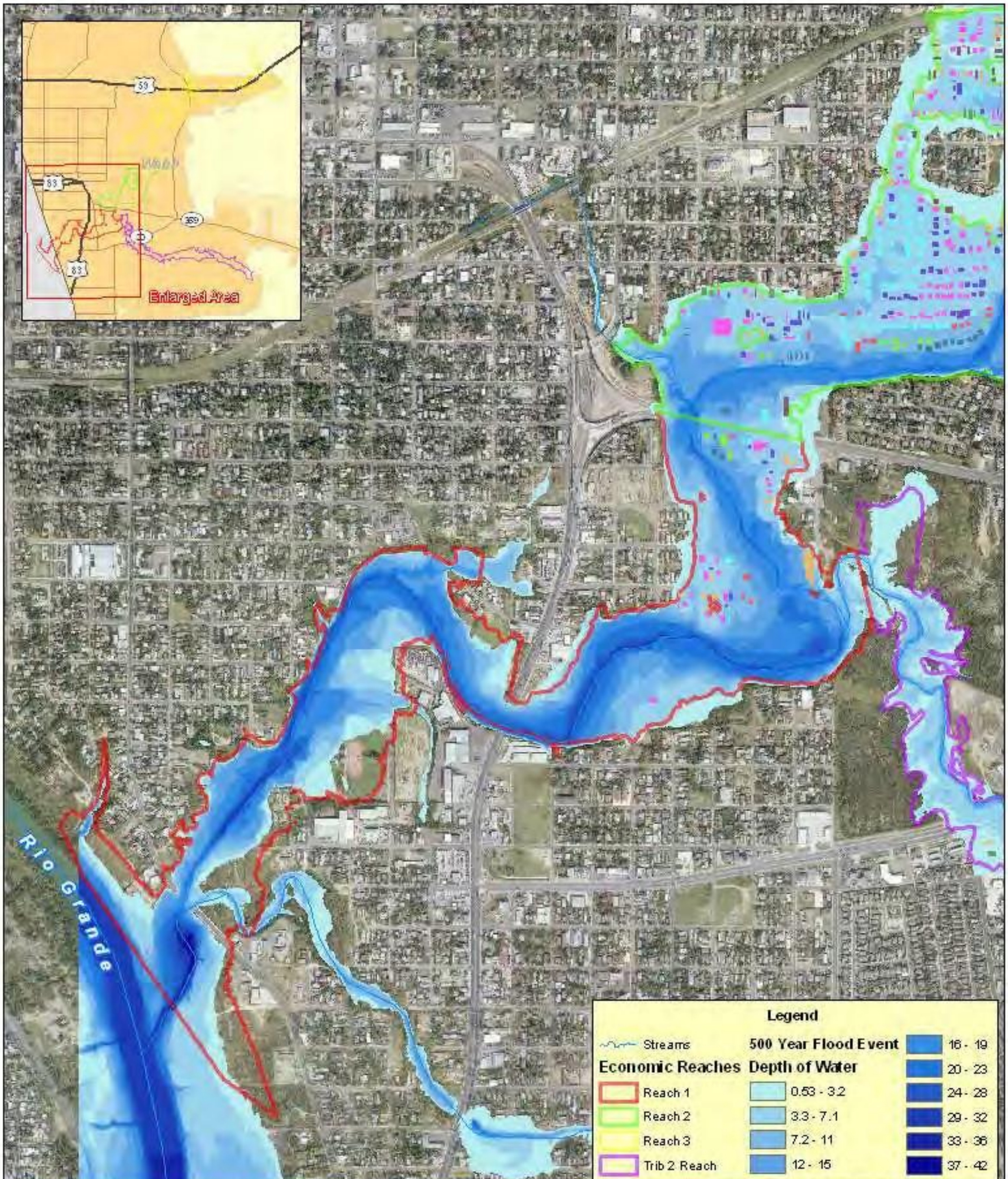


Figure 7.

Chacon Creek Reach 1

(Image source: USACE, 2010)



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Fort Worth District

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Figure 7a.

Chacon Creek
Reach 1
1% Inundation
(Image source: USACE, 2010)

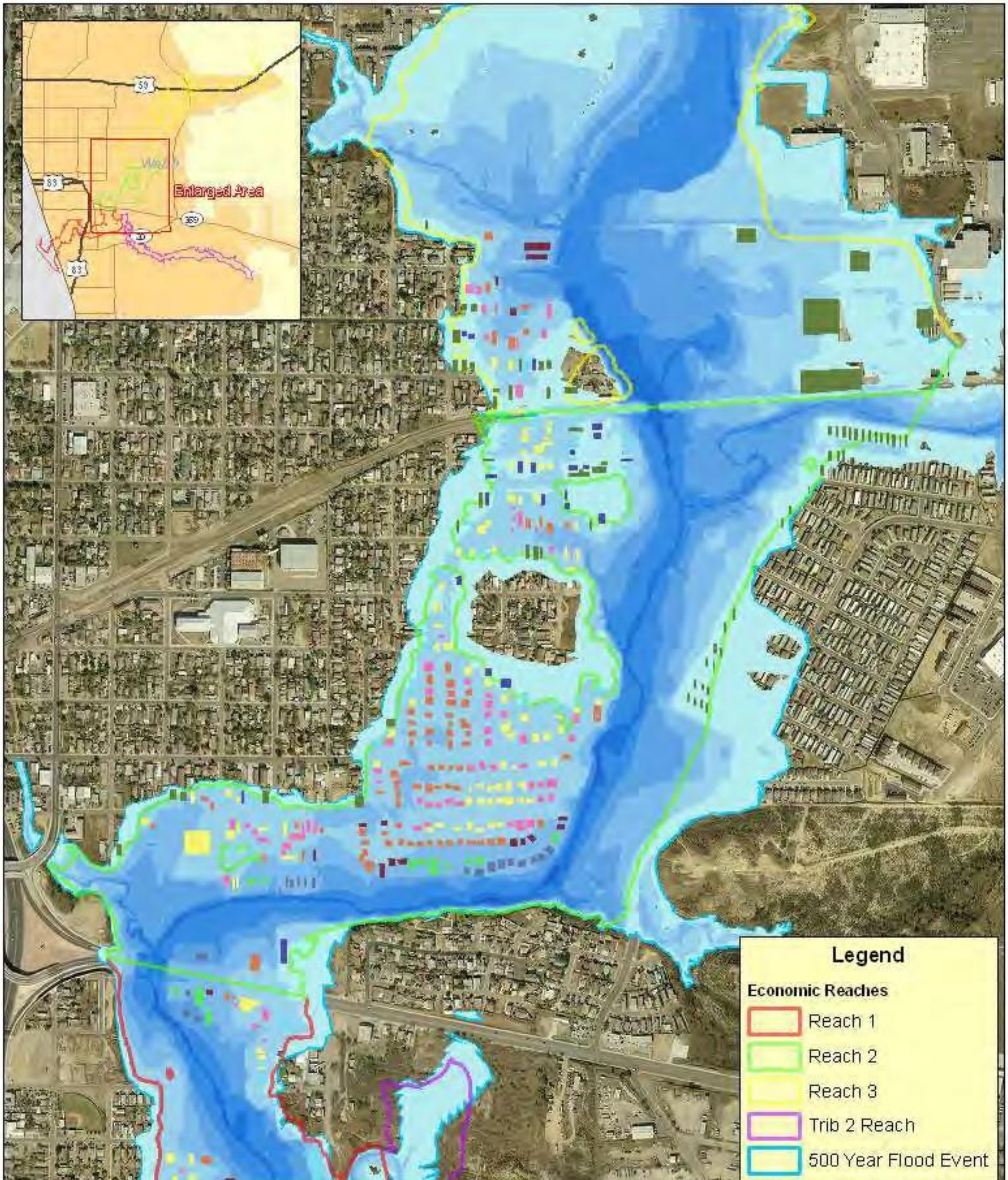
Miles
0 0.25 0.5

Feet
0 1,250 2,500

N
S

Figure 8. Chacon Creek Reach 2

(Image source: USACE, 2010)



US Army Corps of Engineers
Fort Worth District

Figure 8a.

Chacon Creek
Reach 2
1% Inundation

(Image source: USACE, 2010)

Miles

0 0.05 0.1 0.2

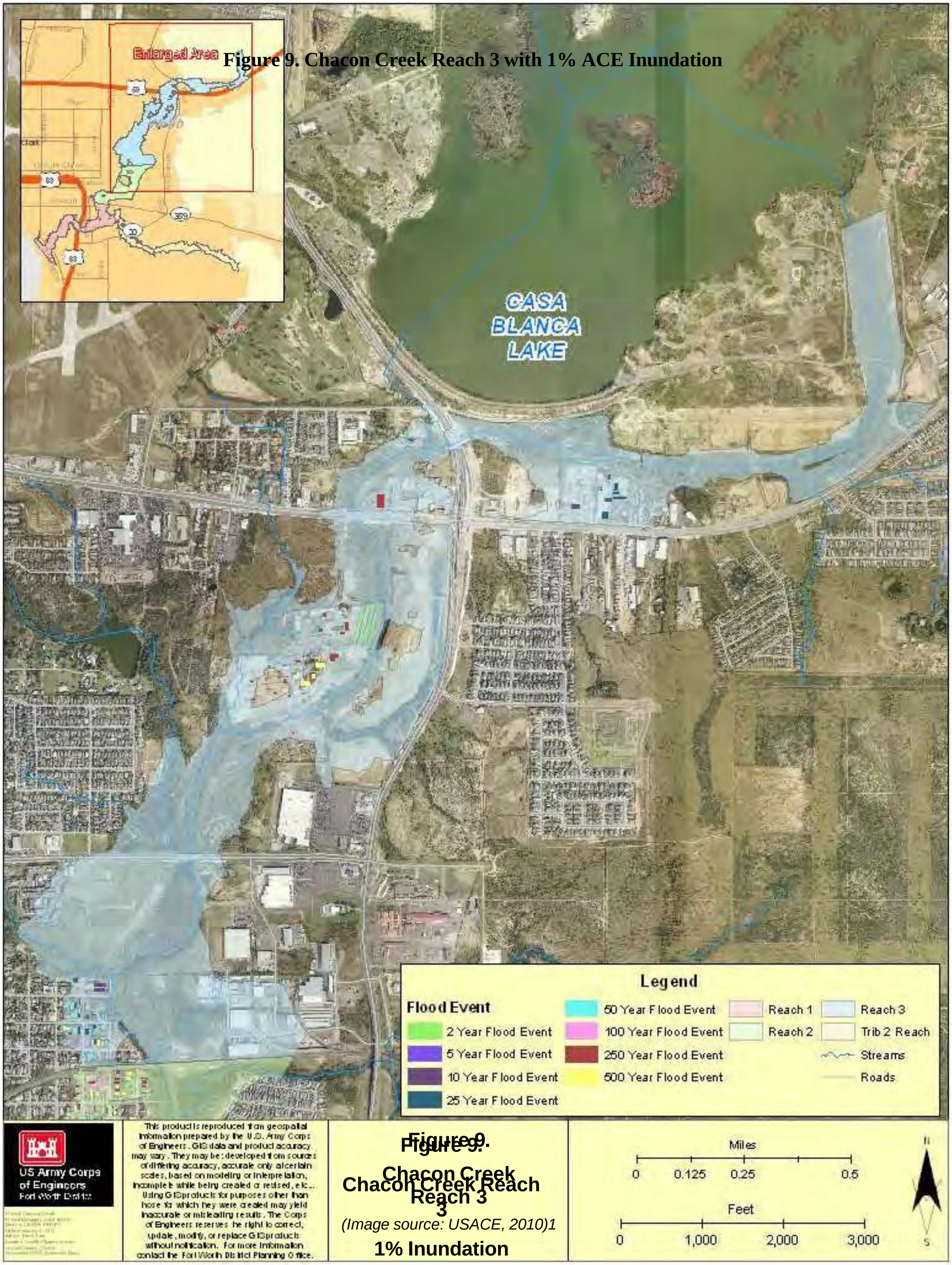
Feet

0 250 500 1,000 1,500

N

S

Figure 9. Chacon Creek Reach 3 with 1% ACE Inundation



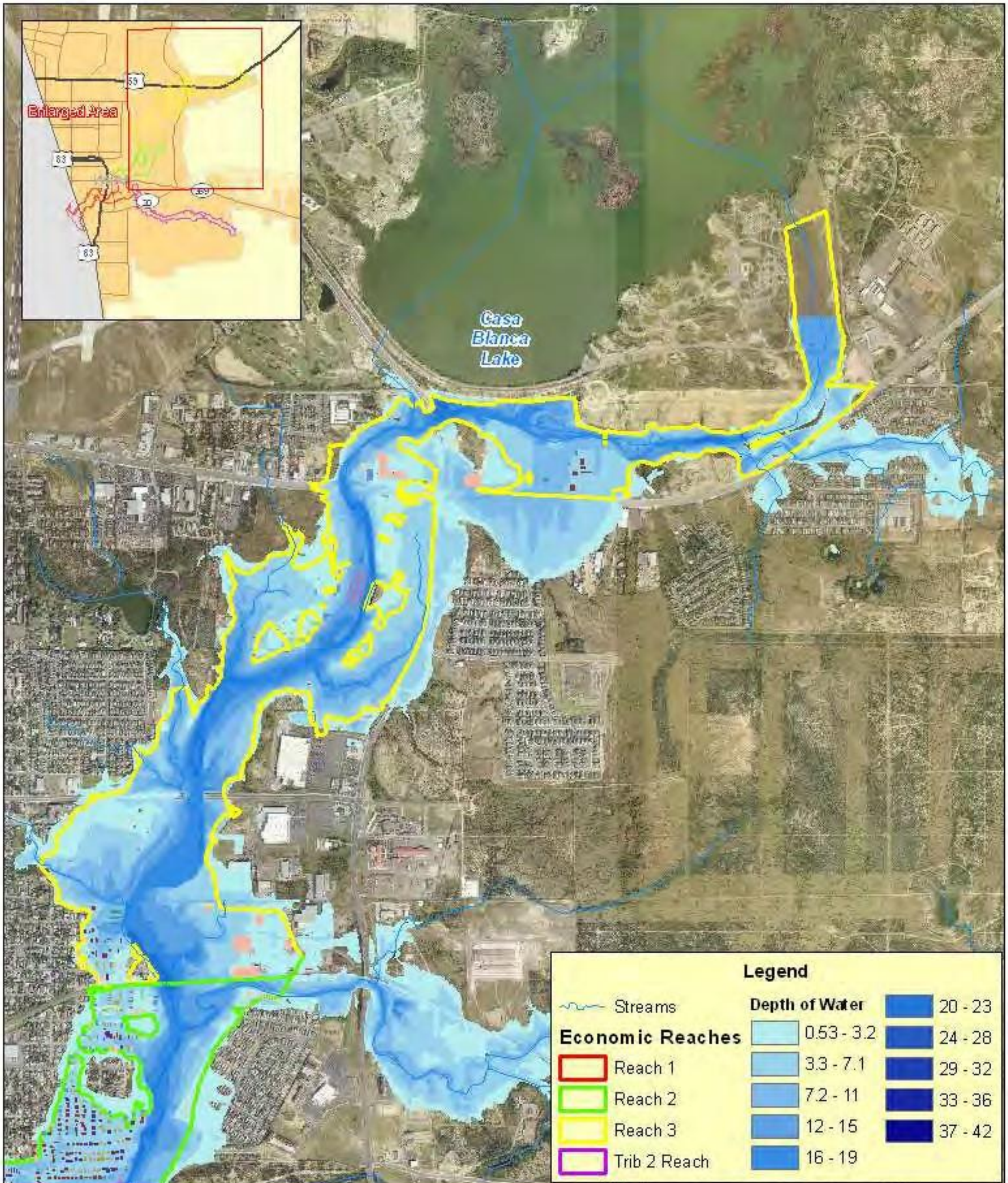


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Figure 9a.

Chacon Creek Reach 3
1% Inundation

(Image source: USACE, 2010)

Miles
0 0.25 0.5 0.75

Feet
0 1,250 2,500 5,000

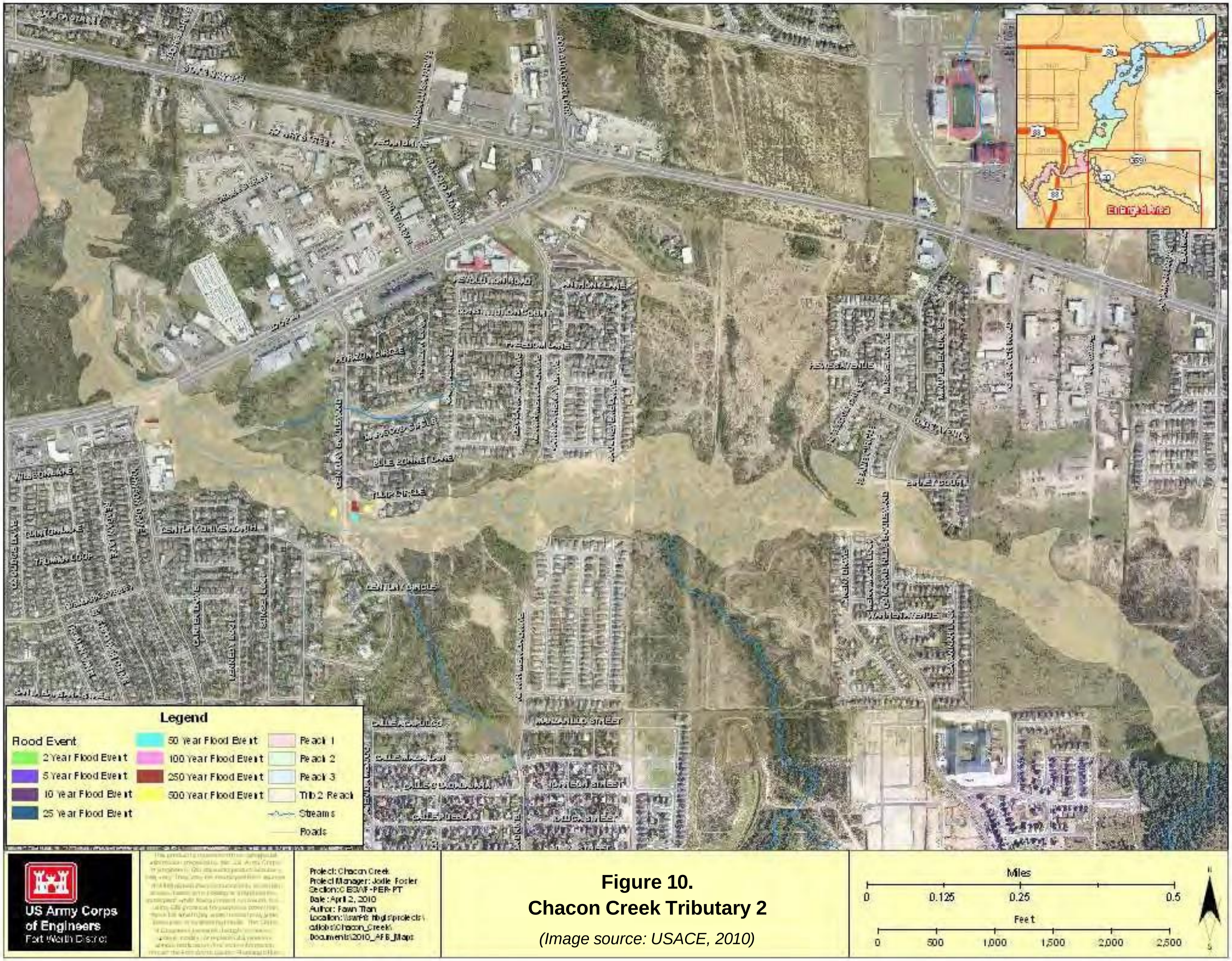
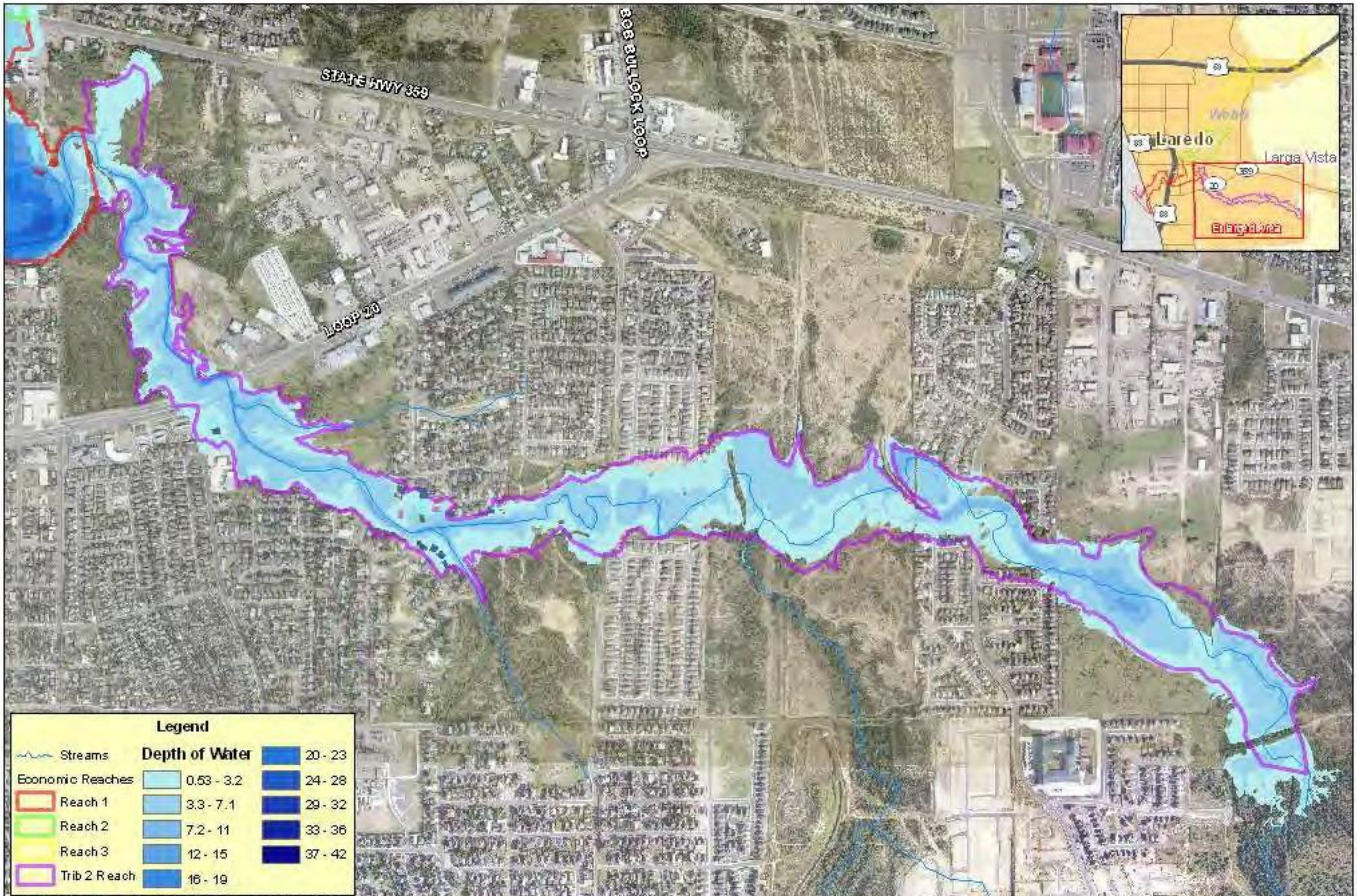


Figure 10.
Chacon Creek Tributary 2
(Image source: USACE, 2010)



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Project: Chacon Creek
Project Manager: Jodie Foster
Section: CESWF-PER-PT
Date: February 3, 2010
Author: Fawn Tran
Location: \\swf-fs1\gis\projects\cwtobs\Chacon_Creek\Documents\2009_Appendix_Maps

Figure 10a.
Chacon Creek Tributary 2 1% Inundation
(Image source: USACE, 2010)

Miles
0 2.5 5 10
Feet
0 10,000 20,000 30,000 40,000 50,000

Economics and Price Levels

The initial screening of alternatives occurred in April 2009 by USACE Forth Worth District, and all price levels from that analysis have been escalated to February 2018 price levels and the current, associated 2.75 percent discount rate by the City of Laredo. Appendix A contains preliminary discussion of the depreciated replacement values, single event damages, vehicle damages, and expected annual damages for the 2009 analysis (in 2018 escalated dollars), which were used for the preliminary alternative analysis. The No-Action Alternative for the initial screening of alternatives is also measured against these economics.

Privately Owned Vehicles

Damages for privately owned vehicles (POV) were estimated based on the average number of vehicles per residence characteristic of the study area and the probability of their being present at the time of a flood. An analysis was made of registered motor vehicles per occupied housing unit for counties within Metropolitan Statistical Areas (MSA) in Texas, using data from the U.S. Census and the Texas State Department of Highways and Public Transportation. The number of registered vehicles per occupied housing unit in the MSA clusters around a mean value of 2.48. Given that not all registered motor vehicles are associated with private residences and some housing units are unoccupied, an average of 2.0 vehicles per residence is assumed for this analysis. It is anticipated that 1.5 of these would be present during non-work hours (128 hours per week) and 0.5 present during work hours (40 hours per week). Therefore, the expected number of vehicles present at any given time that a flood might occur is derived as follows:

$$((128/168) * 1.5) + ((40/168) * 0.5)$$

or 1.26 vehicles per residence

Values for vehicles associated with single-family homes as well as multi-family and mobile residences were based on the national average price of new and used vehicles as reported by the U.S. Bureau of Transportation Statistics (BTS). Prices for new vehicles are calculated by subtracting CNW Marketing Research vehicle leasing data from Bureau of Economic Analysis data, which combines sales and leases. Used car sales data is derived from sales from franchised dealers, independent dealers, and casual sales. The average new and used sales price also includes leased vehicles. The most recent price reported by BTS is $12,774. Under the assumption that a family’s purchase of a vehicle is a function of income, this average price can be adjusted down to the Census block level based on Census Bureau data for median family income. From the 2000 U.S. Census, the median household income is $41,994 nationally. Median household income for the Census blocks that intersect the study area ranges from$17,566 to $57,392. This translates into individual values for vehicles within the study area of $5,343 to $17,458.

Value of Floodplain Inventory

Within the study area, as surveyed during the 2009 analysis, 449 structures are in the 0.2% ACE with a combined value of $55 million, which escalated to 2018 values is approximately $64.2 million.

Structures are categorized as either residential (single- or multi-family), commercial (retail, industrial), or public (government, schools, hospitals, churches). Residential structures make up 83.1 percent of the structures and 83.8 percent of the structure and contents value. Foundations for the residential inventory are both slab and pier and beam but with no basements. Commercial structures make up 16 percent of the structures and 13.5 percent of the structure and contents value. Public structures make up less than one percent of the structures and 2.7 percent of the structure and contents value.

No significant public structures, such as schools or hospitals, are in the study area with the exception of two ancillary structures associated with a private correctional facility. The majority of the commercial structures in the study area are associated with a CAFO in reach 3 of the main stem of Chacon. Virtually all of the remaining commercial structures in the study area are small office and retail establishments. Appendix A includes an addendum that contains a list of the damage curve values used to estimate flood damages, along with graphics that depict the depth-damage function for that type of structure and for the associated contents.

- In Reach 1, there are 52 structures: 36 residential, 15 commercial, and one public. The total value of structures and contents in the reach is approximately $6,269,500.
- In Reach 2, there are 308 structures: 303 residential, four commercial, and one public. The total value of structures and contents in the reach is approximately $45,603,500.
- In Reach 3, there are 81 structures: 29 residential, 50 commercial, and two public. The total value of structures and contents in the reach is approximately $10,413,800.
- In Tributary 2, there are eight structures: five residential and three commercial with a total value of $1,891,200.

Reach 2 comprises nearly 68.6 percent of the total structures and 71.1 percent of the value. Reach 3 comprises about 18.0 percent of the structures and 16.2 percent of the value. Reach 1 comprises 11.6 percent of the structures and 9.8 percent of the structure and contents value.

An estimated 400 POVs are in the study area, with an estimated value of about $3.38 million or 5.0 percent of the total floodplain investment value.

On the next page, Table 6 is a summary of the number and value of structures and contents and POVs by reach and by floodplain. (For corresponding images of each of these reaches, see Figures 7–10 in the previous section.)

Table 6. Number and Value of Floodplain Properties and Privately Owned Vehicles (Feb. 2018 Prices - $000)

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Rio Grande Confluence to State Highway 359 (Reach 1)																
Commercial	3	169.3	5	448.6	6	514.1	8	595.7	11	785.8	13	1,085.0	15	1,957.9	15	1,957.9
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	115.3	1	115.3	1	115.3
Single-Family	1	103.5	2	353.2	5	833.1	8	1,219.3	12	1,504.1	25	3,059.0	33	3,933.6	34	3,973.4
Mobile Home	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	133.7	2	222.9	2	222.9
Total	4	272.8	7	801.8	11	1,347.1	16	1,815.0	23	2,289.9	40	4,393.0	51	6,229.7	52	6,269.5
POV	1	6.39	2	19.77	5	47.04	8	69.85	13	100.29	27	201.30	36	264.27	37	267.62
State Highway 359 to Texas Mexican Railway (Reach 2)																
Commercial	0	0.0	0	0.0	0	0.0	1	225.6	2	332.8	3	732.7	3	732.7	4	983.4
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	97.3
Single-Family	15	2,133.3	24	3,682.4	34	5,228.7	102	16,045.1	150	24,182.2	222	34,969.1	256	39,191.6	266	40,615.2
Multi-Family	0	0.0	0	0.0	0	0.0	1	87.9	2	484.9	3	689.2	3	689.2	3	689.2
Mobile Home	4	353.8	5	459.7	6	569.8	7	683.2	11	1124.7	20	1976.6	27	2615.1	34	3218.4
Total	19	2,487.0	29	4,142.2	40	5,798.5	111	17,041.9	165	26,124.6	248	38,367.5	289	43,228.6	308	45,603.5
POV	20	166.28	30	266.99	40	355.36	120	1,061.11	174	1,590.20	258	2,298.22	305	2,636.81	327	2,804.14
Texas Mexican Railway to Lake Casa Blanca (Reach 3)																
Commercial	16	314.7	16	314.7	20	635.4	27	1,466.0	28	1,469.4	29	1,483.5	45	3,997.4	50	5,517.1
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1,514.3	2	1,514.3
Single-Family	0	0.0	0	0.0	3	353.0	9	884.8	16	1,543.9	17	1,597.3	18	1,701.0	22	2,087.9
Multi-Family	0	0.0	0	0.0	2	538.5	3	1,004.2	3	1,004.2	3	1,004.2	3	1,004.2	3	1,004.2
Mobile Home	0	0.0	0	0.0	0	0.0	1	94.6	3	243.6	4	290.3	4	290.3	4	290.3
Total	16	314.7	16	314.7	25	1,526.9	40	3,449.6	50	4,261.1	53	4,375.4	72	8,507.3	81	10,413.8
POV	0	0.00	0	0.00	6	58.08	14	125.35	26	186.52	26	186.52	27	192.92	31	217.21

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Chacon Creek Tributary 2																
Commercial	0	0	0	0	0	0	0	0	0	-	0	-	3	198.7	3	198.7
Single-Family	0	0	0	0	0	0	0	0	1	236.6	2	776.1	3	1,069.6	5	1,692.6
Total	0	0	0	0	0	0	0	0	1	236.6	2	776.1	6	1,268.3	8	1,891.2
POV	0	0	0	0	0	0	0	0	1	12.8	2	40.0	3	55.5	5	88.1
Total Watershed																
Structures	39	3,074.5	52	5,258.6	76	8,672.6	167	22,306.4	239	32,912.2	343	47,912.0	418	59,233.8	449	64,178.1
POV	21	172.7	32	286.8	51	460.5	142	1,256.3	214	1,889.8	313	2,726.0	371	3,149.5	400	3,377.1

Table 7. Single Event Flood Damages, Structures and Privately Owned Vehicles (April 2009 Prices - $000)

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Rio Grande Confluence to State Highway 359 (Reach 1)																
Commercial	3	14.0	5	33.0	6	54.1	8	84.3	11	117.7	13	186.3	15	333.1	15	523.1
Public	0	-	0	-	0	-	0	-	0	-	1	16.9	1	30.0	1	35.5
Single-Family	1	12.2	2	41.0	5	81.5	8	174.2	12	296.4	25	541.4	33	933.3	34	1,243.1
Mobile Home	0	-	0	-	0	-	0	-	0	-	1	17.2	2	40.4	2	67.7
Total	4	26.2	7	74.0	11	135.6	16	258.4	23	414.1	40	761.8	51	1,336.8	52	1,869.4
POV	1	3.9	2	11.5	5	25.4	8	48.6	13	78.0	27	137.5	36	222.3	37	258.8
State Highway 359 to Texas Mexican Railway (Reach 2)																
Commercial	0	-	0	-	0	-	1	5.8	2	25.3	3	132.9	3	234.1	4	308.0
Public	0	-	0	-	0	-	0	-	0	-	0	-	0	-	1	4.1
Single-Family	15	238.2	24	572.6	34	1,000.8	102	2,329.1	150	3,887.7	222	6,455.8	256	9,354.3	266	11,617.5
Multi-Family	0	-	0	-	0	-	1	40.2	2	66.5	3	115.2	3	153.6	3	205.9
Mobile Home	4	36.2	5	67.6	6	92.8	7	160.8	11	271.4	20	495.1	27	781.8	34	1,068.9
Total	19	274.4	29	640.2	40	1,093.6	111	2,535.9	165	4,250.9	248	7,199.0	289	10,523.7	308	13,204.4
POV	20	94.5	30	192.2	40	268.1	120	618.4	174	1,008.4	258	1,641.0	305	2,177.0	327	2,501.7

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	**Value**	**No.**	**Value**	**No.**	**Value**	**No.**	**Value**	**No.**	**Value**	**No.**	**Value**	**No.**	**Value**	**No.**	**Value**
Texas Mexican Railway to Lake Casa Blanca (Reach 3)																
Commercial	16	72.6	16	92.9	20	120.3	27	193.3	28	274.2	29	330.5	45	621.9	50	1,116.0
Public	0	-	0	-	0	-	0	-	0	-	0	-	2	13.7	2	125.7
Single-Family	0	-	0	-	3	16.8	9	124.9	16	303.8	17	329.1	18	383.5	22	436.6
Multi-Family	0	-	0	-	2	50.3	3	169.0	3	263.1	3	267.6	3	281.7	3	293.3
Mobile Home	0	-	0	-	0	-	1	26.3	3	71.4	4	76.0	4	90.1	4	102.5
Total	16	72.6	16	92.9	25	187.4	40	513.5	50	912.5	53	1,003.1	72	1,390.9	81	2,074.2
POV	0	-	0	-	6	20.3	14	82.9	26	150.4	26	157.3	27	168.6	31	182.7
Chacon Creek Tributary 2																
Commercial	0	-	0	-	0	-	0	-	0	-	0	-	3	4.5	3	5.8
Single-Family	0	-	0	-	0	-	0	-	1	16.8	2	54.7	3	87.1	5	146.6
Total	0	-	0	-	0	-	0	-	1	16.8	2	54.7	6	91.6	8	152.3
POV	0	-	0	-	0	-	0	-	1	2.8	2	13.6	3	23.4	5	36.8
Total Watershed																
Structures	39	373.1	52	807.1	76	1,416.6	167	3,307.8	239	5,594.4	343	9,018.7	418	13,343.1	449	17,300.4
POV	21	98.4	32	203.7	51	313.8	142	749.9	214	1,239.5	313	1,949.5	371	2,591.4	400	2,980.0

Single Event Damages

On the previous page, Table 7 presents single event damages to properties and POVs in the study area. All three reaches along Chacon Creek experience damages at the 50% ACE, with the study area experiencing an estimated $20,280,370 in damages at the 0.2% ACE. Chacon Reach 1 (Rio Grande confluence to State Hwy. 359) contributes 10.5 percent to the total damages; Chacon Reach 2 (State Hwy. 359 to Tex Mex Railway) contributes 77.4 percent; Chacon Reach 3 (Tex Mex Railway to Lake Casa Blanca) contributes 11.1 percent; and the Tributary 2 reach accounts for 0.9 percent of the damages.

Expected Annual Damages

Expected Annual Damages (EAD) for the study area total $1,034,970. Reach 1 of Chacon Creek contributes 8.3 percent; Chacon Creek Reach 2 contributes 77.8 percent; and Chacon Creek Reach 3 contributes 13.4 percent to the total expected annual damages. Tributary 2 contributes only 0.4 percent toward the EAD. Table 8 summarizes the expected annual flood damages.

Table 8. Expected Annual Damages by Reach (February 2018 Prices - $000)

	Property Type				
Reach	Residential	Commercial	Public	POV	Total
Rio Grande Confluence to State Highway 359 (Reach 1)	$44,240	$29,700	$440	$11,790	$86,170
State Highway 359 to Texas Mexican Railway (Reach 2)	$634,060	$4,710	$30	$166,700	$805,500
Texas Mexican Railway to Lake Casa Blanca (Reach 3)	$40,480	$87,350	$980	$9,920	$138,730
Tributary 2	$3,800	$160	$0	$610	$4,570
Grand Total	$722,580	$121,920	$1,450	$189,020	$1,034,970

RIPARIAN HABITAT RESOURCES

This section presents the types of vegetation in the study area and their existing quality as wildlife habitat and describes the process used to determine existing condition habitat values for the wetland and riparian cover types.

Vegetation

Gould *et al* (1969) divided Texas into ecological regions based on the distribution of vegetation. The study area is within the South Texas Plains Ecological Region. This South Texas region owes its diversity to the convergence of the Chihuahuan Desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande to the south, and coastal grasslands to the east. The South Texas Plains are characterized by Tamaulipan thornscrub vegetation community consisting of mesquite, blackbrush acacia (*Acacia rigidula*), spiny hackberry (*Celtis pallida*), and other shrubs intermixed with a variety of grasses.

Forested areas can develop along small drainages and typically support small trees, such as sugarberry (*Celtis laevigata*) and ash species (*Fraxinus* spp.). The suppression of fire, multiple invasions of non-native plants, loss of wetlands, encroachment of brush, livestock grazing, and habitat fragmentation have arguably altered the current vegetation. A list of vegetation observed in the study area is included in the Environmental Appendix B, Addendum C.

As defined by species composition and general appearance, the vegetation communities that the USACE Project Development Team observed in the study area are typical of small drainages in the South Texas Plains. Disturbed upland portions of the study area support a mesquite-mixed shrub- buffelgrass shrubland, which is nearly ubiquitous throughout the study area, however a few remnant stands of Sugarberry-Mexican Ash (*Fraxinus berlandieriana*) forest are found in the middle portion of the study area.

The persistence of invasive non-native plant species, specifically, salt cedar, Arundo cane, and buffelgrass has significantly degraded habitat value for wildlife and ecological function and has prevented the reestablishment of desirable native species. Other introduced invasive plant species include kleingrass (*Panicum coloratum*), Kleberg's bluestem (*Dichanthium annulatum*), and low abundances of white leadtrees (*Leucaena leucocephala*). These plants escaped from cultivated settings or introduced to provide forage to cattle and proliferated in an environment lacking species specific disease and pests. The plants have and will continue to colonize newly disturbed areas forming dense monotypic stands over wide areas and have little value to native wildlife. Buffelgrass is still being spread and cultivated in large areas as a "superior" forage for cattle. These plants alter fire regimes, out-compete native plant species, and in some cases exhibit allelopathic characteristics.

Ecosystem Responses to Invasive Species

Three primary invasive plant species, salt cedar, Arundo cane, and buffelgrass, have altered ecosystem processes and corresponding habitat quality in the study area. This section considers salt cedar and buffelgrass; the most prominent and widely-distributed non-native species in the study area.

Salt cedar is a large woody stress tolerant shrub introduced from Eurasia and Africa that has rapidly expanded in riparian areas of the United States since it was introduced in 1837 (Stenquist 1999). Salt cedar is drought tolerant (Cleverly *et al*. 1997), fire tolerant (Busch 1995), has high resprout capacity after fire events (Stromberg and Rychener 2010), and has pronounced growth and seed production rates (Warren and Turner 1975). Salt cedar has a competitive advantage compared to native species due to its deep root system, which can tolerate extended periods of drought, its tolerance of saline soils, and robust seed production (disperses seed throughout its extended growing season). The species spreads rapidly and typically forms dense monocultures, which impact native plant abundance and diversity as well as ecosystem function. Geomorphic channel response in salt cedar dominated areas have been documented to cause bank stabilization, promote channel entrenchment, and reduced potential for native species establishment (Gurnell 2014).

Unlike most native wood riparian plant species salt cedar can propagate in the absence of physical disturbance events in regulated waterways such as Chacon Creek. The seed and seedbed ecology of native woody species requires damp seedbeds found on the active floodplain to initiate germination and promote the establishment of native woody vegetation communities. Salt cedar can regenerate in the absence of physical disturbance events and consequently serves as a major habitat component in degraded riparian areas under altered hydrologic regimes, which are insufficient to support robust native woody species regeneration. The reduced amount of physical disturbance in the floodplain has increased the dominance of salt cedar stands over time.

Habitat characteristics of salt cedar systems confer mixed benefits to animal species. Although salt cedar is a non-native species and native vegetation stands are more desirable, it provides important habitat qualities in riparian areas where physical disturbances are absent and potential for native vegetation regeneration is low. Salt cedar provides vegetation structure and is an important habitat for nesting riparian bird species (Sogge *et al*. 2008; Paxton *et al*. 2011). Non-avian use of salt cedar is not fully understood, however reptile and mammal utilization of both salt cedar and mixed habitats has been documented (Bateman and Ostoja 2012).

Buffelgrass is perennial C4 warm season bunchgrass introduced into areas of Texas from Africa as early as 1917, with increasing successful plantings occurring between 1949 and 1985 (Hanselka 1998). The species has infested areas in south Texas (Cox *et al* 2008). The species is considered valuable for livestock and has led to increased cattle stocking rates but is of poor value for wildlife (Hanselka 1998). Buffelgrass is still being spread and cultivated in large areas as a "superior" forage for cattle.

Buffelgrass is present throughout the project area, particularly in open canopy and upland settings. The species exhibits a high tolerance to drought and grazing pressures, and also vigorously responds to precipitation events (Marshal *et al*. 2012). Buffelgrass is ecologically problematic due to its dense monotypic stands, which grow, senesce, and dry in total synchrony, unlike the diverse native vegetation where species avoid competition by partitioning phenological niches (Wolkovich and Cleland 2014; Wallace *et al*. 2016). As a result, buffelgrass stands are extremely susceptible to wildfire, unlike the native riparian shrubland vegetation which is very well adapted to wildfire. Once established, invasive grasses create an increased potential for wildfire and that further displace native flora; causing a domino syndrome of biodiversity loss and collapse of native ecosystem components and functions.

The introduction and spread of buffelgrass presents a threat to biodiversity in the study area (Marshall and Ostendorf 2011). Buffelgrass is ubiquitous throughout the study area and forms a major component of the herbaceous understory. This non-native species competes with native grasses and forbs and forms extensive monocultures. Buffelgrass reaches greater densities compared to native grasses, is fire tolerant, and promotes a grass-fire cycle that is capable or replacing native vegetation (McDonald and McPherson 2013). Although the percent cover of buffelgrass was as high as 80 percent in some areas, this species does little to prevent erosion and does not provide suitable forage for most species.

Wildlife

The South Texas Plains support a wide variety of wildlife (Gould 1969). Dense riparian vegetation is often an important source of forage and cover that is lacking in the more xeric upland habitats. A list of wildlife observed in the study area is included in the Environmental Appendix B, Addendum D. Common birds include the Altimira oriole (*Icterus gularis*), Chachalaca (*Ortalis vetula*), green jay (*Cyanocroax yncas*), olive sparrow (*Arremonops rufivirgatus*), road runner (*Geococcyx californianus*), scaled quail (*Callipepla squamata*), and white-tipped dove (*Leptotila verreauxi*). Also, three rare tropical birds that are considered "South Texas Specialty Species" (Woodin, 2000) were recorded along the Rio Grande in Laredo. These include the White-collared Seedeater (*Sporophila torqueola*), Clay-colored Robin (*Turdus grayi*), and Red-billed Pigeon (*Columba flavirostris*).

Common mammals of the South Texas Plains include badger (*Taxidea taxus*), bobcat (*Felis rufus*), eastern cottontail (*Sylvagus floridanus*), gray fox (*Urocyon cinereoargentus*), javelina (*Tayassu tajacu*), ringtail raccoon (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), and a variety of small mammals including mice and rats.

Common snakes in the South Texas Plains include the blotched water snake (*Thamnophis marcianus transversa*), diamondback water snake (*Nerodia rhombifera*), Mexican racer (*Coluber constrictor oaxaca*), Texas glossy snake (*Arizona elegans*), western diamondback rattlesnake (*Crotalus atrox*), and the Texas indigo snake (*Drymarchon corais*). Common lizards of the South Texas Plains include the blue spiny lizard (*Sceloporus cyanogenys*), southern prairie lizard (*Sceloporus undulatus consobrinus*), Texas banded gecko (*Coleonyx brevis*), Texas spiny lizard (*Sceloporus olivaceus*), and Texas spotted whiptail (*Cnemidophorus gularis*).

Study Area Habitat Value

Habitat cover types within Chacon Creek were categorized using previous investigations, interpretation of aerial photography, and field observations. Three cover types were delineated in the study area: Riverine, Wetland, and Riparian (USFWS 1981). For a detailed discussion of each cover type, see Appendix B "Ecosystem Restoration."

- The Riverine cover type is used to assess the aquatic system in the study area, which consists of a narrow strip that runs the length of the study area and covers approximately 20 acres or about five percent of the study area. The Index of Biological Integrity (IBI) was used to evaluate aquatic habitat for wildlife and is described under Aquatic Resources below.
- Wetland cover type is used to assess the wetland systems, and consists of approximately four acres—about one percent of the study area.
- Riparian forest cover type, which consists of approximately 400 acres, about 94 percent of the study area, is used to describe the riparian terrestrial systems in the study area.

USFWS Habitat Evaluation Procedures (HEP) were used to evaluate the suitability of existing terrestrial and wetland habitats for wildlife in the study area (USFWS 1980; 1981). HEP is a habitat- based evaluation methodology that uses a habitat sampling approach to assess existing and future habitat suitability, compare study alternatives, and analyze mitigation measures to offset study impacts. In a typical HEP study, a select number of species is chosen for each habitat cover type in the study area.

The suitability of habitats is then quantified by measuring the conditions described by a Habitat Suitability Index (HSI) model for each species evaluated. The resulting HSI value represents the suitability of habitat on a scale from 0.0 (unsuitable) to 1.0 (suitable). The availability of habitats in the study area is quantified as Habitat Units (HU). To derive HUs for the selected species and cover type, the HSI value (suitability) of a given habitat or cover type is multiplied by the number of acres of that type in the study area.

Evaluation Species Selection

The species selected for this evaluation are representative of common wildlife likely to use habitats found in small drainages of the South Texas Plains Ecological Region. The list of published HSI models was searched for species whose range is contiguous with the study area and who use habitats existing in the study area or habitats that could be restored or created within the study area as a result of restoration efforts. The following eight HSI models were initially selected as applicable for evaluation of the existing and potential habitats within the Chacon Creek study area:

- American Coot (*Fulica americana*) (USFWS, 1985a)
- Beaver (*Castor canadensis*) (USFWS, 1982a)
- Belted kingfisher (*Ceryle alcylon*) (USFWS, 1985b)
- Field sparrow (*Spizella pusilla*) (USFWS, 1983)
- Red-winged blackbird (*Agelaius phoeniceus*) (USFWS, 1985c)
- Yellow warbler (*Dendroica petechia*) (USFWS, 1982b)

Due to the limited suitability of existing and potential habitats for the beaver and yellow warbler, these two models were determined to be non-effective and were eliminated from further consideration. Following the USFWS (2006b) evaluation of aquatic habitat suitability, the bluegill (*Lepomis macrochirus*) (USFWS 1982c) was considered for inclusion in the habitat assessment. However, the bluegill model requires the evaluation of several variables for which no data exist, and these data would be exceedingly difficult to measure, impossible to measure within the time constraints of the study. Therefore, the slider turtle (*Pseudemys scripta*) (USFWS 1986) was selected alternatively for the assessment of aquatic habitats.

In summary, the selected models approved by the USFWS for Chacon Creek habitat assessment are the following:

- American coot
- Belted kingfisher

- Red-winged blackbird
- Slider turtle

The number and type of HSI models available is limited. Since HEP is an approved model, this system was chosen. Species were chosen to best reflect the study area.

While the models were developed for each species, they envelope the reference habitat for that species and others that use it. For example, the use of the red-winged blackbird model allows habitat for this species and other passerine birds preferring wetlands, meadows, prairies or open grassy areas that may be present in the study area to be evaluated for present and potential future use.

In 2017, updated habitat assessments were conducted for each of the species listed above for consistency.

Wetland Habitat Value

The wetland systems in the study area were divided into stands and are identified by number (Wetland Stand 1 = W1 in Figures B-1 through B-7 in Appendix B). Herbaceous wetlands were assessed using three species, the American coot, the slider turtle, and the red-winged blackbird. These species require permanent to semi-permanent water and emergent vegetation. Using a Geographic Information System (GIS), a point was randomly located within each wetland stand. Data was collected from a single point in each stand of wetland. The average overall HSI for the existing wetlands is 0.30, as shown in Table 9.

Riparian Habitat Value

The terrestrial system in the study area was divided into areas identified by number (Riparian/Forested Area 1 = F1) in Figures B-1 through B-7 in Appendix B. Using GIS, five points were randomly located within each reach of the riparian cover. Habitat data were collected from each of the selected points. At the randomly selected points within each reach, the collection of data continued southward until the addition of new data changed the average reach conditions by less than 10 percent, or until data were collected from all five points within a reach.

Each of the variables used to calculate habitat suitability for the selected models was measured using the methods suggested by the model authors. At each riparian sample point, variables were measured using an along-channel transect, a cross-channel transect, a point, and visual estimation. The HEP models used to assess the riparian areas were the American coot, belted kingfisher, and slider turtle. The average overall HSI for existing condition riparian areas in the study area is 0.21, as shown in Table 9.

Table 9. Existing Wildlife Habitat Suitability Indices (HSI) and Habitat Units (HU)

Cover Type	Acres	HSI	HU
Wetland	67.2	0.32	59.4
Riparian	128.4	0.30	111.3
Total			170.7

Combined, the wetland and riparian habitats provide 85.34 HUs for the study area. For additional information about habitat values, see Appendix B.

Riparian and Wetland Habitat Significance and Function

Nationally, the loss of aquatic and riparian habitats is widely recognized. Freshwater animal species are disappearing five times faster than terrestrial animals, due in part to the widespread physical alteration of rivers (Ricciardi and Rasmussen; 1999; NPS 2003). Of 860,000 river miles within the United States, approximately 24 percent have been impacted by channelization, impoundment, or navigation. The USFWS estimates 70 percent of the riparian habitats nationwide have been lost or altered, and 50 percent of all listed threatened or endangered species depend on rivers and streams for their continued existence. In some geographic areas, loss of natural riparian vegetation is as much as 95 percent, indicating that riparian areas are some of the most severely altered landscapes in the country (NRCS 2002). The National Research Council (NRC) has stated that restoration of riparian functions along America's water bodies should be a national goal (NRC 2002). Urban riparian buffers are the framework for healthy streams and water quality and provide greenways that improve the quality of life for citizens (Okay 2000).

Riparian forests, including bottomland hardwood forests, especially those occurring in the south, were designated as a nationally threatened ecosystem. On a national scale, there has been an 84-percent decline in riparian forests since early settlement (Noss *et al*. 1995). Prior to European settlement, the bottomland hardwood ecosystem in Texas once extended over 6.5 million hectares. It is estimated that less than 40 percent of this original extent remains (Frye 1986), with only a few small and isolated patches of old growth scattered among the floodplains of the eastern third of the state. Losses of intact bottomland hardwoods in the past 50 years have at times been greater than 120,000 ha per year (Barry and Knoll 1999). Factors such as urbanization, channelization, timber harvest, agriculture, and the introduction of exotic species have all contributed to the degradation and declining trend of riparian forests.

Based on analysis of more than 21,000 plant and animal species within the state of Texas as compared to other US states and the District of Columbia, only four states have exceptional levels of biodiversity, with Texas ranked second overall, and ranked first for diversity of birds and reptiles. Unfortunately, Texas ranks fourth in the number of extinctions, and is ranked eleventh overall for species at risk (Stein 2002).

Migratory birds are of great ecological value and contribute immensely to biological diversity. Over 300 species of birds are listed as Nearctic-Neotropical migrants in North America, and over 98 percent of those have been recorded in Texas, meaning that of the more than 600 species of birds documented in Texas, 54 percent of them are neotropical species that depend on Texas to provide habitat for nesting or migration. Many of those are dependent on southwest Texas riparian areas specifically.

Neotropical migratory birds have declined in numbers for several decades. Initially, the focus of conservation for this important group of birds was focused on breeding habitat and wintering grounds. However, recently it has been recognized that the loss, fragmentation, and degradation of stopover habitat is potentially the greatest threat to the survival and conservation of neotropical birds (Smithsonian Migratory Bird Center). In arid and semi-arid areas of the United States, stopover sites are restricted to small defined habitats along shelter belts, hedgerows, desert oases, and riparian corridors. The riparian corridors of Texas provide an opportunity for the birds to replenish fat reserves, obtain shelter from predators, and access water for re-hydration prior to continuing, what is for most neotropicals, a trip of over 1,000 miles one-way.

The national and state trend for habitat loss is evident in the Laredo area, which makes this significant national, state, and local resource even more important. The Chacon Creek watershed corridor is divided by the dam creating Lake Casa Blanca. A portion of the corridor on the western side of Chacon Creek and south of E Saunders St between the Lake Casa Blanca and the Rio Grande contains a CAFO adjacent to the stream channel. The introduction of exotic plant and animal species has had a substantial effect on riparian areas, leading to displacement of native species and the subsequent alteration of ecosystem properties (NRC 2002). Problematic non-native woody and herbaceous plant species are found throughout the project area and the USFWS and TPWD recommended local elimination of these species because they limit the value of important riparian ecosystems.

Desirable habitat for migratory waterfowl and neotropical migrants is limited in the Laredo area. However, the project area is centrally located along the Rio Grande River, which runs from Colorado to the Gulf of Mexico, and provides an important corridor through the southwest. Any improvement to the documented degraded state of the riparian zone would increase the amount of scarce habitat along a documented migratory bird corridor.

The study area consists primarily of riparian habitat, yet the approximately 401 acres provide only 181 AAHUs. Exotic species have become established in the riparian area. Non-forested riparian areas and forested areas with adequate solar exposure support a near monoculture of buffelgrass. In the forested riparian areas, salt cedar is becoming established. Specific measures such as exotic species removal and revegetation in the riparian area could directly increase the AAHUs and improve the health of the riparian habitat located within the study area. Any improvements to the riparian habitat including riparian woodlands and wetlands would make an important contribution to restoring the one of the last natural stream corridors in the City of Laredo.

Riparian woodlands are essential to the overall health of the aquatic ecosystems through providing shade to reduce stream water temperatures, streambank stabilization due to complex root systems, buffer functions to arrest surface water contaminants before they enter water bodies, and serve as a source of organics for aquatic organisms.

- Riparian woodlands provide shade to the aquatic ecosystem. Shade helps maintain lower water temperatures, especially in shallow or intermittent streams. Lower water temperatures help keep down harmful algae blooms and help keep dissolved oxygen levels higher to support better habitat for aquatic life. Without the adequate shade, temperatures rise and dissolved oxygen levels drop. In addition, during spawning season when water levels are higher, riparian areas serve as spawning and rearing habitat for aquatic organisms.

- Riparian woodlands help stabilize stream banks and reduce prevent erosion. Without riparian vegetation, especially mature trees, streams banks can may become unstable and more erodible. Erosion results in an increase in suspended solids and higher turbidity levels, which results in suffocation in some microorganisms and decreased light penetration, and overall reduction aquatic plant growth. The root systems of trees immediately adjacent to the water provide diversity in aquatic structure.
- Riparian woodlands improve water quality and enhance aquatic habitat filter pollutants harmful to aquatic life. Riparian woodlands serve as buffer zones to arrest surface flows conveying pollutants from various land uses. These pollutants generally include but are not limited to phosphorus and nitrogen from lawn fertilizers, petroleum products from gasoline engines, and other chemicals such as pesticides and fertilizers.
- Finally, another important function of riparian woodlands is the important allochthonous materials (i.e. material that has been imported into an ecosystem, including detritus) that they provide to the aquatic habitat and organisms. Because the reproductive cycle of many insects requires woody plant communities, the riparian woodland serves as an important contributor to the food base of the aquatic system. A fully functioning aquatic ecosystem must include those species that derive their existence both on land and water (ducks, egrets, certain hawks, Neo-tropicals, small mammals, herptefauna). These species require both a functioning water component and wooded riparian component. Without both, such species' habitat requirements are not fulfilled and their important contributions are absent from the aquatic cycle. The contributions these species make are many and varied, but some of the most important include facilitating detritus inputs and availability and population control through foraging.

AQUATIC RESOURCES

This section presents the species of aquatic vegetation and wildlife found in the study area and describes the process used to determine habitat

Aquatic Habitat

Vegetation removal, urban development, flow alteration, and exotic species invasion have all impacted the aquatic habitat of Chacon Creek. The Chacon Creek low-flow channel generally carries less than five cfs during normal conditions. The narrow stream channel is usually lined and commonly shaded from overhanging vegetation. The lower reach of Chacon Creek is characterized by deeper and wider pools as groundwater and backwater influences from the Rio Grande are realized. This riverine habitat is a narrow non-continuous band within the channel.

In the upper reaches of the creek, some stretches of stream channel become shallow and wider, with thick stands of cattails *(Typha* spp.) and could be considered as herbaceous wetlands. Three additional areas that could be considered palustrine wetlands also occur in the study area. They are characterized by at least some herbaceous emergent vegetation, such as spike rush, along the channel edges and persistent stems of inundated woody vegetation within areas of open water. Although these high value aquatic habitats persist in the study area, poor water quality, human caused disturbance, scour during high flows, sedimentation, and infestation of invasive species has contributed to their degradation.

Aquatic Species

In October 2006, a fisheries survey was conducted on Chacon Creek in Laredo, Webb County, Texas, by the USFWS and City of Laredo Environmental Services Department personnel. The purpose of this survey was to determine baseline fish-community structure within the area of Chacon Creek. Three sites were selected to sample fish.

Table 10 lists the species and numbers collected. For the full baseline fisheries survey report, see Appendix B.

Table 10. Chacon Creek Fish Species Collected October 2006

Family	Species	Count
Atherinidae	Inland Silverside (*Menidia beryllina*)	113
Centrarchidae	Bluegill Sunfish (*Lepomis macrochirus*)	9
Characidae	Mexican Tetra (*Astyanax mexicanus*)	19
Cichlidae	Rio Grande Cichlid (*Cichlasoma cyanoguttatum*)	1
	Blue Tilapia (*Tilapia aureus*)	9
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	33
Cyprinidae	Blacktail Shiner (*Cyprinella venusta*)	68
	Sand Shiner (*Notropis stramineus*)	3
Poeceliidae	Western Mosquitofish (*Gambusia affinis*)	102
	Sailfin Molly (*Poecillia latipinna*)	65
Total		**442**

The fisheries survey and an IBI were used to assess the aquatic habitat in the study area. An IBI provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these metrics to define species richness, trophic composition, and abundance. The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages. Each metric is scored by Environmental Protection specialists with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric’s score for a total score. An IBI can then be converted to a habitat index by dividing the IBI score by the maximum IBI score possible. For the full HEP and IBI reports, see the Environmental Appendix B.

Aquatic Habitat Value

The IBI score for existing aquatic habitat is 27, which when converted to an HSI, is .49. Table 11 provides the existing acres and HUs of the riverine system on Chacon Creek.

Table 11. Existing Aquatic Habitat Value

Cover Type	Acres	HSI	HU
Aquatic	.96	0.49	.47

Water Quality

Although no direct water quality measurements are available for Chacon Creek, there is substantial illegal dumping within the floodplain. Additionally, there is substantial urban development both encroaching on the floodplain and immediately adjacent to Chacon Creek. Storm water runoff that collects in residential areas is concentrated in roadways and in most places enters the study area without any man-made diversions or natural buffers. Further, runoff transports oil, grease, pesticides, and other natural and human-made pollutants, finally depositing them into Chacon Creek and wetlands, as well as underground sources of drinking water. The placement of flow control devices or the creation of natural vegetative buffers could improve habitat conditions in aquatic, wetland, and terrestrial habitats.

The Rio Grande is the City's primary source for public water supply. Nonpoint source pollution (NPS), which comes from many diffuse sources and is caused by precipitation runoff moving over and through the ground, is the main issue confronting Rio Grande water quality. The Texas Commission on Environmental Quality (TCEQ) assessed the water quality of the Rio Grande downstream from Texas Mexican International Railway Bridge and found that it does not support either recreational use or fish consumption due to elevated levels of fecal coliform bacteria.

The increase of impervious surfaces in the western and lower Chacon Creek watershed contributes to the rapid flooding and high flow volumes characteristic of Chacon Creek after high rainfall events. The sediment and pollution in turn contributes to turbidity in the stream and wetlands. High turbidity leads to increased water temperature and limits growth of aquatic plants, both of which reduce dissolved oxygen in the aquatic system.

Jurisdictional Waters Including Wetlands

Jurisdictional Waters play an important role in project planning. Impacts to Jurisdictional Waters must be avoided, minimized, or mitigated to the extent possible.

Section 10

Under Section 10 of the River and Harbor Act of 1899 (33 USC 403), USACE is responsible to regulate *all work or structures in or affecting the course, condition or capacity of navigable waters of the United States*.

No navigable waters of the U.S. are within the proposed project area. The Rio Grande, which *is* considered navigable waters under Section 10, is adjacent to, but outside of, the southern tip of the study area, therefore this resource will not be discussed further in this report.

Sections 404 and 401

Under Section 404 of the Clean Water Act (CWA) (33 USC 1344), Congress directed USACE *to regulate the discharge of dredged and fill material into all waters of the United States including wetlands*. Two major goals of the CWA are to achieve the following:

- Prohibit the discharge of pollutants into waters.
- Improve water quality to a safe level for recreation and wildlife and fisheries purposes.

Based on information gathered during biological surveys, approximately 4.62 acres of the restoration area are considered Waters of the United States. Authorizations for modifications to Waters of the US proposed by a restoration project could potentially be obtained through a Nationwide Permit (NWP) 27 and a mandatory Preconstruction Notification (PCN) should be submitted to the USACE and resource agency coordination (Environmental Protection Agency (EPA), USFWS, Texas Commission on Environmental Quality (TCEQ), TPWD, and Texas Historical Commission) is required in some cases.

NWP 27 “Aquatic Habitat Restoration, Enhancement, and Establishment Activities” pertains to activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To be authorized by this NWP, the aquatic habitat restoration, enhancement, or establishment activity must be planned, designed, and implemented so that it results in aquatic habitat that resembles an ecological reference. An ecological reference may be based on the characteristics of an intact aquatic habitat or riparian area of the same type that exists in the region. An ecological reference may be based on a conceptual model developed from regional ecological knowledge of the target aquatic habitat type or riparian area.

Activities authorized by this NWP include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms, as well as discharges of dredged or fill material to restore appropriate stream channel configurations after small water control structures, dikes, and berms, are removed; the installation of current deflectors; the enhancement, rehabilitation, or re-establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to enhance, rehabilitate, or re-establish stream meanders; the removal of stream barriers, such as undersized culverts, fords, and grade control structures; the backfilling of artificial channels; the removal of existing drainage structures, such as drain tiles, and the filling, blocking, or reshaping of drainage ditches to restore wetland hydrology; the installation of structures or fills necessary to restore or enhance wetland or stream hydrology; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities.

Compensatory mitigation is not required for activities authorized by NWP 27 since activities must result in net increases in aquatic resource functions and services.

NWP Regional Conditions for the State of Texas require compensatory mitigation at a minimum one- for-one ratio for all special aquatic site losses that exceed 1/10 acre and require pre-construction notification (PCN), and for all losses to streams that exceed 300 linear feet and require PCN, unless the appropriate District Engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. Best management practices are also required where practicable to reduce the risk of transferring invasive plant and animal species to or from project sites.

The Texas Commission on Environmental Quality (TCEQ) is responsible for conducting Section 401 certification reviews of U.S. Army Corps of Engineers Section 404 permit applications for the discharge of dredged or fill material into waters of the United States, including wetlands. The TCEQ conditionally certifies that the activities authorized by NWP 27 should not result in a violation of established Texas Surface Water Quality Standards as required by Section 401 of the Federal Clean Water Act and pursuant to Title 30, Texas Administrative Code, Chapter 279. General Condition 12 of the certification requires Soil Erosion and Sediment Controls.

As a matter of practice, the USACE does not permit itself regarding Section 404 of the CWA. However, USACE activities are still subject to CWA compliance. The USACE has determined the proposed project meets the conditions for NWP 27 and provides an increase in aquatic habitat output. The project area does not entail impacts to any Special Status Waters, Ecologically Sensitive Waterbodies, or Natural and Scenic Waterways. Thus, the project is pre-certified for Section 401 Water Quality Certification and subject to general and specific conditions set by TCEQ. The 404(b)(1) analyses and NWP 27 conditions can get found in Appendix K.

THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service (USFWS) lists nine Federally endangered species that are known to occur in Webb County (Table 12). No Federally designated critical habitat for any of the listed species is present in the action area. There is proposed critical habitat for the red knot, Mexican fawnsfoot, salina mucket, and Texas hornshell within the action area. Red knot and Texas hornshell proposed critical habitat does not include the action area.

The Fort Worth District engaged in initial formal consultation with USFWS as required as a condition of Section 7 of the Endangered Species Act (ESA) if a proposed action is likely to adversely affect a listed species. A Biological Assessment (BA), which determines whether a proposed action is likely to adversely affect listed species, proposed species, or designated critical habitat, will be submitted to USFWS and included in the study documentation (Appendix E). Concurrence correspondence prepared by USFWS that documents whether the proposed action would jeopardize the continued existence of a listed species, would be included in the final study documentation.

Table 12. Federally Listed Threatened and Endangered Species, Webb County, Texas

Common Name	Scientific Name	Status
Tricolored Bat	*Perimyotis subflavus*	Proposed Endangered
Piping Plover	*Charadrius melodus*	Threatened
Red Knot	*Calidris canutus rufa*	Threatened
Cactus Ferruginous Pygmy-owl	*Glaucidium brasilianum cactorum*	Threatened
Monarch Butterfly	*Danaus plexippus*	Candidate
Mexican Fawnsfoot	*Truncilla cognata*	Proposed Endangered
Salina Mucket	*Potamilus metnecktayi*	Proposed Endangered
Texas Hornshell	*Popenaias popeii*	Endangered
Ashy Dogweed	*Thymophylla tephroleuca*	Endangered

Tri-Colored Bat

The Tricolored Bat (TCB) is one of the smallest bats in North America. As its name implies, the TCB is notable for its tricolored fur that appears dark at the base, lighter in the middle, and dark at the tip, often appearing yellowish to nearly orange (USFWS 2023b). In the United States, TCB are known to be found in 39 states, including Texas, along with areas of Canada and Central America.

During the spring, summer, and fall (non-hibernating seasons), TCB primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees. TCB have also been 7 observed roosting in Spanish moss and lichen. In the summer months, TCB have been observed occupying pine needles, eastern red cedar, artificial roosts including barns, bridges, and beneath porches (USFWS 2021b). With regards to the habitation of transportation structures, it was found that bats prefer concrete bridges and culverts likely due to thermal properties and frictional properties for ease of roosting, and distance to water and suitable foraging habitat from these structures are also important factors (Wetzel 2023). During the winter, TCB hibernate in caves and mines, although in the southern U.S. where caves area sparse, TCB often hibernate in road-associated culverts and sometimes tree cavities or abandoned water wells (USFWS 2021b). Overwintering TCB were found to prefer culverts longer in length with more sections for an increased surface area, as well as larger entrance dimensions (Meierhofer et al 2019).

TCB exhibit high site fidelity and often return year after year to both the same hibernaculum as well as the same summer roosting locations. TCB are opportunistic, insectivorous feeders and consume small insects, including caddisflies, flying moths, small beetles, small wasps and flying ants, true bugs, and flies. TCB emerge early in the evening and forage at treetop level or above but may forage closer to ground later. Foraging most commonly occurs over waterways and along forest edges. TCB disperse from overwintering habitat to summer roosting habitat in the spring around mid-March and return to winter hibernacula in the fall around mid-November (USFWS 2021b).

Piping Plover

USFWS listed the piping plover (*Charadrius melodus*) as threatened and endangered on 11 December 1985 (50 FR 50726, December 11, 1985). The piping plover is an endangered species in the northern Great Plains and Great Lakes where it breeds in the summer. Piping plovers wintering in Texas are part of the northern Great Plains and Great Lakes populations and, therefore, are listed as threatened (USFWS, 2009). The wintering range on the Atlantic and Gulf coasts stretches from North Carolina to Mexico (AOU, 1998; 50 FR 50726, December 11, 1985). Migration occurs both through the interior of North America east of the Rocky Mountains (especially in the Mississippi Valley), and along the Atlantic Coast (AOU, 1998). Approximately 35 percent of the known global population of piping plovers winters along the Texas Gulf Coast, where they spend 60 to 70 percent of the year. Piping plover concentrations in Texas are believed to occur inland counties for flyover while primarily wintering to areas along the Gulf shoreline. On their wintering grounds, piping plover use beaches, mudflats, sandflats, dunes, and offshore emergent placement areas, as well as sandflats in existing USACE placement areas. Piping plovers are known to stopover along portions of the Trinity River; but they occur less frequently and temporarily in the more inland areas and especially urban areas.

Red Knot

Red knots of the rufa subspecies (Calidris canutus rufa) are medium-sized shorebirds that breed only in Arctic Canada and migrate approximately 18,500 miles annually between Arctic breeding grounds and primary wintering areas in Tierra Del Fuego, at the southern tip of South America. They also winter in three other distinct coastal areas of the Western Hemisphere: the southeastern United States (mainly Florida and Georgia, with smaller numbers in South Carolina), the Gulf of Mexico coast of Texas, and Maranhão in northern Brazil. The USFWS began proposing that this species be considered a Candidate for listing in 2008 and published a final designation of threatened status in 2014 (79 FR 73706, December 11, 2014).

In South American wintering areas, red knots are found principally in intertidal marine habitats, especially near coastal inlets, estuaries, and bays, or along intertidal earthen shelf formations. The Delaware Bay area (in Delaware and New Jersey) is the largest known spring migration stopover area, with far fewer migrants congregating elsewhere along the Atlantic coast. The concentration in the Delaware Bay area occurs from the middle of May to early June, corresponding to the spawning season of horseshoe crabs. The knots feed on horseshoe crab eggs, rebuilding energy reserves needed to complete migrations to the Arctic. Surveys at wintering areas and at Delaware Bay during spring migration indicate a substantial decline in the red knot in recent years. Research shows that since 1998, a high proportion of red knots leaving the Delaware Bay failed to achieve threshold departure masses needed to fly to breeding grounds and survive an initial few days of snow cover, and this corresponded to reduced annual survival rates (73 FR 75176, December 10, 2008). The primary factor threatening the red knot is destruction and modification of its habitat, particularly the reduction in key food resources resulting from reductions in horseshoe crabs, which are harvested primarily for use as bait and secondarily to support a biomedical industry. Counts of red knots within the principal wintering areas in Chile and Argentina declined by nearly 75 percent from 1985 to 2007 and declined by an additional 15 percent in 2008.

Along the Texas coast, red knots forage on beaches, oyster reefs, and exposed bay bottoms and roost on high sand flats, reefs, and other sites protected from high tides. They are believed to use the beaches along the Texas coast but not in the project area. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. It has been reported that Coquina clams (*Donax variabilis*) serve as a frequent and often important food resource for red knots along Gulf beaches. April 13, 2023, the U.S. Fish and Wildlife Service proposed additional habitat within Texas in the Federal Register (88 FR 22530). A review of the proposed habitat within Texas primarily updates the TX critical habitat unit or subunit for the State, no changes to critical habitat are within the action area.

Cactus Ferruginous Pygmy-owl

The cactus ferruginous pygmy-owl (pygmy-owl), a subspecies of the ferruginous pygmy-owl (*G. brasilianum*), is a small, cryptic owl that is often difficult to observe. The pygmy-owl was listed as an endangered species originally in 1997, delisted in 2006, and then relisted again in 2011. At the northern edge of its geographic range, the pygmy-owl reaches central Arizona and extreme southern Texas (USFWS 2022). In Texas, it occurs in the live oak (*Quercus virginiana*)/honey mesquite (*Prosopis glandulosa*) forest of the historical Wild Horse Desert, primarily in Brooks and Kenedy counties. Historically, it was also often reported along the Rio Grande in Starr and Hidalgo counties. Pygmy-owls are small birds, approximately 17 centimeters long with male owls weighing an average of 58-66 grams and females at 70 to 75 grams. The pygmy-owl is reddish brown overall, with a cream-colored belly streaked with reddish brown. Color may vary, with some individuals being more grayish brown (Proudfoot and Johnson 2000, pp. 15-16).

Pygmy-owls are found in a variety of vegetation communities, including Sonoran desertscrub and semidesert grasslands in Arizona and northern Sonora, thornscrub and dry deciduous forests in southern Sonora south to Michoacán, and Tamaulipan brushland in northeastern Mexico and live oak forest in Texas. However, available information regarding specific pygmy-owl habitat elements within these vegetation communities is mostly limited to Arizona, Texas, and northern Sonora. The pygmy-owl is a creature of edges found in semi-open areas of thorny scrub and woodlands in association with giant cacti, scattered patches of woodlands in open landscapes, mostly dry woods, and evergreen secondary growth (König et al. 1999, p. 373). It is often found at the edges of riparian and xeroriparian drainages and even habitat edges created by villages, towns, and cities. The pygmy-owl is a secondary cavity nester, and nests occur within woodpecker holes and natural cavities in giant cacti, but also in trees and even in a sand bank (Flesch 2003, pp. 130–132).

Due to their small size and occurrence in similar habitats as many of their predators, pygmy-owls are preyed upon by a variety of species. Documented and likely predators in Texas and Arizona include raccoons (*Procyon lotor*), great horned owls (*Bubo virginianus*), Cooper's hawks (*Accipiter cooperii*), Harris' hawks (*Parabuteo unicinctus*), Western screech owls (*Megascops kennicottii*), bull snakes (*Pituophis catenifer sayi*), and domestic cats (*Felis domesticus*) (Abbate et al. 1999, p. 27; Proudfoot and Johnson 2000, p. 10).

Monarch Butterfly

The monarch butterfly is a brightly colored orange and black butterfly that annually migrates from across north America to winter in Mexico and portions of California. While a globally distributed species due to the transportation and trade of milkweed, in December 2020, recent consistent declines in the monarch's population from urbanization, agriculture, and climate change prompted the USFWS to evaluate the status of the species. Currently, the species is listed as a candidate species under the Endangered Species Act but is on hold for final designation while other priority species are listed (USFWS, 2023).

While monarchs can forage and utilize the nectar of various flowering species, the milkweed plant is the only known plant the species is able to utilize for reproduction. Eggs are laid on milkweed plants and are crucial for sustainability of the species' North American populations. Critical habitat is therefore based on availability of milkweed, fortunately, the species can utilize milkweed in urban or residential areas such as a community garden. During its overwintering in Mexico, the species utilized oyamel fir tree roosts (USFWS, 2023) in the mountains and eucalyptus, pins, and cypress trees within California (USFWS, 2023).

Texas Hornshell

The Texas hornshell was listed as endangered on March 3, 2018. The Texas Hornshell is a medium sized freshwater mussel species approximately 3 inches in length with a laterally compressed shell. Shell color ranges from dark brown to green and individuals can be differentiated by distinct lines of color on the shell. Juvenile Texas hornshell mussels have distinct green rays on the shell (Carman 2007).

The Texas hornshell is an endemic freshwater mussel found in medium to large waterways in the Rio Grande drainage in Texas and New Mexico. The species historically ranged from the Pecos River near Roswell, New Mexico to the confluence with the Rio Grande and southeast to the Gulf of Mexico (USFWS 2016b). It is thought that the species has been extirpated from the Rio Grande downstream of Laredo, however the exact upstream and downstream limits of the species are not known. The Texas hornshell primarily occurs in shallow, slow-running perennially flowing water tucked under travertine shelves and among large diameter channel bed materials, such as boulders, where soft sediment accumulates.

The life history of the Texas hornshell is similar to other freshwater mussels. The species is a benthic filter feeder, subsisting on microorganisms, inorganic, and organic materials from the water (Howard and Cuffey 2006). Spawning generally takes place from March to August. Reproduction occurs when males release sperm into the water column, which is drawn into the body of female mussels. Fertilization and the development of larvae takes place in the gill chamber, or marsupial chamber, of female Texas hornshell mussels over a 4-6 week period after which glochidia, microscopic mussel

larvae, are released. Glochidia are released in a sticky mucous net or string and must attach to the gills, head, or fin of a host fish. Glochidia are parasitic and will die if they do not attach to a host fish where they feed on fish body fluids. Glochidia metamorphize to juvelines in about 30 days at which point the juveniles will release from the host fish a drop into channel substrate. The lifespan of the Texas hornshell is approximately 20 years, however precise longevity is unknown (Carman 2007).

Freshwater mussels such as the Texas hornshell are considered the most rapidly declining group of aquatic organisms in North America (Winemiller *et al*. 2010). The primary threats to species viability are related to accumulations in fine sediment, reduction in surface water flows, and water quality impairments (USFWS 2016b). The entire range of the Texas hornshell has been fragmented by large dams and reservoirs, effectively precluding recolonization of the species in channel segments where it was been extirpated, leading to reduced dispersal and fragmented populations. Additionally, the presence of dams has diminished or removed periodic flood pulses from river ecosystems. Dams may also reduce habitat due to excessive silt deposition upstream of dam features. Conservation of mussels species also requires to the conservation of their host fish species.

Salina Mucket and Mexican Fawnsfoot

The Salina mucket is medium sized (more than 120 mm) with an ovate outline they are typically brown, tan, or black on the periostracum, however, juveniles can have green lines along the periostracum (USFWS, 2023). The lifecycle is similar to other freshwater mussel species, the host fish is hypothesized to be the freshwater drum (*Aplodinotus grunniens*) however, this has not been documented in the field. Juvenile predominantly live in the sediment while mature individuals tend to feed from the water column. Salina mucket populations have dwindled significantly through urban and agricultural development along the Texas-Mexico border. Currently, the species can only be found in the Lower Canyon and Martin Canyon potion of the Rio Grande.

The Mexican fawnsfoot is a small size (45mm) freshwater mussel with a narrow and elevated beak (USFWS, 2023). Individuals' physiology can vary from yellow to green or gray to green with chevron markings. The lifecycle and reproduction of the Mexican fawnsfoot is not as well studies as other populations however based on its taxonomy it is theorize the species utilizes host fish during its glochidia phase. Similarly, if the glochidia fails to attach to the host fish, the individual will perish since the species use a parasitic relationship with the host fish. The host fish for the species is unknown but theorized to be the freshwater drum. Similar to the Salina mucket, the Mexican fawnsfoot juveniles predominantly live in the sediment while mature individual filter feed through the water column. Mexican fawnsfoot similarly occupied a large range within the Rio Grande, however, populations are restricted to Eagle Pass, Texas.

Both the saline mucket and Mexican fawnsfoot have historically been found within the Rio

Grande and its tributaries spreading into both Texas and Mexico. Since mussels are not a mobile species, distributed of the species into smaller tributaries is during large flood events, any dam or structures redirecting flow impact the species. Both species have similar factors affecting the survivability of freshwater mussel species such as water quality due to accumulation of fine sediments and a lack of flowing water. South Texas populations are further confined to smaller portions of riverine habitat and are therefore highly affected by drought. In July 2023, The U.S. Fish and Wildlife Service listed in the Federal Register salina mucket and Mexican fawnsfoot as proposed endangered including proposed critical habitat. Proposed critical habitat for the salina mucket includes Brewster, Terrell, and Val Verde counties within Texas. Proposed critical habitat for the Mexican fawnsfoot includes Zapata and Webb counties within Texas.

Ashy Dogweed

Ashy dogweed is a narrow endemic (i.e., is only found in a restricted geographic range) that occurs in open grassland and scattered shrub-dominated vegetation (Tamaulipan thornscrub habitat) with deep sandy loam soils of the Hebbronville series in south Texas (USFWS 2011). Soil is considered the most important attribute for characterizing habitat for rare plant species (Elith and Leathwick 2009) and potential habitat, based on soils and associated plant communities, occurs in the action area. A USDA Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS) custom soil resource report was generated for the Lower Chacon Creek watershed to review available habitat on appropriate soils (Appendix B). The action area contains approximately 5.8-acres of Hebbronville loamy fine sand (HeB); however, the singular occurrence of this soil type is within an urban setting that has been developed and previously disturbed, therefore ashy dogweed was removed from consideration.

SPECIES ELIMINATED FROM ANALYSIS

During the review, it was found that 6 federally listed, proposed, or candidate species would not be affected by the proposed action and, thus, were eliminated from further consideration because no suitable habitat exists, or the Action Area is outside of their known range(s). Because each of these species have no potential to occur in the Action Area, only a brief description of the species range and habitat was provided to document consideration (Table 13).

Table 13-Species Eliminated from the Analysis

Species	Habitat Association	Effect Determination	Effects Analysis
Mammals			
Tricolored Bat	TCB primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees. During the winter, TCB hibernate in caves and mines. TCB often hibernate in road-associated culverts and sometimes tree cavities or abandoned water wells.	No Effect	Lacks suitable habitat
Birds			
Cactus ferruginous Pygmy-Owl	The pygmy-owl is found in semi-open areas of thorny scrub and woodlands in association with giant cacti, scattered patches of woodlands in open landscapes, mostly dry woods, and evergreen secondary growth.	No Effect	Lacks suitable habitat
Piping Plover	Along the Texas coast, piping plover use beaches, mudflats, sandflats, dunes, and offshore emergent wetland placement areas.	No Effect	Lacks suitable habitat
Red Knot	Along the Texas coast, red knots forage on beaches, oyster reefs, and exposed bay bottoms and roost on high sand flats, reefs, and other sites protected from high tides.	No Effect	Lacks suitable habitat
Insects			
Monarch Butterfly	Monarchs need healthy and abundant milkweed embedded within diverse nectaring habitat. Many monarchs use a variety of roosting trees along the fall migration route. Although monarch butterfly can occur within the project areas, they will not be affected by construction due to the lack of milkweed presence and unlikelihood of milkweed to occur in the sites due to the severe degradation of habitat by invasive species and urbanization.	No Effect	Lacks suitable habitat
Flowering Plants			
Ashy Dogweed	The action area contains approximately 5.8-acres of Hebbronville loamy fine sand (HeB); however, the singular occurrence of this soil type is within an urban setting that has been developed and previously disturbed, therefore ashy dogweed was removed from consideration.	No Effect	Lacks suitable habitat

CULTURAL RESOURCES

Cultural resources include properties of traditional cultural significance, such as burial sites and cemeteries, historic sites such as old structures, and any archaeological or historical artifacts found on the properties.

Any proposed undertaking under the responsibility of the USACE must comply with all Federal and State Cultural Resources laws and regulations, Executive Orders, and USACE Regulations. All applicable legislative and regulatory mandates are to be considered in the event that any study provides a basis for a Federal undertaking. Any projects will need to consider the legal responsibilities and obligations of the USACE with respect to the following specific laws and regulations:

- National Historic Preservation Act (NHPA) of 1966 (PL 89-665 et seq.)
- National Environmental Policy Act (NEPA) of 1969 (PL 90-190)
- Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (PL 101-601)
- Executive Order 13007, Accommodation of Sacred Sites, 24 May 1996
- Government-to-Government Relations with Native American Indian Tribal Governments, Presidential Memorandum of 29 April 1994
- Engineer Regulation (ER) 1105-2-100, Guidance for Conducting Civil Works Planning Studies

The potential for unknown, intact, subsurface cultural resources exists within the study area. Depending on the magnitude and extent of any proposed action, additional cultural surveys might be necessary. Areas that cannot be surveyed might require archaeological monitoring during implementation of any proposed action.

Archaeological Resources

State archaeological site records indicate 47 known sites within or close to the study area. Seven sites are potentially eligible for listing in the National Register for Historic Places (NRHP). Further evaluations will be necessary if any proposed action has the potential for impacts to these sites prior to implementation. The remaining 40 sites have been determined to be ineligible for the NRHP due to disturbance, erosion, and other post depositional processes that have destroyed the sites and their context and do not need to be further considered for any proposed action.

Two of the seven potentially eligible sites have potential for intact buried deposits and should be further investigated, if project activities could disturb the site. In addition, further survey is required for the section of the project area between Highway 83 and the Rio Grande. The only survey of this area was conducted in 1979 when survey standards were not as rigorous as they are today, however, no major finds are anticipated.

Sites in the region tend to be very small artifact scatters subject to erosion and urban development. In such circumstances, small sites do not tend to retain the integrity required to be considered eligible for listing in the NRHP. In the remaining project areas, the recently conducted surveys appear to adequately meet current survey standards. In the unlikely event that any NRHP-eligible sites are discovered along the portion of the project corridor between US Hwy. 83 and the Rio Grande that could be impacted by ecosystem restoration activities, those impacts will be assessed after the methods for restoration have been determined and the expected extent of impacts is known. Given the high density of sites recorded in the region, it is reasonable to expect archaeological material will be encountered. However, the urbanization of the area suggests it is unlikely that the sites will retain enough integrity to be considered eligible for the NRHP.

Architectural Resources

Preliminary indications are that no structures in the study area meet age and/or integrity requirements to qualify for the NRHP based upon association with significant people, events, architectural design, or information potential. After specific project designs have progressed to the point where an area of potential effect can be determined, a more thorough reconnaissance of the structures within that area will need to be conducted to determine if any standing building, bridge, or other structure might be eligible for the NRHP. However, it is unlikely that any will be identified.

HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Results from a recent database search revealed limited industrial development within the study area. The more significant sites within the study area include ten Leaking Underground Storage Tank (LUST) sites and three Resource Conservation and Recovery Information System - Small Quantity Generator (RCRIS-SQG) sites. A Phase I Environmental Site Assessment (ESA) completed in 2001 identified 18 large dump sites, three clusters of 55-gallon steel drums, and an apparent CAFO. A site inspection conducted March 2006 concluded that these sites no longer existed, except for the CAFO.

A few dump sites were observed east of the study area, but no evidence of any hazardous, toxic and radioactive waste (HTRW) sites. Due to the magnitude of previous dump sites, surface and subsurface sampling for total petroleum hydrocarbons (TPH), metals, and pesticides should precede any excavation.

In 2023, an Environmental Condition of Property (PCP) report was prepared to document the environmental conditions of approximately 846.7 acres of land planned for the Study along Chacon Creek. Based on the environmental conditions found during the ECP analysis, each reach of the Study was categorized into an area type. Reach 1 and Reach 2 were classified at an ECP category of 4, which is defined as an area or parcel of real property where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred, and all remedial actions necessary to protect human health and the environment has been taken. Reach 3 was classified at an ECP category of 5, which is defines as an area or parcel of real property where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred and removal or remedial actions, or both, are under way, but all required actions have not yet been take. For detailed information on Phases I and II of the ESA, as well as the PCP report, see Appendix I "HTRW."

RECREATIONAL RESOURCES

The City of Laredo has a significant shortage of recreational facilities, both as identified by residents in a survey conducted for the city by Texas Tech University in March 2007 as part of their Comprehensive Master Planning efforts and based on the standards developed by the National Recreation and Park Association. On the next page, Table 14 shows the number of existing recreation facilities and the projected need based on the survey for additional facilities.

Table 14. Existing and Projected Recreation Facilities, Laredo, Texas

Facility	Existing Need	% Respondents Definite Need	Projected Additional Need
Baseball Field (league)	19	38	40
Baseball Field (practice)	8	36	81
Basketball Court (outside)	24	42	35
Football field	1	32	14
Golf Course	0	NA	6
Pavilion / Picnic Shelter	26	69	121
Picnic Table	75	NA	906
Playground	30	NA	264
Recreation Center	8	59	7
Soccer Field (league)	11	36	48
Soccer Field (practice)	11	36	77
Softball Field (league)	3	29	56
Softball Field (practice)	3	36	85
Swimming Pool (outdoor)	5	NA	10
Tennis Court	24	41	123
Trail	4.4 mi	58	25 mi

Source: City of Laredo, 2008

The City of Laredo has a substantial deficiency in the number and size of its park facilities. The City estimates that 2,684 acres are needed to accommodate the expected 2011 population of 294,256. based on standards of a minimum 11 acres per 1,000 residents. The City is, however, meeting demand for recreation centers based on the National Recreation and Park Association (NRPA) standards of facility development, but lags in other facilities for baseball, basketball, football, soccer, softball, swimming, tennis, and volleyball.

Although data was used from the March 2007 survey, it should be known that the survey was conducted independently from this Feasibility Study. USACE was made aware of the survey results during plan formulation when coordinating with the city about master planning efforts and recreational needs. No work-in-kind credit was afforded to the city as part of their independent master planning efforts. Because the survey was done independently from the USACE study, survey questions were not required to be approved by the Office of Management and Budget (OMB).

REGIONAL ECONOMIC DEVELOPMENT AND OTHER SOCIAL CONCERNS

Socioeconomics

This section summarizes the socioeconomic characteristics of the study area and the potential impact on the formulation and evaluation of any proposed action.

Population and Ethnicity

According to the U.S. Census Data, Webb County's population increased by approximately 36 percent between 2000 and 2015. The study area represents approximately 7 percent of the total county population currently, as estimated from U.S. Census block data that intersect the floodplain. Minority population comprised 94.3 percent of the population for Webb County in 1990, 95.6 percent in 2000, and 96.3 percent in 2015. Table 15 shows a summary of the county population by ethnicity and Table 16 displays the study area population from the census block data.

Table 15. Webb County Population Characteristics

	Webb County					
	1990		2000		2015	
Population	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Total	133,239	100.0	193,117	100.0	263,251	100.0
Male	63,959	48.0	93,039	48.2	128,182	48.7
Female	69,280	52.0	100,078	51.8	135,069	51.3
Hispanic	125,084	93.9	182,296	94.4	250,899	95.3
White	7,551	5.7	9,258	4.8	9,641	3.7
Asian, Hawaiian, Pacific Islander	394	0.3	764	0.4	1,540	0.6
Black	37	0.0	360	0.2	728	0.3
Other	173	0.1	241	0.1	275	0.1
American Indian	0	0.0	198	0.1	168	0.1

Source: U.S. Bureau of Census for 1990 and 2000 data; 2016 American Community Survey for 2015 data

Table 16. Study Area Racial Composition

	Study Area 2010	
Population	Number	Percent
Total	19,360	100.0
Male	9,491	49.0
Female	9,869	51.0
Hispanic	18,900	97.6
White	330	1.7
Asian, Hawaiian, Pacific Islander	47	0.2
Black	39	0.2
Other	34	0.2
American Indian	10	<0.1

Source: 2010 U.S. Census Data from HAZUS

Employment

To compare economic sectors of the County with those of the study area, the data in Table 17 was obtained from the 2015 County Business Patterns (US Census Bureau), which outlines the number of establishments for the major North American Industry Classification System (NAICS) classifications. The table gives the total number of establishments per NAICS category for Webb County and for the zip codes that intersect the study area.

Table 17. County and Study Area Business Establishments

Sector	Webb County		Study Area	
	Number	Percent	Number	Percent
Total Establishments	5,245		3,189	
Accommodation and food services	404	7.7%	290	9.1%
Administrative and support and waste management and remediation services	188	3.6%	100	3.1%
Agriculture, forestry, fishing and hunting	4	0.1%	1	0.0%
Arts, entertainment, and recreation	53	1.0%	44	1.4%
Construction	229	4.4%	148	4.6%
Educational services	43	0.8%	33	1.0%
Finance and insurance	302	5.8%	225	7.1%
Health care and social assistance	531	10.1%	428	13.4%
Industries not classified	8	0.2%	5	0.2%
Information	60	1.1%	44	1.4%
Management of companies and enterprises	22	0.4%	15	0.5%
Manufacturing	60	1.1%	49	1.5%
Mining, quarrying, and oil and gas extraction	76	1.4%	40	1.3%
Other services (except public administration)	283	5.4%	193	6.1%
Professional, scientific, and technical services	364	6.9%	254	8.0%
Real estate and rental and leasing	215	4.1%	142	4.5%
Retail trade	788	15.0%	623	19.5%

Sector	Webb County		Study Area	
	Number	Percent	Number	Percent
Transportation and warehousing	1,218	23.2%	320	10.0%
Utilities	14	0.3%	6	0.2%
Wholesale trade	383	7.3%	229	7.2%

Source: County Business Patterns or U.S. Bureau of the Census, 2015

Given that Laredo is the southern terminus for the I-35 transportation corridor and is a major border crossing into Mexico, the North American Free Trade Agreement (NAFTA) has had a tremendous impact on the area, as evidenced by the growth of employment in the transportation and warehousing sector. Laredo's retail trade also attracts a great number of consumers from Mexico. If the transportation of goods is disrupted, employment in Laredo would be adversely impacted.

Table 18 includes a summary of unemployment rates for Webb County, Laredo, and the study area.

Table 18. Employment Statistics

	Webb County			Webb County
	2000	2006	2007	2015
Employed	69,019	83,302	85,741	98,251
Unemployed	6,441	5,069	3,926	3,843
Unemployment Rate	9.3%	5.7%	4.4%	3.9%

Source: Texas Workforce Commission, 2007

The county, and likely the study area, has seen unemployment rates decrease over the last 15 years. Since 2000, Webb County's unemployment rate has decreased almost 6 percent.

Income

To assess the existence of low-income populations for the study area, median household incomes for all the census blocks that intersect the floodplain were examined (Table 19). Based on a family size of four (the average number of persons per household for Webb County is 3.75), a poverty threshold of approximately $25,000 in annual income was used for comparison, as shown in Table 20.

Table 19. Income and Poverty Characteristics

Household Characteristic	2000	2015	
	Webb County	Webb County	Study Area
Total Households	50,647	74,775	4,693
Aggregate Income	$2,049,513,400	$3,995,955,200	$239,098,964
Average Income	$40,467	$53,440	$50,948

Source: U.S. Bureau of the Census, 2000, and American Community Survey 2015

Table 20. Poverty Status

Household Characteristic	Webb County	Study Area
Total for Poverty Determination	67,106	4,693
Total Above Poverty Level	43,898	2,983
Total Below Poverty Level	23,208	1,710
Percent Above Poverty Level	65.4%	63.6%
Percent Below Poverty Level	34.6%	36.4%

Source: U.S. Bureau of the Census, 2010

The percentage of the households in the study area and the County that live below the poverty level is over 34 percent, as compared to over 36 percent for households within the study area.

Housing

Table 21 summarizes the percentage of home ownership and percentage of rentals.

Table 21. Housing Characteristics

	Webb County		Study Area
	2000	2010	2010
Total Units	55,206	87,748	5,497
Occupied Units	50,740	80,282	5,132
Owner Occupied	33,320 (66%)	49,655 (62%)	3,766 (73%)
Renter Occupied	17,420 (34%)	30,627 (38%)	1,366 (27%)
Vacant Units	4,466	7,466	365
Vacancy Rate	8.1%	8.5%	6.6%

Source: U.S. Bureau of the Census, 2000 and 2010

This table depicts higher home ownership rates for the study area—73 percent, compared to a home ownership rate of 62 percent for Webb County. This translates into a higher rental rate for the County than the study area.

Environmental Justice

In accordance with Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations,” USACE analyzed census block data to identify minority and low-income populations within the study area. Data was collected using U.S. Census Bureau Data to examine both population and income in the study area, at the most detailed level possible. The data indicate that all blocks that intersect the study area have minority populations over 50 percent, with Hispanic populations exceeding 95 percent in every census block. In addition, some

census blocks have low income populations. Steps will be taken to address Environmental Justice Considerations to ensure that proposed alternatives do not negatively affect low income populations.

Noise

Noise is described as unwanted sound, which is measured and perceived by its characteristic amplitude and frequency. *Amplitude* is a measure of the strength of the sound and is directly measured in terms of changes in the pressure of a sound wave. *Frequency*, commonly perceived as *pitch*, is the number of times per second the sound causes air molecules to oscillate. Sound is represented on a logarithmic scale in decibel (dB) units. The threshold of human hearing is approximately 0 dB, and the threshold of pain is around 120 dB.

The three common classifications of noise are:

- General audible noise that is heard by humans
- Special noise, such as sonic booms and artillery blasts that can have a sound pressure or shock component
- Noise-induced vibration, also typically caused by sonic booms and artillery blasts, involving noise levels that can cause physical movement (vibration) and even possible damage to natural and man- made structures, such as buildings and cultural resource structures.

Throughout the study corridor, general audible noise is prevalent and originates from vehicular and train traffic at bridge crossings and surrounding urban landscape, machinery in nearby commercial properties, and general noise associated with the urban setting. In the upper portions of the study area near Lake Casa Blanca aircraft noise from operations at the Laredo International Airport is also prevalent in daylight hours.

Light

Given that the study is within an urban area, lighting already permeates much of the project area. Residential and streetlights shine into the creek corridor throughout the study area. High intensity lighting from parks and athletic fields also shines into the project at several locations during early nighttime hours. Most of these lights are on timers and cut off during the late night hours or are not used unless the park is hosting an event.

FUTURE WITHOUT-PROJECT CONDITIONS

To effectively evaluate alternatives for any proposed project improvements, it was necessary to forecast the most likely future conditions if no Federal action is taken to solve the water resource problems and opportunities. These conditions are known as the *future without-project* conditions. All project alternatives are measured against the future without-project conditions. For the purposes of this study, the period of analysis is 50 years.

Future Land Use

Based on the City of Laredo's projections for future land use patterns and zoning based on the city's Comprehensive Plan, land use in the study area is projected to change substantially in the coming years. The City provided the following conceptual representation of its expectations for growth over the next 30 years based on expected changes in land use zoning. Within the Chacon Creek study area, low- and medium-density residential land use is expected to make up 25 percent of the study area, compared to the current 52.2 percent. As shown in Table 22, high-density residential will be eliminated from the study area in the future as will heavy industrial uses.

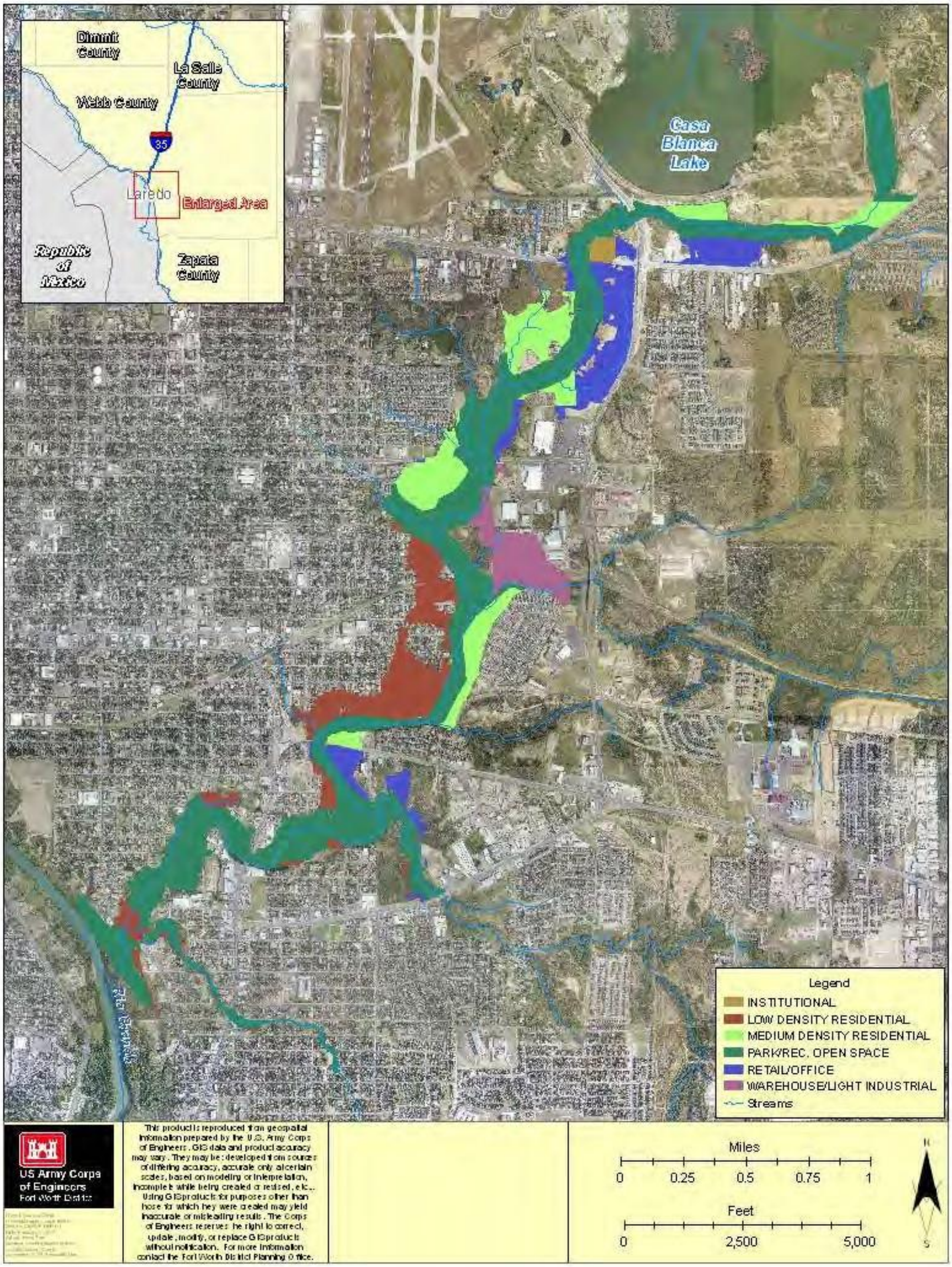
Table 22. Chacon Creek 2032 Future Land Use

Classification	Acres	Percent of Total
Institutional	7.0	0.7%
High-density Residential	-	-
Light Industrial	49.7	4.9%
Heavy Industrial	-	-
Retail / Office	144.6	14.4%
Park / Open Space	553.3	55.0%
Low-density Residential	121.9	12.1%
Medium-density Residential	129.4	12.9%
Total	1,005.9	100%

Source: City of Laredo, 2002

Light industrial is expected to make up almost five percent of study area land use. Retail and office will make up 14.4 percent of the land use, up from the current 12.6 percent. Parks and recreational open space will increase dramatically making up 55 percent of the study area compared to the current 20.5 percent. A small increase in the amount of land dedicated to institutional uses is expected for the study area in the coming years. Figure 11 shows future land use in the study area.

The North American Free Trade Agreement has had substantial impact on land use within the basin and is expected to continue to result in significant changes. The City of Laredo projects that by the year 2032, Chacon Creek watershed will be fully developed as a direct result of development related to the economic activity generated by NAFTA.



(Image source: USACE, 2010)

Figure 11. Study Area Future Land Use

Air Quality

In the future without-project, the current conditions for air quality, as described earlier in the "Affected Environment" section, would continue.

Geology, Soils, and Topography

In the future without-project, the current conditions for geology, soils, and topography, as described earlier in this section, would continue.

Groundwater

In the future without-project, the current conditions for groundwater, as described earlier in the "Affected Environment" section, would continue.

Hydrology and Hydraulics

Under a future, without-project condition, flood damages and costs would increase in both frequency and magnitude as the basin continues to develop. The impact of NAFTA on the development of the basin will put a greater strain on the carrying capacity of the basin, resulting in changes in the floodplain of the area.

For purposes of this study, careful consideration was given to the hydrologic performance of Casa Blanca Dam under both baseline and projected future without-project conditions. While dam safety issues obviously raise concerns on behalf of downstream property owners, there is no evidence to suggest that the Casa Blanca Dam would fail over the project life to provide its inherent hydrologic function from impacts investigated as part of this feasibility study.

From a hydrologic performance standpoint, Lake Casa Blanca attenuates flood hydrographs. Its peak outflows during passage of frequency-based flood events are the dominant peaks at all computational nodes situated between the dam and the mouth of Chacon Creek. The lake reduces the peak discharges for 50% and 1% ACE events by about 50 and 39 percent, respectively. For extreme events, such as those that could threaten to overtop Casa Blanca Dam, its relative attenuating effects would be even further minimized (more so, when approaching an "inflow equals outflow" condition).

Based upon these hydrologic performance characteristics, the dam would be expected to provide its inherent hydrologic function across the full scale of frequencies applied as part of the plan formulation process. For extreme events, capable of threatening to overtop the dam, the risks to proposed project features would be virtually identical, regardless of whether the dam were to fail or if it were to remain intact. For such a rare event, resultant damage to project features would be expected to include the typical earthen scour and loss of riparian vegetation.

Terrestrial, Riparian, and Aquatic Resources

Vegetation

If not controlled, non-native species are expected to persist if not proliferate in and along Chacon Creek. With the increased urban-riparian interface, the potential for wildfire to affect commercial or residential property increases. Fire risk would increase with increasing densities of buffelgrass.
Currently, buffelgrass is spread almost completely over 150 acres. The continuation of buffelgrass colonization and monoculture formations of partially forested habitats would be expected. Salt cedar would likely cause gradual changes to soil salinity and undesired bank stability, which would inhibit growth of many native plants and would allow further proliferation of salt cedar. Habitat values in the Chacon Creek waterway would continue to degrade as a result of continued spatial expansion invasive species.

Wildlife Habitat

The quality of wildlife habitat in the project area and the density and diversity of wildlife species would remain similar to existing conditions in the short term. In the long term, these conditions would gradually deteriorate as a result of compositional shifts in vegetation structure and species composition. The proliferation of non-native species would continue to degrade the habitat values in the study area and will colonize newly disturbed areas forming dense monotypic stands over wide areas that would provide reduced habitat diversity for native wildlife.

Aquatic Habitat

Erosion, sedimentation, and flow of non-point source pollution into the creek were considered in forecasting future without-project conditions and are expected to continue, which will further degrade the aquatic habitat. However, the city has pledged up to five cfs of water from the Casa Blanca Golf Course, pending its closing. Should the golf course not close, a wastewater treatment plant (WWTP) is expected to furnish this water volume. Thus, the potential for continued aquatic habitat degradation would be lessened by providing adequate water supply for Chacon Creek.

Study Area Habitat Value

On the next page, Table 23 presents the existing and future without-project estimates of habitat values. For Wetland and Riparian habitat, the values were calculated using the HEP model, and Riverine habitat was first evaluated using the IBI, then converted to a HSI. For a more detailed description of habitat values and assessment, see the Environmental Appendix B.

- The wetland AAHU value for the future without-project conditions is 0.51 over 50 years. This represents a 56% reduction in Habitat Units (HU), from 0.84 HU in target year one, to 0.37 HU in target year 50.

- Riparian AAHU for the future without-project conditions is 181.31 over 50 years. This represents a 11% reduction in HU, from 180.5 HU in target year one, to 160.45 in target year 50.
- Riverine AAHU for the future without-project conditions, is 0.21 over 50 years. This represents a 6.7% reduction in HU, from 0.21 HU in target year one, to 0.19 HU in target year 50.

Table 23. Habitat Value for Chacon Creek Study, Existing and Future Without-Project Conditions

		Future Without-Project					
	Target Year	1	5	10	25	50	AAHU
Wetland	HSI	0.69	0.60	0.60	0.30	0.30	
	Acres	3.66	3.66	3.66	3.66	3.66	
	Target Year HU	0.84	0.73	0.73	0.37	0.37	0.507
Riverine	HSI	0.64	0.70	0.65	0.70	0.65	
	Acres	0.96	0.96	0.93	0.91	0.88	
	Target Year HU	0.21	0.22	0.20	0.21	0.19	0.211
Riparian	HSI	0.45	0.50	0.40	0.50	0.40	
	Acres	401.12	401.12	401.12	401.12	401.12	
	Target Year HU	180.50	200.56	160.45	200.56	160.45	181.307

Threatened and Endangered Species

In the future without-project, the current conditions for threatened and endangered species, as described earlier in Section Two under “Affected Environment,” would continue. A summary of implications of future without-project and current conditions is provided below.

Mexican fawnsfoot

Suitable habitat for the Mexican fawnsfoot exists in Chacon Creek. Under a future without-project scenario potential Mexican fawnsfoot habitat in the Chacon Creek would likely continue to degrade due to inconsistent surface flows and declines in water quality as a result from increased fires and non- point source pollution entering the waterway.

Salina mucket

Suitable habitat for the salina mucket exists in Chacon Creek. Under a future without-project scenario potential salina mucket habitat in the Chacon Creek would likely continue to degrade due to inconsistent surface flows and declines in water quality as a result from increased fires and non- point source pollution entering the waterway.

Texas Hornshell

Suitable habitat for the Texas hornshell exists in Chacon Creek. Under a future without-project scenario potential Texas hornshell habitat in the Chacon Creek would likely continue to degrade due to inconsistent surface flows and declines in water quality as a result from increased fires and non- point source pollution entering the waterway.

Water Quality

In the future without-project, the current conditions for water quality, as described earlier in the “Affected Environment” section, would continue.

Jurisdictional Waters Including Wetlands

In the future without-project, there would be no changes or impacts to jurisdictional waters, including wetlands.

Cultural Resources

In the future without-project, the current conditions for cultural resources, as described earlier in the “Affected Environment” section, would continue.

Hazardous, Toxic, and Radioactive Waste

In future without-project conditions, the current conditions for HTRW, as described earlier in the “Affected Environment” section, would continue.

Recreational Resources

Under future, without-project conditions, the City of Laredo would continue to experience a sizable shortage of recreational facilities. While future land use and zoning will shift land use classifications toward use for parks and open space, there will still be increased demand for recreational amenities. The City’s goal is to have a wide variety of trails to reach destinations within and outside of the city. Construction on the phase 1 trails began in 2007 with TxDOT funding. Other phases of trails will be dependent on funding and the success in pursuing and establishing partnerships with Federal and State agencies such as USACE and TxDOT, with the expectation that these *funding and partnership opportunities will allow them to achieve their recreational objectives*. On the next page, Figure 12 shows the layout of the existing and proposed trails along Chacon Creek.

(Image source: USACE, 2010)

Figure 12. Chacon Creek Proposed Trails

Regional Economic Development and Other Social Concerns

This section summarizes the socioeconomic characteristics and the potential impact on the future without-project condition.

Population and Ethnicity

Population projections for Webb County come from the Texas Demographic Center and reflect the projections based on its 2014 analysis. Based on these projections, the total population for Webb County is expected to grow by 97 percent between 2010 and 2050. Virtually all the growth in Webb County is in the Hispanic population, which is projected to grow by over 100 percent between 2010 and 2050. Alternately, the Black population is expected to grow just 49 percent for the same period, and the Anglo population is expected to decrease by just over 14 percent. For a summary of population projections, see Appendix A.

Employment

Table 16 illustrates that employment in the county and study area are heavily reliant on transportation and warehousing, retail trade and health care. These are likely to continue to be the areas that provide most employment in the future. Also, as seen in Table 17 unemployment rates have been dropping over the last ten to fifteen years.

Environmental Justice

Population projections for the future without-project condition indicate that Hispanics will continue to be the majority ethnic group for the city and county. In accordance with Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations,” the study assessed the potential impacts to minority and low-income populations within the study area. The future without-project condition will not impact disproportionately the minority and low-income populations. Median incomes for the census blocks within the study area should continue to stay above the poverty threshold.

Noise

In the future without-project, the current conditions for noise, as described earlier in the “Affected Environment” section, would continue.

Light

In the future without-project, the current conditions for light, as described earlier in the “Affected Environment” section, would continue.

PLAN FORMULATION AND DEVELOPMENT OF ALTERNATIVES

This section details the processes used to formulate a plan that best meets or exceeds the planning objectives as set forth. The formulation of a plan to resolve the flood related and ecosystem problems and needs requires the exploration of possible alternative measures, including structural, non- structural, and ecosystem restoration solutions.

PROBLEMS AND OPPORTUNITIES IDENTIFICATION

A variety of water resource problems give rise to the Federal Interest and sponsor interest in the Chacon Creek study area. The primary problems are associated with increased flooding and ecosystem degradation. This section discusses the following problems and opportunities listed in Table 23.

Table 23. Chacon Creek Study Area Problems/Opportunities

	Problem	Opportunity
1	Flooding along Chacon Creek	Reduce flood damages along Chacon Creek
2	Lost habitat and reduced habitat value due to urbanization and the construction of Lake Casa Blanca along Chacon Creek	Restore lost and degraded habitat
3	Impact of invasive species on the ecosystem	Manage invasive species
4	Continuing soil erosion contributing to headcuts and degrading aquatic habitat	Reduce soil erosion
5	Lost and reduced habitat values of wetlands due to urbanization	Restore wetlands
6	Shortage of recreational facilities	Provide recreational facilities to meet current and future demands

Chacon Creek and Lake Casa Blanca are located along what used to be the eastern and northern edges of development associated with the City of Laredo. Recent development east of Chacon Creek and along the eastern tributaries has filled in much of the watershed. A majority of the study area is bordered by residential and commercial development. Much of the watershed west of Chacon Creek, and a substantial portion of lands adjacent to the study area within the 100-year floodplain, have been developed. Chacon Creek is located in a high urban growth corridor and has flooded adjacent residences and businesses.

Development in the 100-year floodplain began in the 1970s and the city joined FEMA’s Regular Program, in which Flood Insurance Rate Maps (FIRM) went into effect and marked communities’ participation in the final phase of the National Flood Insurance Program in 1982. Continued urban development within the watershed has increased the amount of impervious surfaces and contributes to more flooding and high flow volumes characteristic of Chacon Creek after high rainfall events.

RESOURCE PLANNING

This section describes the goals, objectives, and constraints in planning for projects to address the identified problems and opportunities in the Chacon Creek study area. These goals, objectives, and constraints help lead the formulation and help determine the success of a TSP.

Goals

Legislation requires that Federal water and related land resources planning be directed so as to contribute to the principle of National Economic Development (NED) and/or contribute to the National Ecosystem Restoration (NER).

- Contributions to NED are economic benefits—increases to the net value of the nation's goods and services, expressed in monetary units. NED contributions must also consider the environmental effects of proposed changes on ecological, cultural, and aesthetic attributes of natural and cultural resources.
- Contributions to NER are environmental benefits—increases to the net value of the nation's significant natural habitat, expressed in HUs or values.

The goals of this study are to contribute to NED by reducing flood damages, and contribute to NER by formulating cost-effective, incrementally justified ecosystem restoration projects.

Objectives

Standard Planning objectives reflect an expression of public and professional issues or concerns about the use of water and related land resources resulting from the analysis of existing and future conditions in the study area. These planning objectives guided the development of alternative plans and their evaluation for the study period of analysis.

Plans formulated during this study were evaluated based on their contributions to NED that are consistent with protection of the Nation's environment and on their contributions to NER. In addition to the National goals, additional planning objectives evolved from meetings with the local sponsors, state and Federal agencies, and from observations made in the area. Specific needs, desires, and goals of the community were identified. The following planning objectives were identified for this study:

1. Reduce flood damages along Chacon Creek and decrease the number of residents who reside in the 10% ACE by 75 percent.

2. Reduce risk to life, health, and safety of the residents along Chacon Creek by decreasing the risk of flooding to the extent practicable.

3. Reduce emergency costs associated with the occurrence of large flood events along Chacon Creek.
4. Avoid or minimize project impacts to threatened and endangered species.
5. Restore and maintain the natural character of floodplains.
6. Maximize opportunities for public use within floodplains by connecting park facilities along Chacon Creek.
7. Restore a diverse and sustainable ecosystem for Chacon Creek.
8. The formulation of alternatives should avoid areas that are either known or suspected to be contaminated and/or contain hazardous, toxic, and radioactive waste.
9. Measures for flood risk management should strive to minimize the use of concrete or other hard surfaces.
10. The lower portions of the study area where the EPA and the city have performed the streambank stabilization project and planted trees should be considered valuable wildlife habitat and potential migratory areas for the Federally Listed endangered ocelot and Gulf Coast jaguarundi. Project recreation features should avoid clearing riparian areas and other brush vegetation in these areas.

Constraints

Constraints are restrictions that limit the planning process, and they include legal and policy constraints that apply to every Corps study, as well as study-specific constraints that only apply to this study. To provide direction for the plan formulation efforts, the following constraints were taken into account:

1. The formulation of alternatives that reduce flood damages and flood fighting costs in one area should not result in measurable increases in the extent and magnitude of flooding in another area.
2. Project considerations would avoid conflicts with the Rio Grande Compact of 1938, which established interstate apportionments of Rio Grande waters between the states of Colorado, New Mexico, and Texas.
3. Formulation of alternatives should minimize and avoid adverse aesthetic and visual impacts, avoid any long-term adverse impacts to air and water quality, and minimize noise pollution to the extent possible.
4. Modifications to the Texas Mexican International Railway Bridge should be avoided due to the expected cost of modifications and anticipated traffic delays.

Collaborative Planning

Engineering Circular 1105-2-409, "Planning in a Collaborative Environment," provides guidance for the Corps to follow while conducting feasibility level studies using collaborative planning. The Chacon Creek Feasibility Study uses collaborative planning to develop ecosystem restoration and flood risk management measures.

As part of this study, the Corps collaborated with the United States Fish and Wildlife Service (USFWS) to ensure that fish and wildlife resources are adequately considered in the planning process.

The city has been successful in obtaining various grants and methods of funding for the Chacon Creek watershed. Funds have been provided by the EPA for a small stream bank stabilization project that would benefit the overall health of the creek. However, these projects and funding have provided small, incremental fixes to problems. This study would seek to provide a holistic approach to solving major water resources problems and opportunities. If additional Federal, state, or local partners become available to participate, then potential leveraging of funds and missions will be considered.

METHODOLOGY FOR PLAN FORMULATION

This section describes the methodology used to analyze the outputs of each type of flood risk management measure, recreation benefits, and ecosystem restoration measures.

Flood Risk Management Plan Formulation Process

As noted under "Goals" on page 74, Federal Principles and Guidelines state that the Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) while protecting the Nation's environment, in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements. Benefits from reducing flood hazards accrue primarily through the reduction in actual or potential damages to affected land uses but can also apply to the provision of recreational opportunities.

The future without-project condition provides the basis from which alternative plans are formulated and impacts are assessed. Alternatives, both structural and non-structural, are analyzed and described in terms of their expected performance, not in terms of specific levels of protection. The selected plan, or NED plan, should seek to provide a maximum of net benefits. Net benefits are calculated by annualizing the project costs as well as project benefits and then subtracting the annualized costs from the annualized benefits.

Value Management Workshop

Value Engineering is mandated by Federal law and by Office of Management and Budget (OMB) policy by PL 104-106, Section 4306, dated 10 February 1996, requiring each executive agency to establish and maintain a Value Engineering program. ER 11-1-321, dated 28 February 2005, *provides* *general policy, procedures, and a framework for the execution of the Value Engineering (VE) elements within the Project Management Business Process (PMBP) of the U.S. Army Corps of Engineers (USACE). Value Management (VM) shall be made by implementing the Value Management Plan (REF8023G) from the U.S. Army Corps of Engineers Business Process Manual*.

A Value Management workshop was conducted in February 2007 at the Fort Worth District office. A systematic approach was used in the VM study, and the key procedures involved were organized into three parts: preparation, VM workshop, and post-study. The workshop consisted of team identification and deliverables, issues and opportunities, assumptions and constraints, and workshop results. The workshop generated 54 potential alternatives to address flood risk management, ecosystem degradation, and recreation. Flood risk management measures included both structural and non- structural alternatives such as channelization and permanent evacuations. Ecosystem restoration measures included the construction of wetlands, erosion and invasive species control, and protection of high-quality vegetative communities. Recreation measures included improving aesthetics through landscaping and trash removal and constructing hike/bike trails to link college campuses.

PRELIMINARY INVESTIGATION OF FLOOD RISK MANAGEMENT ALTERNATIVES

Flood risk management measures generally fall into two types, structural and non-structural. This section describes the investigation of preliminary alternatives for flood risk management with the intent to determine which alternatives warrant further analysis. Structural modifications are measures such as channel modifications, levees, and floodwalls. Non-structural measures consist of floodplain evacuation, flood proofing, and flood warning systems. Measures are generally formulated to manage the risk and consequences of the flooding in a particular reach for a particular frequency event.

However, regional measures such as detention that apply benefits to the entire system, can be considered. The following sections discuss in detail all of the regional measures considered and reach- by-reach measures where applicable.

Structural Measures

Benefits attributed to a structural plan are expressed on an annualized basis and are calculated by taking the difference between the expected damages under with-project and without-project conditions.

The computer program known as HEC-FDA, developed by the Hydrologic Engineering Center, Davis, California, was used as the primary assessment tool. Inputs to the program include water surface profiles for the spectrum of frequency storms, ranging from the 50% to 0.2% ACE storm events, as well as a structure database that indicates the elevation, type, and value of each structure in the study area. Also, depth versus percent damage relationships are a required input for each type of structure listed in the database.

Channel Modifications

The potential flood risk benefit of channel modifications generally results from lowering the water surfaces and evacuating fewer structures other than those necessary to excavate the channel. Potential negatives include increased water velocities, which can lead to higher downstream inundation, as well as modification of the creek, thereby requiring mitigation as specified under Section 404 of the Clean Water Act.

Detention

As noted in Section One, the city has already constructed three detention basins within the Chacon Creek watershed. Any additional detention would therefore be relegated to secondary sites that would not provide any adequate additional protection relative to their cost. Therefore, detention will not be analyzed as a viable alternative.

Levees/Floodwalls

Both levees and floodwalls were initially considered as potentially viable alternatives, but were quickly ruled out as infeasible due to relatively low existing expected annual damages in two of the reaches, the limited amount of space to accommodate the footprint of a levee, and the anticipated expense of both a levee and a floodwall. Additionally, both could potentially conflict with design standards the city established by ordinance, which specifies the dimensions for stream buffers along Chacon Creek. Levees and floodwalls could also require significant and periodic maintenance and do not eliminate the need to evacuate during flooding for events that are larger than the design event.

Non-Structural Measures

As stated in ER 1105-2-100, page E-104, the benefits of a non-structural buyout are the total of the following:

5. Annual benefit of the alternate use of the land.

6. Reduction in annual flood insurance subsidies.

7. Average annual public damages prevented (that is, damages to communications and public utilities facilities, and costs for flood fighting and public relief) based on actual FEMA claims.

8. Reduction in Expected Annual Damages that is brought about by the removal of structures, as determined by HEC-FDA.

Identification of a feasible flood risk management buyout plan also depends on meeting several criteria. The buyout evaluation for this study only considered residential structures based on topographical location within each targeted exceedance zone, regardless of the finished first floor elevation. Ideally, the benefit-cost ratio (BCR) for the group of structures should exceed 1.0.

Floodplain Evacuation

One advantage of floodplain evacuations is that they generally provide high marginal benefits, because they target structures that are being damaged at the most frequent events. Floodplain evacuation can also expand open space and enhance natural and beneficial uses and facilitate the secondary use of newly vacated land. The disadvantages are that they often leave many structures flood-prone in less frequent events and might not provide sufficient space for vacated lands to be used optimally. When evaluating alternatives for floodplain evacuation, to avoid double-counting of the internalized portion of the flood damages reduced, costs should use comparable flood-free land costs in the valuation of floodplain land as specified in Section 219 of the Water Resources Development Act of 1999.

Flood-Proofing

Flood-proofing includes both wet and dry types. Wet flood-proofing consists of modifying uninhabited portions of a structure, such as a crawlspace or an unfinished basement, to allow floodwaters to enter and exit to ensure equal hydrostatic pressure on the interior and exterior of the structure and its supports. Equalized pressures will reduce the likelihood of wall failures and structural damage. Wet flood-proofing however, is practical in only a limited number of situations. Dry flood- proofing structures requires making structures watertight below the level that needs flood protection to prevent floodwaters from entering. Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete. This type of measure is normally applicable where structures are only inundated for a few feet. This measure does not minimize the potential damage from high-velocity flood flow and wave action and may not be used to bring a substantially damaged or substantially improved residential structure into compliance with the community's floodplain management ordinance or law. Due to the relatively low structure value of the structures associated with Chacon Creek, these measures were not given further consideration.

Flood Warning Systems

While a flood warning system can be an effective measure in reducing the loss of life during a flood event, the effectiveness of such a system will vary with a range of factors, including the number and location of sirens, level of background noise, sound absorption by buildings, whether it is night or day, and weather conditions. As such, warnings are only part of a comprehensive flood risk management solution. Flood warning systems are also subject to maintenance problems, availability during power failures, and limited broadcast range. Due to the flashiness of rain events along Chacon Creek and the fact that many of the structures are located in high frequency events such as the 5- and 10-year events, flood warning systems would not provide adequate time to allow residents to evacuate and would not prevent damage to structures. As such, a flood warning system was not analyzed as a standalone alternative, but will be considered as a measure to assist with reducing residual damages from the NED alternative.

Recreational Alternatives Formulation

One of the primary reasons for formulating non-structural alternatives is to take advantage of new uses for vacated land, the most common uses being recreation and ecosystem restoration. Overall benefits therefore, can be derived from the reduction in flooding damages as well as benefits from recreational amenities on these lands. This section discusses the various acceptable methods for calculating recreational benefits, the methodology the City used to determine recreation demand, and how this methodology was used to aid in the development of compatible recreational amenities that might optimize flood risk management alternatives.

Recreation Benefits Methodologies

The unit day value (UDV) method, travel cost method (TCM), and contingent valuation method (CVM) are all acceptable methods of calculating recreation benefits. In all cases, the number of visitors must be assumed or determined for each center of recreation such that it does not take benefits from another similar set of recreation opportunities. Double counting the same set of visitors would result in the over counting of demand and benefits. The UDV approach is the most often used because the UDVs are widely accepted and the methodology is straightforward. Benefits were not calculated for existing park facilities because any potential alternatives that included recreational features would replace any existing recreational amenities.

Local Recreation Survey

The City of Laredo performed a local survey to determine the city’s future recreational demand. The analysis done by the City included interviews with key City of Laredo staff, organized recreation providers, and user groups, phone surveys for each of the eight Council Districts, four public meetings for the eight Council Districts, inventory/supply analysis, GIS analysis of land use, projected growth, the City’s Thoroughfare Master Plan, consideration of natural land features such as slope and hydrography, and facility standards analysis of park service areas. The local survey was conducted in March 2007 by The Earl Survey Research Laboratory at Texas Tech University.

The effort yielded 535 completed surveys (of 3,408 calls made), with 60 percent English/40 percent Spanish speaking respondents, and a response rate of 15.3 percent. An overall cooperation rate of 71.7 was obtained for successful calls.

Priorities were established on a community planning district basis with needs categorized by a system of high, medium, and low priority rankings and corresponding time schedules. Latent demand identified by city staff, user groups, and survey respondents included features such as volleyball courts, playgrounds, picnic tables, pavilions, trails, and multipurpose fields. Table 24 illustrates the latent demand estimated by the City after considering citizen, expert, and governmental input.

Table 24. Latent Demand and Projected Recreation Deficiencies, Laredo, Texas

Amenity	Existing	Target Based on 2007 Population	Target Based on 2015 Population	2015 Surplus/ Deficiency
Competitive Soccer Field	12	44	60	(48)
Football Field	0	11	15	(15)
Competitive Baseball Field	22	44	60	(38)
Competitive Softball Field	7	44	60	(53)
Basketball Court	32.5	44	60	(28)
Tennis Court	17	55	75	(58)
Volleyball Court	3	11	15	(12)
Indoor Recreation Center	8	7	10	(2)
Swimming Pool	6	11	15	(9)
18-Hole Golf Course	2	4	6	(4)
Playground	46	221	302	(256)
Picnic Table	211	368	503	(292)
Large Pavilion	11	44	60	(49)
Multipurpose Court	0	9	12	(12)
Skating Facility (Hockey Rink)	2	2	3	(1)
Paved Trail (miles/system)	3.88	11.0	15.1	(11)
Skate Park	7	11	15	(8)
Multipurpose Field	16	11	15	1
Splash Park	5	11	15	(10)
Water Park	0	1	1	(1)

Source: City of Laredo, 2007

Unit Day Value Analysis

The results of the city’s internal survey did not include development of estimates of value for the various proposed recreation types, but the method of their study indicates that the UDV valuation method is most suitable to calculate benefits. UDV point assignments were based on compatible general recreation values established in Economics Guidance Memorandum (EGM) 09-03, Unit Day Values for Recreation, Fiscal Year 2018.

On the next page, Table 25 specifies the method for assigning points for general recreation activities.

Table 25. Guidelines for Assigning UDV Points for General Recreation

Criteria	Total Points	Judgment Factors and Point Ranges				
Recreation Experience	30	Two general activities	Several general activities	Several general activities: one high quality high value activity	Several general activities: more than one high quality high value activity	Numerous high quality high value activities: some general activities
Point Range		0–4	5–10	11–16	17–23	24–30
Availability of Opportunity	18	Several within one-hour travel time; a few within 30-minute travel time	Several within one-hour travel time; none within 30-minute travel time	One or two within one-hour travel time; none within 45-minute travel time	None within one-hour travel time	None within two-hour travel time
Point Range		0–3	4–6	7–10	11–14	15–18
Carrying Capacity	14	Minimum facility for development for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Point Range		0–2	3–5	6–8	9–11	12–14
Accessibility	18	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Point Range		0–3	4–6	7–10	11–14	15–18
Environmental	20	Low esthetic factors that significantly lower quality	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality
Point Range		0–2	3–6	7–10	11–15	16–20

Table 26 lists the values used to convert points to dollar values. These values are derived from EGM 09-03 and serve as the basis for determining specific UDV points and corresponding dollar values for the study.

Table 26. General Recreation UDV Points Conversion to Dollars (2018)

Point Value	Dollar Value
0	4.05
10	4.81
20	5.32
30	6.08
40	7.59
50	8.61
60	9.37
70	9.87
80	10.89
90	11.64
100	12.15

Table 27 lists the criteria and point values for assigning UDV points for general recreation.

Table 27. UDV Points per Recreation Criterion

Criterion	Points
Recreation Experience	10
Availability of Opportunity	3
Carrying Capacity	7
Accessibility	14
Environmental	4
Total	38

- For recreation Experience, a value of 10 points was assessed because each of the recreational alternatives provided several general activities.
- Availability of Opportunity was assessed a value of three because several exist within a 30-minute drive of the location.
- Because there will be adequate facilities so that no deterioration of the resource will occur, a value of seven was assessed for Carrying Capacity.
- Accessibility was assessed a value of 14 because there will be good access for the recreational facilities on good roads.
- The Environmental criterion was assessed a value of four, conservatively, because the facilities are considered of average esthetic quality.

- As estimated in the 2010 USACE study, visitor days are based on projected outdoor recreation participation referenced in the Texas Outdoor Recreation Plan (1995). In addition, these estimated visitor days have been increased 2 percent from the from the 2010 study values. This moderate increase accounts for likely visitation increases based on the population growth in the city as a whole.

PRELIMINARY SCREENING OF FLOOD RISK MANAGEMENT ALTERNATIVES SUMMARY

This section provides a brief narrative of the initial screening process used to determine which alternatives warranted further investigation for each reach. In this initial screening process, not all of the necessary costs to select a final, TSP were included, rather, only those costs determined most germane to make a sound preliminary determination. It is fully expected that costs will rise as the result of additional studies and refinements during the detailed investigation of alternatives. On page 96, Table 28 shows each of the preliminary measures analyzed for each of the three reaches along the main stem of Chacon Creek.

Section 219 of the Water Resources Development Act of 1999 directs the Corps to calculate benefits for non-structural projects the same as structural projects. The Principles and Guidelines, published in 1983 by the U.S. Water Resources Council, dictates that reduction of flood damages borne by floodplain activities should not be claimed as a benefit of evacuation and relocation because they are already accounted for in the fair market value of floodplain properties. As a result, estimated flood damages associated with a property must be based on a comparable property in a flood free condition to avoid double counting. For this study area, there is no significant difference between costs of residential properties within the floodplain and residential structures outside the floodplain. Property values given in the Real Estate Plan were based on a gross appraisal that considered both floodplain and non-floodplain comparable sales values in the estimate of real estate costs.

As referenced previously, no changes have been implemented to the alternatives analysis. All costs and benefits reflected below are based on the original study structure inventories and measures but have had costs and benefits escalated to 2018 prices.

Reach 1

For Reach 1, no structural measures were considered as viable options and none will be carried forward into the Detailed Investigations of Alternatives. Four non-structural alternatives were considered during the preliminary screening of alternatives for Reach 1. The net benefits for these scenarios ranged from –$43,720 for the 4% ACE (25-year) to $3,850 for the 20% ACE (5-year). Because secondary uses for evacuated land can be used to help justify a non-structural alternative, at least one of the non-structural alternatives will be analyzed by proposing recreational activities that have a strong, direct relationship to these non-structural measures.

Table 28. Preliminary Screening Summary (February 2018 Prices - $000)

Cost	Structural			Non-structural - Buyout			
	Small Channel	Medium Channel	Large Channel	2-year	5-year	10-year	25-year
Reach 1							
Number of Structures	-	-	-	4	7	11	16
Number of Parcels	-	-	-	3	6	9	13
Total Cost	-	-	-	$585.61	$1,024.82	$1,610.43	$2,342.44
Annual Cost	-	-	-	$29.03	$50.80	$79.84	$116.13
EAD Benefits	-	-	-	$24.14	$54.65	$67.50	$72.41
Net Benefit	-	-	-	($4.89)	$3.85	($12.34)	($43.72)
Benefit/Cost Ratio	-	-	-	0.83	1.08	0.85	0.62
Reach 2							
Number of Structures	25	31	32	19	29	41	111
Number of Parcels	20	26	27	16	25	36	109
Total Cost	$4,884.29	$5,943.01	$6,320.77	$2,781.65	$4,245.67	$6,002.50	$16,250.66
Annual Cost	$242.15	$294.63	$313.37	$137.91	$210.49	$297.59	$805.66
EAD Benefits	$574.66	$642.23	$657.57	$350.97	$476.64	$545.04	$693.13
Net Benefit	$332.51	$347.60	$344.20	$213.06	$266.15	$247.44	($112.53)
Benefit/Cost Ratio	2.37	2.18	2.10	2.54	2.26	1.83	0.86
Reach 3							
Number of Structures	-	-	-	16	-	25	40
Number of Parcels	-	-	-	1	-	10	19
Total Cost	-	-	-	$2,342.44	-	$3,660.06	$5,856.09
Annual Cost	-	-	-	$116.13	-	$181.46	$290.33
EAD Benefits	-	-	-	$72.54	-	$107.10	$127.34
Net Benefit	-	-	-	($43.59)	-	($74.36)	($162.99)
Benefit/Cost Ratio	-	-	-	0.62	-	0.59	0.44

Reach 2

Three structural measures were considered for Reach 2. The preliminary net benefits for each channel alternative for Reach 2 ranges from $332,510 for the small channel size to $347,600 for the medium channel. Given that the medium channel alternative produced the greatest net benefits, it is the only structural configuration carried forward into the detailed investigations for comparison with other viable alternatives.

Four non-structural alternatives were considered during the preliminary screening of alternatives. The net benefits for these scenarios ranged from -$112,530 for the 4% ACE (25-year) to $266,150 for the 20% ACE (5-year). The standalone non-structural alternatives were not carried forward into the detailed investigations of alternatives as actual alternatives, but as the costs of these plans are refined, these will be displayed in the tables so that a true comparison can be made between all plans. The 2- and 5-year floodplain evacuations do not include enough vacated land to have a viable secondary use to help justify a project. However, the 10- and 25-year floodplains in Reach 2 have structures that are mainly confined to a certain area known as Villa Del Sol. Because these structures are confined to this area and the parcels are mostly connected to each other, recreation can be considered a viable use of the vacated land to gain additional benefits to help justify a non-structural project. Therefore, non- structural plans analyzed during the detailed investigation of alternatives will include recreation as a secondary use of the land for the 10- and 25-year floodplain evacuations.

The plans carried further for detailed investigations for Reach 2 include the medium-width structural plan and the 10- and 25-year floodplain evacuations. In addition, combination plans of structural and non-structural plans might be considered.

Reach 3

For Reach 3, no structural measures were considered as viable options, and none were carried forward into the Detailed Investigations of Alternatives. Three non-structural alternatives were considered during the preliminary screening of alternatives for Reach 3. There were no structures located within the 5-year floodplain. The net benefits for these scenarios ranged from -$162,990 for the 4% ACE (25-year) to -$43,590 for the 50% ACE (2-year). Due to the fact that the parcels are spread over a large area, there is no secondary use of the land, such as recreation, that would be compatible with floodplain land and would produce enough benefits to justify the project. Therefore, no flood risk management alternatives were carried into the detailed investigations of alternatives for Reach 3.

Tributary 2

As noted earlier, Tributary 2 will not be considered further in this study.

DETAILED INVESTIGATION OF FLOOD RISK MANAGEMENT ALTERNATIVES

This section evaluates those flood risk management alternatives identified from the array of preliminary alternatives for further, more detailed consideration. All costs and benefits provided below are escalated to 2018 dollars, and no changes have been made to the alternatives or structure inventory from the 2010 study.

In addition to the benefits derived from expected flood damage reduction, six of the alternatives carried forward also include benefits that could be generated by inclusion of recreational amenities on the vacated lands. Annual charges for these alternatives include not only the recreational amenities but also interest, amortization, and operations and maintenance. On the next page, Table 29 summarizes all of the alternatives that were investigated in detail, along with the associated costs, net benefits, and benefit-to-cost ratios.

The non-structural alternatives are based on flooding events and, in one case, were expanded to include structures partially in the next less-frequent event. Recreation benefits values were determined using the method described earlier in “Unit Day Value Analysis” on page 81. Costs for land and structures, demolition, and real estate administration were estimated for screening purposes based on information supplied by the Real Estate Services Branch, Cost Engineering, and Civil Design Section of the Fort Worth District. Preliminary costs and benefits were also obtained from the Fort Worth District Planning Branch and the City of Laredo.

Alternative 1 (A1): No-Action (Future Without-Project) Plan

The City of Laredo has existing zoning and building code regulations that govern various detention and drainage practices when undertaking actions within the floodplain. The city adopted these regulations to help prevent erosion caused by storm water. However, based on field observations, the existing regulations are not sufficient to prevent further erosion, and the wetland habitats would continue to suffer from the altered flows and low water quality.

The future without-project condition under the No-Action Alternative implies acceptance of the existing and future adverse impacts caused by increased erosion, persistence of invasive species, and continued flow of non-point source pollution that results in further environmental degradation. Thus, the No-Action Alternative fails to meet the planning objectives.

Structural Alternatives

The following discussion provides a more detailed description of the best-performing structural alternative for Reach 2 brought forward for further analysis.

Table 29. Detailed Investigation Summary (April 2009 Prices - $000; 4.375%)

Cost Item	Reach 2 Structural (A2)	Reach 1 10-Year w/ Recreation (A3)	Reach 2 10-Year w/ Recreation (A4)	Reach 2 Partial 25-Year w/Recreation (A5)	Reach 2 "VDS Plan" (A6)	Reach 2 25-Year w/ VDS Rec. (A7)	Reach 2 VDS Plan w/ Small Channel (A8)	Reach 1 10-Year w/Rec. and"VDS Plan" (A10)
Structures	31	11	42	62	62	111	62	73
Parcels	26	9	37	57	57	109	57	66
Without EAD	$805.5	$86.2	$805.5	$805.5	$805.5	$805.5	$805.5	$891.7
Residual EAD	$163.2	$18.7	$288.7	$244.0	$244.0	$112.3	$120.0	$262.7
EAD Benefits	$642.3	$67.5	$516.8	$561.5	$561.5	$693.2	$685.5	$629.0
Recreation Benefits	$28.5	$157.6	$448.6	$628.8	$674.9	$674.9	$674.9	$911.3
Total Benefits	$670.8	$225.1	$965.4	$1,190.3	$1,236.4	$1,368.1	$1,360.4	$1,540.3
Structure and Land	$3,320.5	$1,757.0	$4,498.9	$6,641.2	$6,641.2	$11,889.8	$6,641.2	$8,398.2
Demolition, Cleanup	$669.8	$237.6	$907.4	$1,339.5	$1,339.5	$2,398.2	$1,339.5	$1,577.2
Real Estate Admin	$498.1	$263.5	$674.9	$996.2	$996.2	$1,783.5	$996.2	$1,259.7
Recreation Costs	$161.2	$1,228.1	$5,814.7	$7,780.0	$7,838.4	$7,838.4	$7,838.4	$9,066.5
Other Costs	$2,860.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2,591.4	$0.0
Total Costs	$7,509.8	$3,486.3	$11,895.8	$16,756.9	$16,815.4	$23,910.0	$19,406.8	$20,301.7
Investment								
Total First Cost	$7,509.8	$3,486.3	$11,895.8	$16,756.9	$16,815.4	$23,910.0	$19,406.8	$20,301.7
Interest During Const.	$333.4	$156.9	$537.6	$756.8	$759.5	$1,075.6	$873.6	$916.4
Total Investment Cost	$7,843.2	$3,643.2	$12,433.4	$17,513.7	$17,574.9	$24,985.6	$20,280.4	$21,218.2
Annual Charges								
Interest	$345.6	$162.7	$557.3	$784.4	$787.2	$1,114.9	$905.6	$949.9
Amortization	$46.0	$21.7	$74.3	$104.5	$104.8	$148.4	$120.6	$126.5
O&M	$59.0	$29.5	$82.5	$88.4	$88.4	$88.4	$117.9	$117.9
Total Annual Charges	$450.5	$213.9	$714.1	$977.3	$980.5	$1,351.7	$1,144.1	$1,194.3
Annual Benefits								
Inundation Reduction	$642.3	$67.5	$516.8	$561.5	$561.5	$693.2	$685.5	$629.0
Recreation	$28.5	$157.6	$448.6	$628.8	$674.9	$674.9	$674.9	$911.3
Total Annual Benefits	$670.8	$225.1	$965.4	$1,190.3	$1,236.4	$1,368.1	$1,360.4	$1,540.3
Net Annual Benefits	$220.3	$11.2	$251.3	$213.0	$255.9	$16.3	$216.3	$345.9
Benefit/Cost Ratio	1.49	1.05	1.35	1.22	1.26	1.01	1.19	1.29

Alternative 2 (A2): Reach 2 Structural Plan

Because the medium channel alternative generated the greatest net benefits among the preliminary structural alternatives investigated, it was the only one brought forward for more detailed analysis. This alternative was further refined to include recreational amenities on the upper bench that would be less susceptible to more frequent flooding events, annual operations and maintenance (O&M), and mitigation costs required to compensate for the anticipated ecosystem losses associated with the proposed channel improvements.

This alternative consisted of $3,320,500 in land and structures costs, $669,800 for demolition of the structures, $498,100 in real estate administration costs, $2,860,100 for channel excavation, and $161,200 for recreational amenities. Total cost for this alternative is $7,509,800 with total annual charges of $450,500. This alternative generates $220,300 in net benefits with a benefit/cost ratio of 1.49-to-1.00. Alternative 2 is shown in Figure 15 and the generated recreation benefits are listed in Table 30.

Table 30. Recreation Benefits for A2: Reach 2 Structural

Activity	Visitor Days	Number	Unit	Annual Benefits
Disc Golf	4,167	9	Holes	$28,500
Total Benefits				$28,500

Non-Structural Alternatives

This section provides a detailed description of the most thoroughly developed non-structural measures to be included in the final array of investigated alternatives.

Alternative 3 (A3): Reach 1 10-Year Floodplain Evacuation with Recreation

This alternative was carried forward into detailed investigations because it had a positive benefit/cost ratio in the preliminary investigations of alternatives. This non-structural alternative would consist of purchasing and removing 11 structures in Reach 1 within the 10% ACE (10-year frequency event) floodplain. Benefits based on the reduction of expected annual damages are estimated at $67,500, and benefits from recreation are estimated at $157,600. Costs include $1,757,000 for the land and structures, $237,600 for the demolition of these structures, $263,500 for real estate administration, and $1,228,100 for recreation, for a total of $3,486,300. Total annual charges are $213,900 over 50 years with net benefits of $11,200 annually and a benefit/cost ratio of 1.05-to-1.00.

This alternative was compared to the 20% ACE (5-year frequency event) and the 10% ACE (10-year frequency event) *without* recreation as a means to measure the performance of a more viable, developed, and comprehensive alternative. The 20% ACE had total costs of $1,024,800 which annualized to $50,800. Benefits from reduction in expected annual damages were $54,700 producing net benefits of $3,900. The 10% ACE had total costs of

$1,610,400 which annualized to $79,800. Benefits from reduction in expected annual damages were $67,500 producing net benefits of -$12,300.

The recreational component for this alternative consists of two areas. Area A (Figure 19) is directly south of State Highway 359 and west of North India Avenue, located on parcels containing structures in the 2-, 5-, and 10-year flood frequencies. Because of this area's proximity to a major highway and the larger park, it was not desirable to attract much day use to the site, which is most appropriate as a trailhead. Therefore, only parking, associated utilities, and four picnic tables are planned for Area A.

Area B (shown in Figure 20) is approximately four blocks downstream of Area A. Buyout and recreational amenities were planned along with additional ecosystem land acquisition to increase and ensure connectivity of the corridor. On the east side, Area B is adjacent to ecosystem restoration property containing the planned wetland Site 3, which includes a boardwalk for interpretive use. West of Area B is residential property. Therefore, it was determined that this park could support more use than Area A and would include amenities to support the neighborhood and potential educational use of the wetland. Amenities include parking, playground, sidewalk/path, and connective links to the maintenance road/trail and the boardwalk. A restroom and eight picnic sites are planned for the site.
Recreation benefits for this alternative are shown in Table 31.

Table 31. Recreation Benefits for A3: Reach 1 10-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	1,920	12	Tables	$157,600
Total Benefits				$157,600

Figure 19. Alternative 3 - Reach 1 Area A

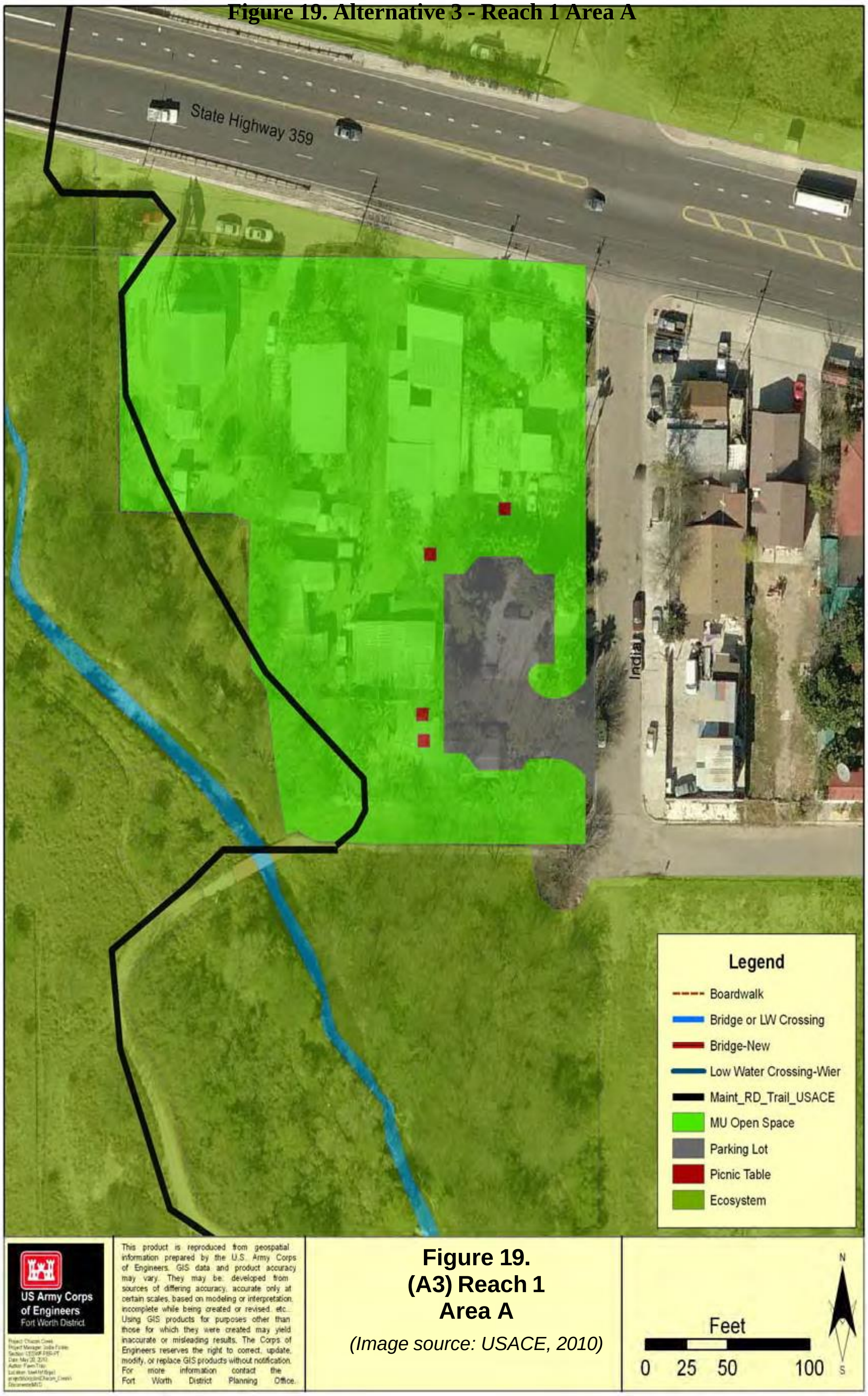


Figure 19.
(A3) Reach 1
Area A
(Image source: USACE, 2010)

Figure 20. Alternative 3 - Reach 1 Area B

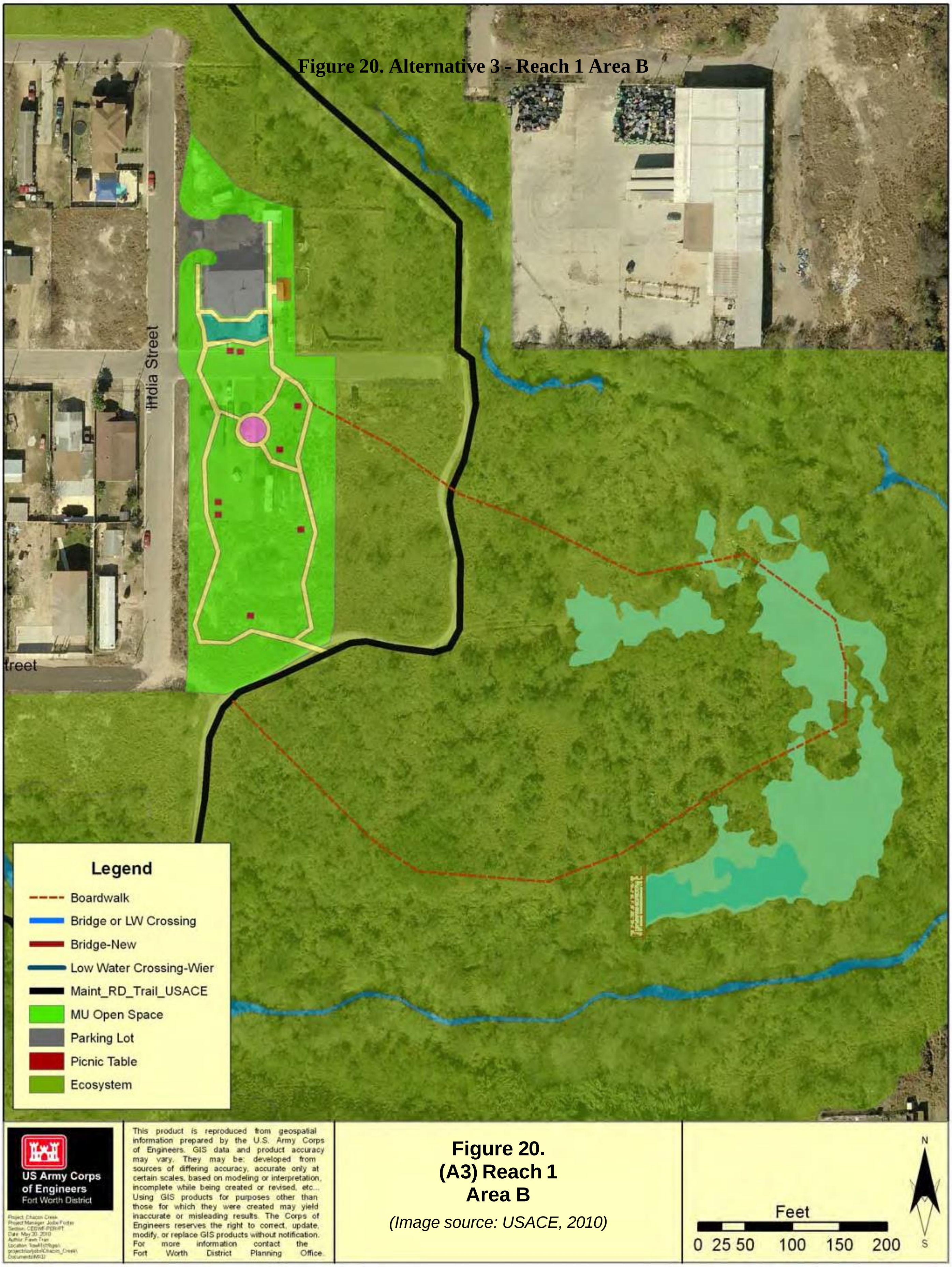


Figure 20.
(A3) Reach 1
Area B
(Image source: USACE, 2010)

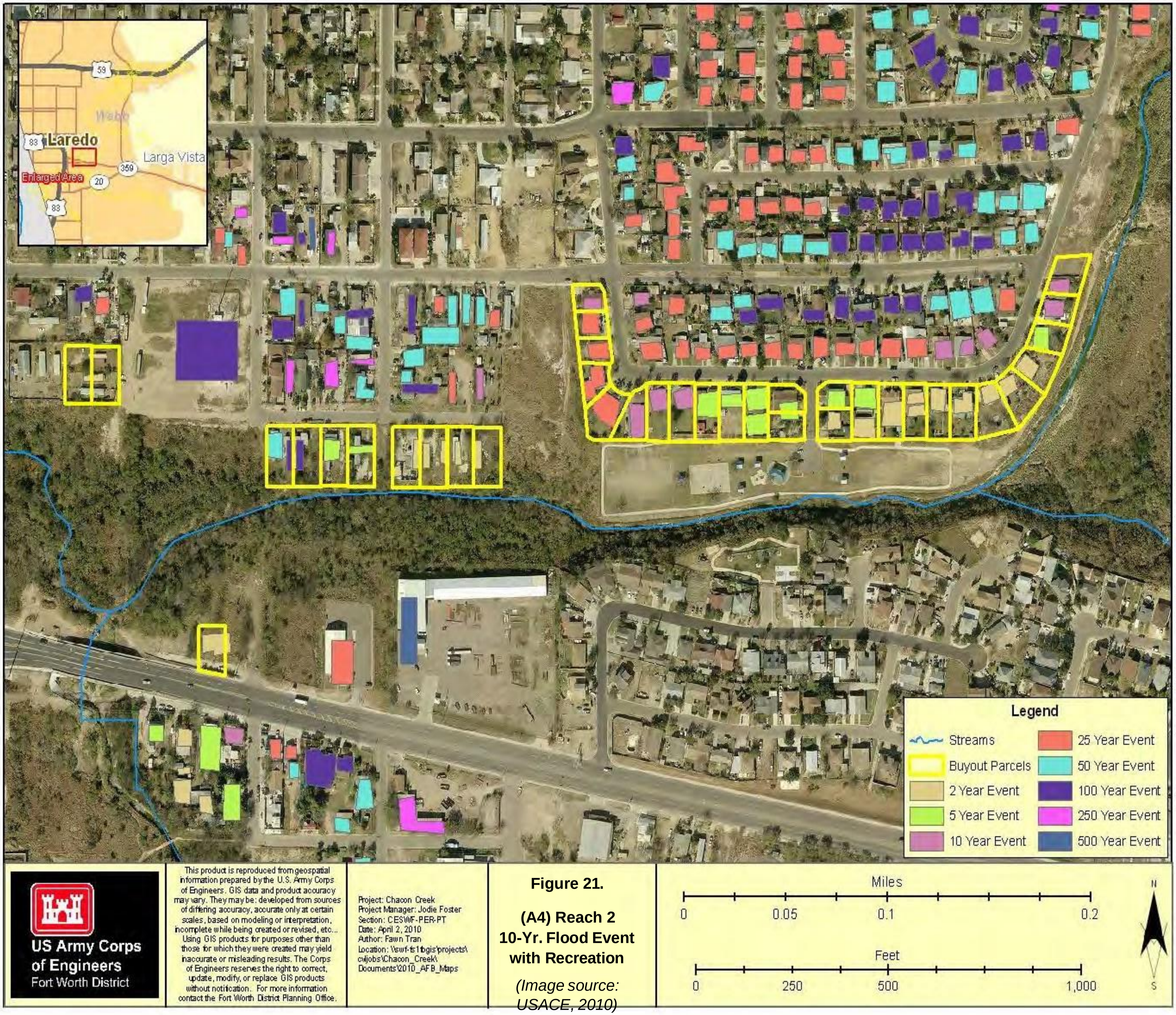


Figure 21.

(A4) Reach 2 10-Yr. Flood Event with Recreation

(Image source: USACE, 2010)

Alternative 4 (A4): Reach 2 10-Year Floodplain Evacuation with Recreation

This non-structural alternative is carried forward because it evacuates virtually all of the structures in the more frequent flood events and provides a viable area for coherent secondary use in the form of recreation. This non-structural alternative would buy out the 42 residential structures located within the 10% ACE (10-year frequency). The alternative would generate $516,800 in EAD benefits and
$448,600 in recreational benefits, for a total of $965,400. Costs include $4,498,900 for the land and structures, $907,400 for the demolition of these structures, $674,900 for real estate administration costs, and $5,814,700 in recreational costs, for a total of $11,895,800. Total annual charges are $714,100 over 50 years with net benefits of $251,300 annually and a benefit/cost ratio of 1.35-to-1.00.

This alternative is shown in Figure 21. The alternative would evacuate 35 structures within the 10% ACE (10-year event), including all of the structures in the 20% ACE (5-year event). An additional seven structures are evacuated due to the fact that they are either sandwiched between 10-year event structures or would remain isolated by themselves at the end of Guatemozin Street leaving them in close proximity to the creek and still requiring utilities.

The recreation plan associated with this alternative includes quality, basic amenities found in typical neighborhood parks, as well as several higher quality, but not exclusive amenities. These recreational amenities would cover approximately eight acres of the proposed parkland. Ready access to the park is available by both bus route and area roads and ample parking is included in the plan. The points system used to calculate the recreation benefits yielded that a value of $6.84 per visit for this level of parks is reasonable. Table 32 lists the recreation benefits in this alternative.

The table also notes several recreation items with zero benefits, as these items have already been constructed at this location. Subsequent alternatives also reference these items, which are not included as benefits for both without- and with-project conditions. This methodology provides continuity with the 2010 study.

Table 32. Recreation Benefits for A4: Reach 2 10-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	6	Tables	-
Multiuse Open Space (unreserved)	26,075	3.2	Acres	$178,353
Multiuse Open Space (Reserved)	5,250	3.2	Acres	$35,910
Large Playground (1 large = 4 small)	20,998	4	Sites	$143,626
Medium Playground	10,499	2	Sites	$71,813
Amphitheatre	2,000	1	Site	$13,680
Multiuse Courts	765	1	Site	$5,233
Total Benefits				**$448,615**

Alternative 5 (A5): Reach 2 Partial 25-Year Floodplain Evacuation with Recreation

This non-structural alternative was carried forward because it evacuates virtually all of the structures in the more frequent events and provides a viable area for coherent secondary use in the form of recreation, just as in the previous alternative but to a greater degree. It would include the permanent evacuation of 41 residential structures within the 10% ACE (10-year frequency) and an additional 21 structures in the 4% ACE (25-year frequency), located on the south side of S. Espana Drive and the south side of Guatemozin Street.

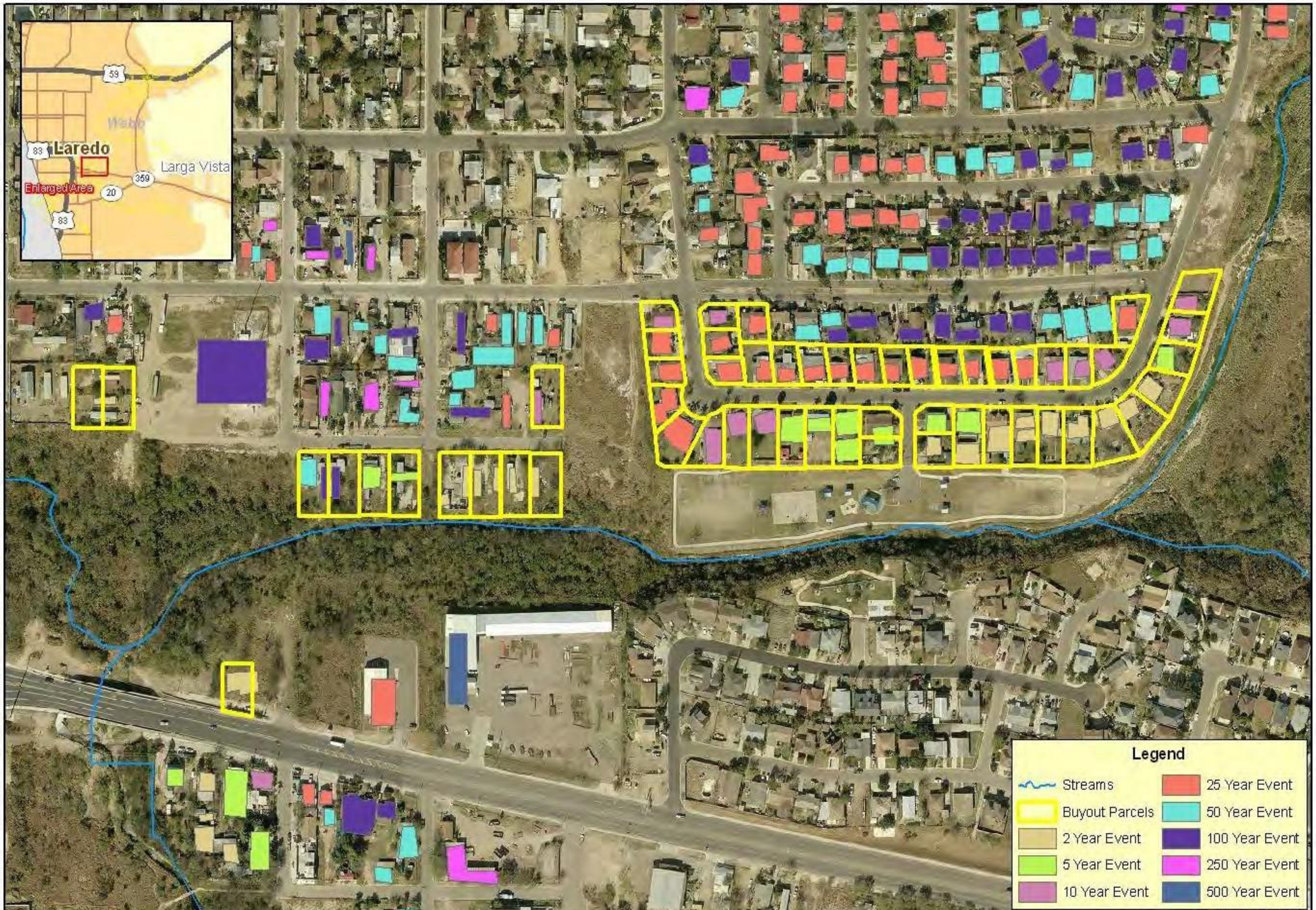
This alternative would generate $561,500 in EAD benefits and $628,800 in recreational benefits, for a total of $1,190,300. Costs include $6,641,200 for land and structures, $1,339,500 for demolition of these structures, $996,200 for real estate administration costs, and recreation costs of $7,780,000, for a total of $16,759,900 in first costs. Total annual charges are $977,300 over 50 years, with net benefits for this alternative at $213,000 annually and a benefit/cost ratio of 1.22-to-1.00. This alternative is shown in Figure 22.

This alternative evacuates the most susceptible structures in the 4% ACE (25-year event) and all the structures in the 10% ACE (10-year event). Three structures are included due to their proximity to the creek. Other structures in the 4% ACE, which are located north of Cortez Street, extend up into a residential area, and are scattered among other residential structures, are not proposed to be evacuated. Although they receive damages by a 25-year event, they are located at the highest elevations and receive flooding only when a true 25-year event would occur. If these structures were purchased, there would be high annual operations and maintenance requirements and the vacated lands would not generate benefits. These parcels would just be maintained (i.e., mowed) by the city in perpetuity.

Benefits from the recreation plan for this alternative are derived from increased open fields for general and reserved use, as well as a large group shelter that can accommodate 200 visitors for reserved functions. The shelter's hard surface would also accommodate hard-court sports when there is no special activity planned. The points system used to calculate the recreation benefits indicates a value of $7.29 per visit for this level of amenities is reasonable. The value is higher than the smaller, 5-year buyout plan due to the addition a large group shelter and an increase in the amount of open acres available for field activities. Table 33 shows the recreation benefits for this alternative.

Table 33. Recreation Benefits for A5: 25-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	4,167	0.5	Acre	-
Multiuse Open Space (Unreserved)	40,743	5	Acre	$297,016
Multiuse Open Space (Reserved)	8,250	5.5	Acres	$60,143
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$628,799**



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Project: Chacon Creek
Project Manager: Jodie Foster
Section: CESWF-PER-PT
Date: April 2, 2010
Author: Fawn Tran
Location: \\swf-fs1\bgis\projects\cwjobs\Chacon_Creek\Documents\2010_AFB_Maps

Figure 22.
(A5) Reach 2Partial 25-Yr. Event with Recreation
(Image source: USACE, 2010)

Miles
0 0.05 0.1 0.2
Feet
0 250 500 1,000
N
S

Alternative 6 (A6): Reach 2 “VDS Plan”

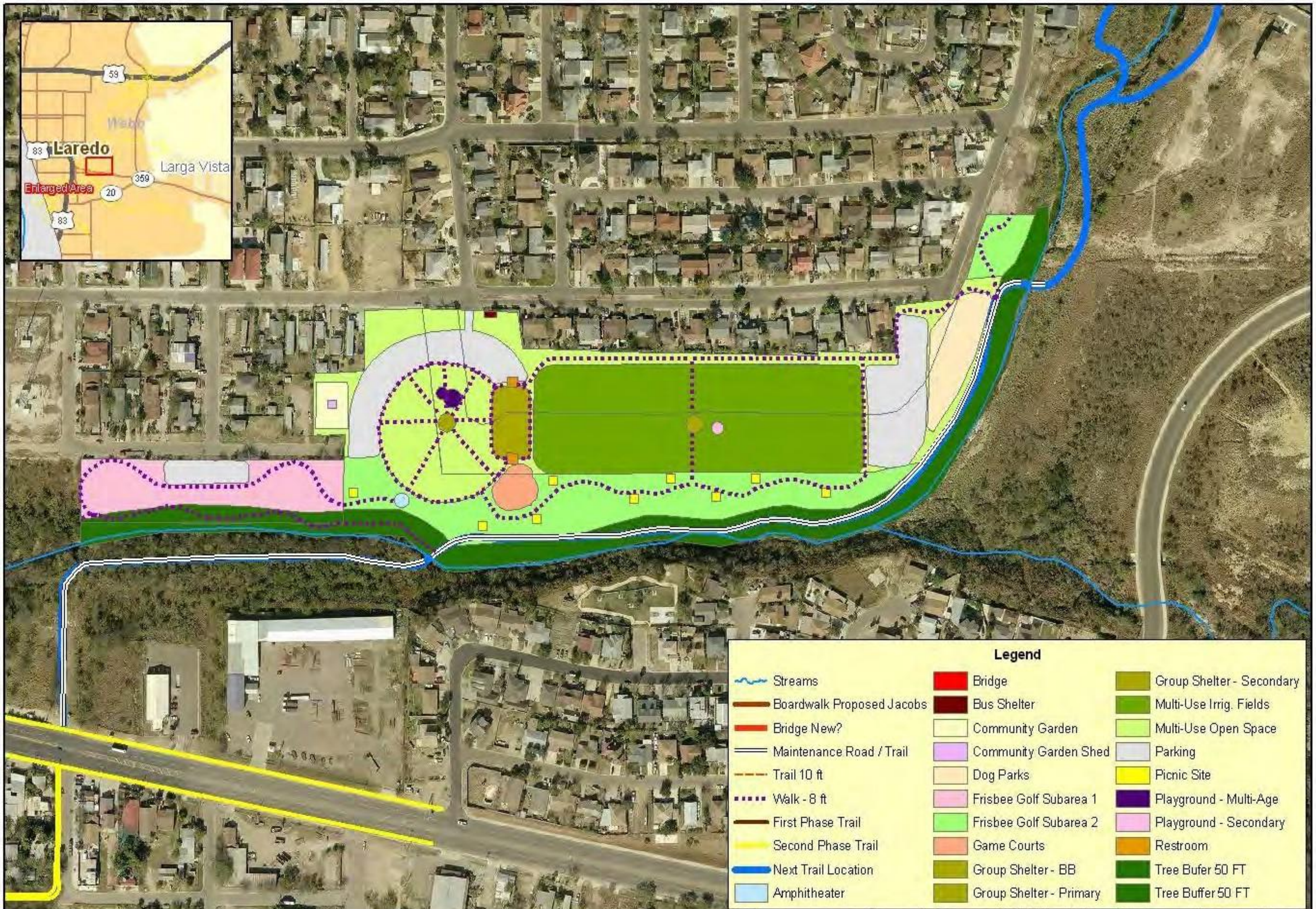
This plan is called the VDS Plan because it is generally located in the Villa Del Sol neighborhood. This non-structural alternative is virtually the same as the Partial 25-Year with Recreation Plan (A5) with slight differences in the number and location of recreational amenities. Recreational amenities in the previous plan were constrained to remain on project lands, while this alternative makes more efficient use of land not specifically included in a proposed project measure. It should be noted that these lands are all within the modeled floodplains but are located on parcels that do not need to be purchased. These lands are currently open space and recreation facilities owned by the City of Laredo and consist of Subarea 2 as described in Appendix F. The costs for Subarea 2 in this alternative are 100 percent non-Federal responsibility.

This plan would generate the same $561,500 in flood risk management EAD benefits and $674,900 in recreational benefits for a total of $1,236,400, which is an increase of $46,100 annually over the recreational benefits of A5. To achieve this increase in annual recreation outputs, recreational costs increase to $7,838,400 with total annual charges increased to $980,500. This plan, however, generates $255,900 in net benefits and a benefit/cost ratio of 1.26-to-1.00. Figure 23 shows the recreation footprint for the VDS alternative.

The main difference in benefits for Alternative 6 entails relocating the Pit Sports feature outside of the multiuse open fields. This allows more space for both reserved and unreserved uses of the area. The increase in field space also allows for more intensive use of the area for tournament type events and organized team practice. The same value ($7.29) applied to Alternative 5 as was used in Alternative 6. Alternatives 5 and 6 have a slightly higher point value and therefore a higher value recreation experience than Alternative 4. Table 34 shows the recreation benefits for this alternative.

Table 34. Recreation Benefits for A6: Reach 2 “VDS Plan”

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	44,817	5.5	Acres	$326,716
Multiuse Open Space (Reserved)	10,500	7	Acres	$76,545
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$674,901**



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Project: Chacon Creek
Project Manager: Jodie Foster
Section: CESWF-PER-PT
Date: April 2, 2010
Author: Fawn Tran
Location: \\swf-fs1\gis\projects\cwjobs\Chacon_Creek\Documents\2010_AFB_Maps

Figure 23.

(A6) Reach 2VDS with Recreation

(Image source: USACE, 2010)

Miles
0 0.05 0.1 0.2

Feet
0 250 500 1,000

N
S

Alternative 7 (A7): Reach 2 25-Year with VDS Recreation

This non-structural alternative would include the permanent evacuation of all 111 structures located in the 4% ACE (25-year frequency) and combine it with the same recreational amenities as the VDS Plan, along with its associated costs and benefits. This alternative would generate $693,200 in EAD benefits and the same $674,900 in recreational benefits for a total of $1,368,100 in benefits. This alternative assumes the same recreation costs of $7,838,400. Total investment costs are $24,985,600 with annual charges of $1,351,700, while generating $16,300 in annual benefits with a benefit/cost ratio of 1.01-to-1.00.

Just as in Reach 1, these non-structural, recreational alternatives (A4 through A7) were compared to the 50% ACE (2-year frequency event), 20% ACE (5-year frequency event), 10% ACE (10-year frequency event), and 4% ACE (25-year frequency event) *without* recreation, as a means to measure the performance of more viable, developed, and comprehensive alternatives.

- The 50% ACE had total costs of $2,781,650, which annualized to $137,900. Benefits from reduction in expected annual damages were $351,000 producing net benefits of 213,100.
- The 20% ACE had total costs of $4,245,700 which annualized to $210,500. Benefits from reduction in expected annual damages were $476,600 producing net benefits of $266,100.
- The 10% ACE had total costs of $6,002,500 which annualized to $297,600. Benefits from reduction in expected annual damages were $545,000 producing net benefits of $247,400.
- The 4% ACE had total costs of $16,250,700 which annualized to $805,700. Benefits from reduction in expected annual damages were $693,100 producing net benefits of -$86,000.

Combination Alternatives

While analyzing the other alternatives, it seemed appropriate to analyze at least one non-structural/structural combination to ensure that the plan with the most net benefits can be identified.

Alternative 8 (A8): Reach 2 VDS Plan with Small Channel

The proposed combination plan used the VDS Plan as the starting point, because it had the highest net benefits of the non-structural alternatives and combined it with the small channel alternative. Figure 24 shows this combination alternative (A8). The small channel configuration was evaluated because it would minimize any design adjustments necessary to retain the recreation features and benefits of the VDS Plan. Just as in the small channel design discussed for Reach 2, this structural component would entail a 50-foot-wide channel cut for creating valley storage and conveyance, with a second bench averaging a width of 50 feet and 1-on-4 side slopes. Total investment costs for this alternative are $20,280,400 with total annual charges of $1,144,100. Net annual benefits are $216,300 with a benefit/cost ratio of 1.19-to- 1.00.

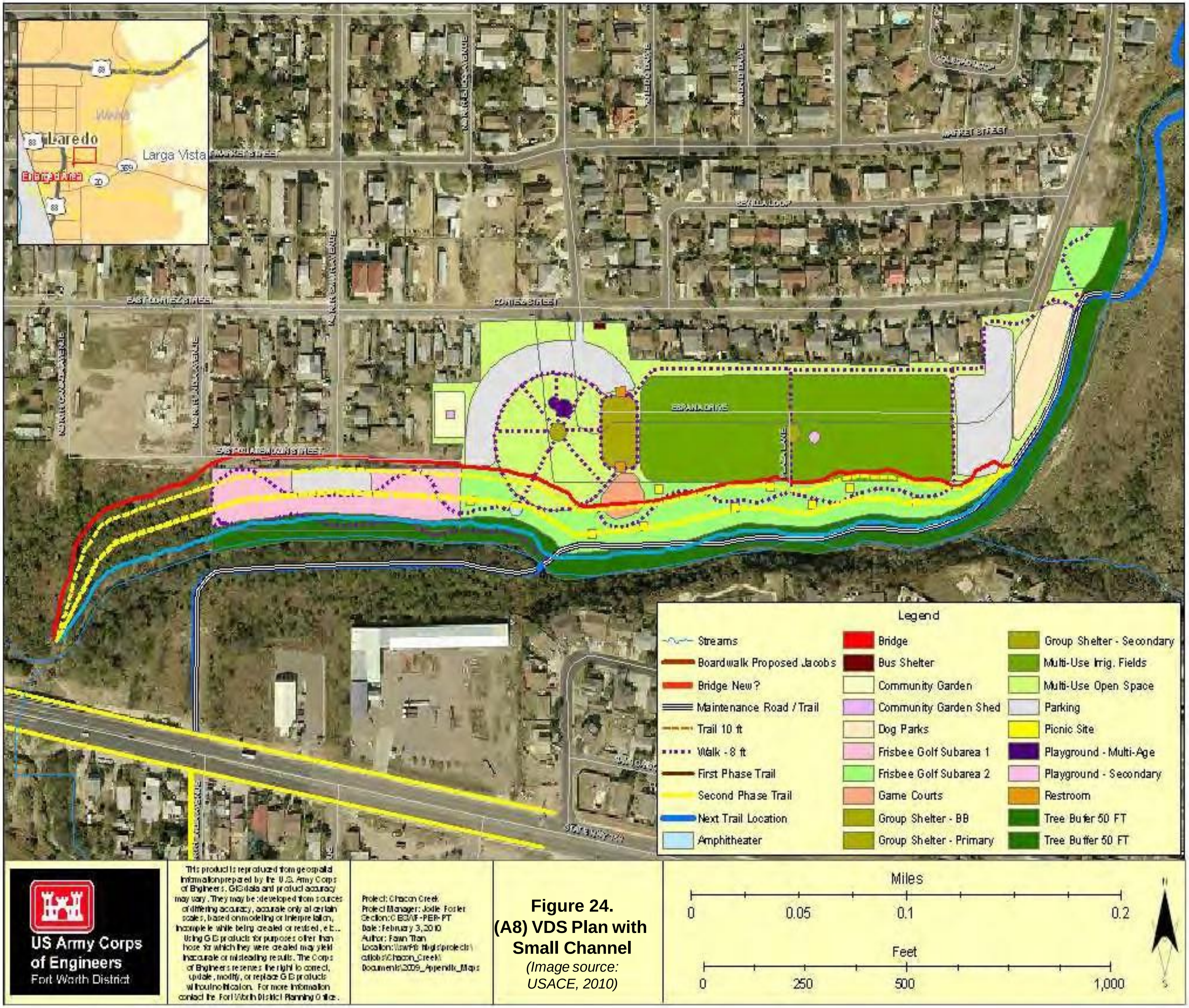

Figure 24.
(A8) VDS Plan with Small Channel
(Image source: USACE, 2010)

Just as in Alternative 6, the main difference in benefits entails relocating the Pit Sports feature outside of the multiuse open fields allowing more space for both reserved and unreserved uses of the area. The increase in field space also allows for more intensive use of the area for tournament type events and organized team practice. The same value ($7.29) was applied to Alternative 8 as used in Alternatives 5 and 6. Just as for Alternative 6 and 7, Table 33 shows the recreation benefits for this alternative.

This alternative represents what is considered to be the optimally performing combination plan because it would alleviate much of the flooding originating from Chacon Creek. However, there would still be flooding from the south and north ends of the reach that floods residences along Cortez and Market Streets just north of the proposed buyout area. Therefore, as part of this plan, a levee feature that would address the easterly flows was considered. This would consist of a levee along the channel beginning north of Market Street and continuing down roughly through the Villa Del Sol Park. The levee would prevent out of bank flows from the creek that currently impact structures north of Cortez Street. However, this feature was deemed to be too expensive relative to the additional benefits it might generate.

The construction costs for a levee as a standalone or combination plan would be significantly higher than that of channel excavation, and because most of the flood risk management benefits would be obtained with the channel feature itself, it would be too expensive to be economically justified. In addition to direct construction costs, a levee feature would raise upstream and downstream water surface profiles and would require hydraulic mitigation, which would further increase costs. Finally, levees require interior drainage features so that they do not create additional flooding. Levees serve as a dam and back up water on the interior side of the levee, and without interior drainage structures, they can actually inundate structures they were designed to protect. This would again result in additional costs. Taking all of these things into consideration, a levee alternative was not considered to be practicable as part of the combination alternative.

Note: Alternative 9 is discussed under NER Plan Selection.

Alternative 10 (A10): Reach 1 10-year with Recreation and “VDS Plan”

The final non-structural alternative combines Alternative 6, Reach 2 “VDS” plan. with Alternative 3, 10-Year Floodplain Evacuation with Recreation. This alternative would consist of purchasing and removing 11 structures in Reach 1 within the 10% ACE (10-year frequency event) floodplain, 41 residential structures within the 10% ACE (10-year frequency), and an additional 21 structures in the 4% ACE (25-year frequency) located on the south side of S. Espana Drive and the south side of Guatemozin Street in Reach 2. This plan would generate $629,000 in flood risk management EAD benefits and $832,495 in recreational benefits for a total of $1,540,300. Costs include $8,398,200 for land and structures, $1,577,200 for demolition, $1,259,700 for real estate administration, and $9,066,500 in recreation costs for a total of $20,301,700. Total annual charges are $1,194,300 over 50 years with net benefits of $345,900 annually and a benefit/cost ratio of 1.22-to-1.00.

Benefits from recreation for the combined alternatives are listed in Table 35. Benefits for the recreation component associated with Reach 1 are calculated at $6.84 per visitor day and recreational amenities associated with Reach 2 are calculated at $7.29 per visitor day.

Table 35. Recreation Benefits for A10: Reach 1 10-year with Recreation and VDS Plan

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	1,920	12	Tables	$157,594
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	44,817	5.5	Acres	$326,716
Multiuse Open Space (Reserved)	10,500	7	Acres	$76,545
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$832,495**

Risk Analysis of Flood Risk Management Alternatives

This section discusses the risk associated with each alternative considered to reduce the risk of flooding, as required by ER 1105-2-100 and Engineering Circular 1165-2-209, dated 31 January 2010. Each alternative will be compared to the other alternatives.

Alternative 1, the No-Action Plan, would result in the most residual flood risk remaining in the study area. Approximately $887,600 in EAD would remain in the study area and approximately 449 structures would remain within the 500-year floodplain. The highest risk would continue for the structures in the high frequency events such as the 2-, 5-, and 10-year events.

Alternative 2, the Reach 2 Structural Plan, targets Reach 2 where there is currently $805,500 in existing EAD. This alternative would result in the reduction of $642,300 in EAD, but would leave
$163,200 in residual damages. To implement this plan, 31 structures would have to be permanently evacuated from the floodplain. The risk of failure from nonperformance on these structures would be nonexistent. However, the main intent of this alternative would be to lower water surface profiles by constructing a bench. This would provide some level of protection to the 277 structures that remained in the 500-year floodplain in Reach 2. The risk of nonperformance of this structural component would be that some level of protection would not be provided to these structures depending on the extent of nonperformance. For instance, if the bench was not properly maintained and some conveyance was lost, the project would not perform to the design standards, but it would still provide flood protection above what currently exists today. Because this alternative only targets Reach 2, there would be an overall residual EAD of $392,700 remaining in the entire study area.

Of any flood risk management alternative, floodplain evacuations are the least susceptible to risk. If structures are removed from the floodplain, they cannot receive future damages. Alternative 3, the Reach 1 10-year Floodplain Evacuation with Recreation Plan, targets Reach 1 where there is currently
$86,200 in EAD. This alternative is justifiable and could be built as part of a Federal project. This plan (A3) would permanently evacuate 11 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 1, there would be an overall residual EAD of $967,500 and 438 structures remaining in the 500-year floodplain in the study area.

Alternative 4, the Reach 2 10-year Floodplain Evacuation with Recreation Plan, would result in the reduction of $516,800 in EAD, but would have a residual EAD of $288,700. This plan would permanently evacuate 42 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 2, there would be an overall residual EAD of $518,200 and 407 structures remaining in the 500-year floodplain in the study area.

Alternative 5, the Reach 2 Partial 25-year Floodplain Evacuation with Recreation Plan, would result in the reduction of $561,500 in EAD, but would have a residual EAD of $244,000. This plan would permanently evacuate 62 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 2, there would be an overall residual EAD of $473,500 and 387 structures remaining in the 500-year floodplain in the study area.

Alternative 6, the Reach 2 “VDS Plan,” would result in the reduction of $561,500 in EAD, but would have a residual EAD of $244,000. From a flood risk management perspective, this plan has the same flood benefits, footprint, and risks as Alternative 5.

Alternative 7, the Reach 2 25-year Floodplain Evacuation with the VDS Recreation Plan, would result in the reduction of $693,200 in EAD, but would have a residual EAD of $112,300. This plan as compared to the other justified alternatives provided the least amount of remaining risk, but also the lowest net benefits due to the cost. This plan would permanently evacuate 111 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. This plan would be more effective than Alternatives 4, 5, or 6 because it would remove all structures within the 25-year floodplain. The only structures that would be left to receive damages from flood inundation in Reach 2 would be located above the 25-year flood frequency. Because this alternative only targets Reach 2, there would be an overall residual EAD of $341,800 and 338 structures remaining in the 500-year floodplain in the study area.

Alternative 8, the Reach 2 Combination VDS with Small Channel Plan, would result in the reduction of $685,500 in EAD, but would have a residual EAD of $120,000. This plan would permanently evacuate 62 structures from the floodplain. However, as part of the total benefits, this plan would also provide reduction of EAD by implementing a small bench in addition to the floodplain evacuation, to further reduce some of the residual damages that remain by implementing Alternatives 5 and 6. This would provide some level of protection to the 197 structures that remained in the 500-year floodplain in Reach 2. The risk of nonperformance of this structural component would be similar to that of Alternative 2, but to a lesser extent. Because this alternative only targets Reach 2, there would be an overall residual EAD of $349,500 remaining in the 500-year floodplain in the study area.

Alternative 10, or the Reach 1 10-year with Recreation and VDS Plan, would result in the reduction of $629,000 in EAD, but would have a residual EAD of $262,700. This plan would permanently evacuate 73 structures from the floodplain. The risk of failure from nonperformance on these structures would be nonexistent. Because this alternative targets only Reaches 1 and 2 and with the associated overall residual EAD of $406,000, 376 structures would remain in the 500-year floodplain in the study area.

NED Plan

The number of structures evacuated, as well as the costs and benefits referenced in this section, relate to the values referenced in the alternatives analysis. The numbers reflect the escalated values, as referenced previously, and the economic benefits have not been updated to include the removal of several structures from the floodplain that have occurred since the 2009 study. Further information regarding updated analysis, modified structure inventory, and changes to the costs and benefits for the NER plan can be found in Section 5, as well as Appendix A.

Because it has the highest net benefits, Alternative 10 - the VDS Plan (Alternative 6) coupled with the Reach 1 10-Year Buyout with Recreation Plan (Alternative 3) was selected as the NED plan. As discussed previously, this non-structural alternative would buy out 74 structures located on the south side of S. Espana Drive and the south side of Guatemozin Street in Reach 2 along the main stem of Chacon Creek. This alternative includes 51 structures in the 10% ACE (10-year), 19 structures in the 4% ACE (25-year), one in the 2% ACE (50-year), and two in the 1% ACE (100-year). Additionally, this alternative would buy out 11 structures in the 10% ACE (10-year) in Reach 1. This alternative generates $629,000 in EAD benefits, $832,495 in recreational benefits for a total of $1,461,500.

Costs for the NED Plan project include $8,398,200 for the land and structures, $1,577,200 for the demolition of these structures, $1,259,700 for real estate administration costs, and recreation costs of
$9,066,500, for a total of $20,301,700. These costs annualize to $1,076,400 over 50 years. O&M costs are estimated at $117,900for total annual costs of $1,194,300 including interest during construction.
Net benefits for this alternative are $267,100 annually with a benefit/cost ratio of 1.29-to-1.00. The structures to be bought out in Reach 2 are the same structures as in the Partial 25-Year Buyout with Recreation (depicted in Figure 22). Recreational amenities for this plan are depicted in Figure 23, and Figures 19 and 20 for the Reach 1 component.

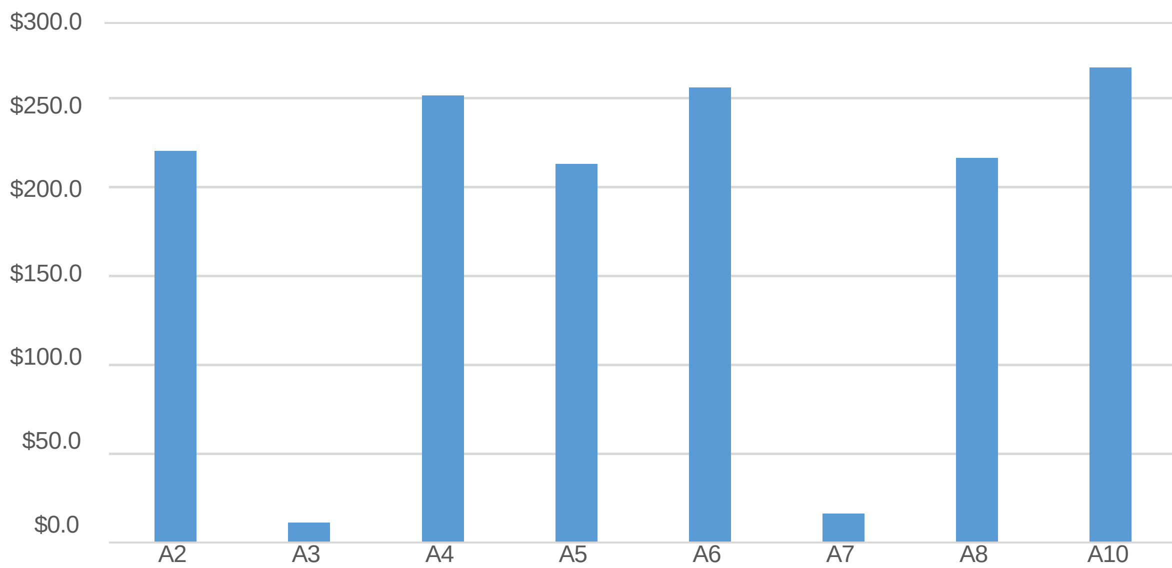

Figure 25. Net Benefits for All Investigated Alternatives (x $1,000)

Ecosystem Restoration Plan Formulation Process

With-project and future without-project conditions were compared using the Institute of Water Resources decision support software IWR Planning Suite II (v2.0.9), which facilitates the evaluation and comparison of ecosystem restoration plans with non-monetary outputs (AAHUs). The cost of preconstruction, engineering, and design (PED), construction management, and actual construction cost of ecosystem restoration measures were annualized to use as the cost for each plan being evaluated.

Delineation of Cover Types

The delineation of cover types was conducted using previous investigations, interpretation of aerial photography, and field observations. A total of four cover types were delineated in the study area: riverine, herbaceous wetland, deciduous shrubland, and deciduous forest. The riverine, deciduous shrubland, and deciduous forest cover types were used to assess the riparian terrestrial systems in the study area. The herbaceous wetland cover type is used to assess the wetland systems in the study area.

Beginning on the next page, Figures 26–32 show the cover type delineations of the Chacon Creek study area. In the figures, cover types are numbered and labeled using “F” for Riparian areas, “R” for Riverine, and “W” for Wetlands.

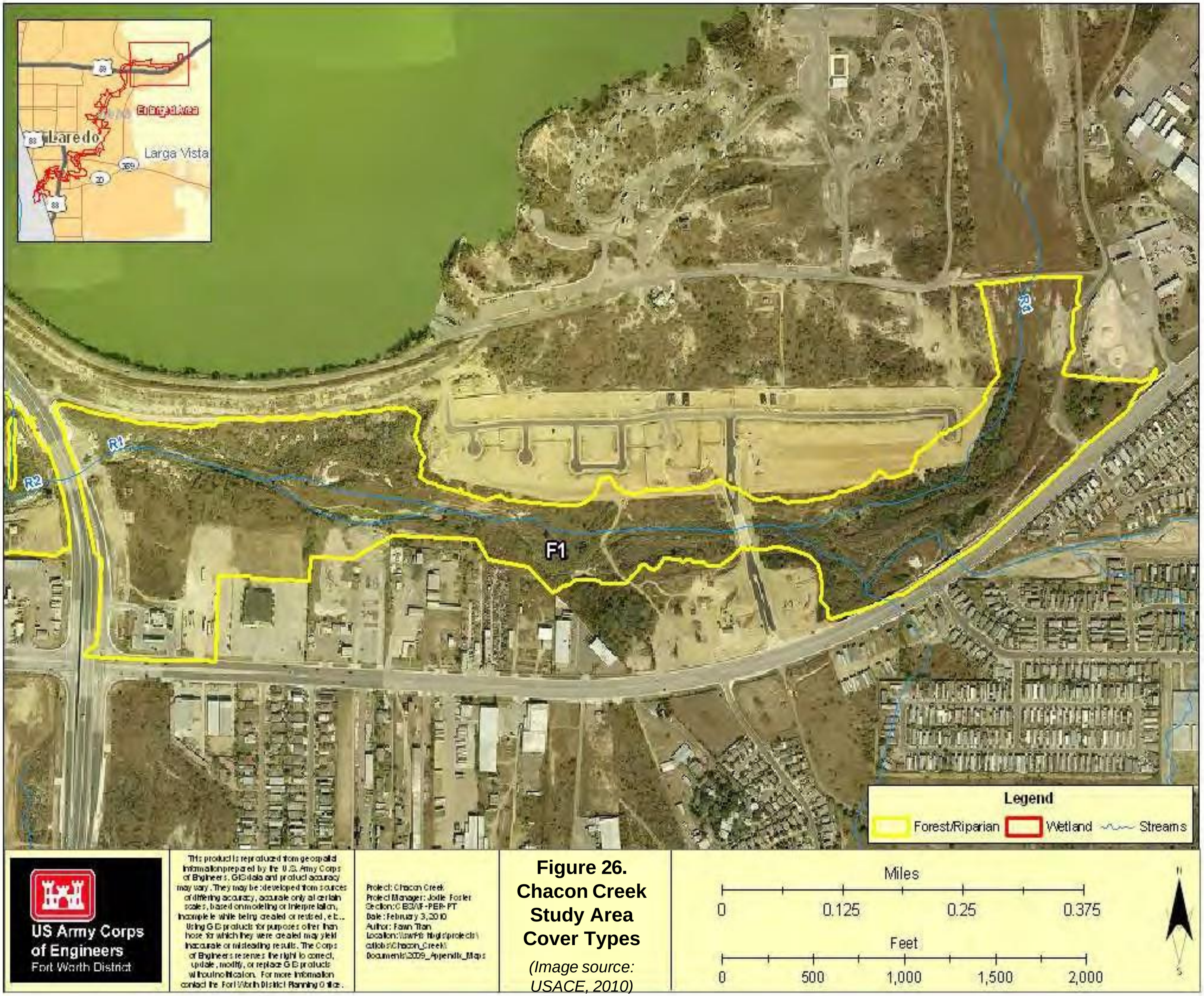

Figure 26. Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

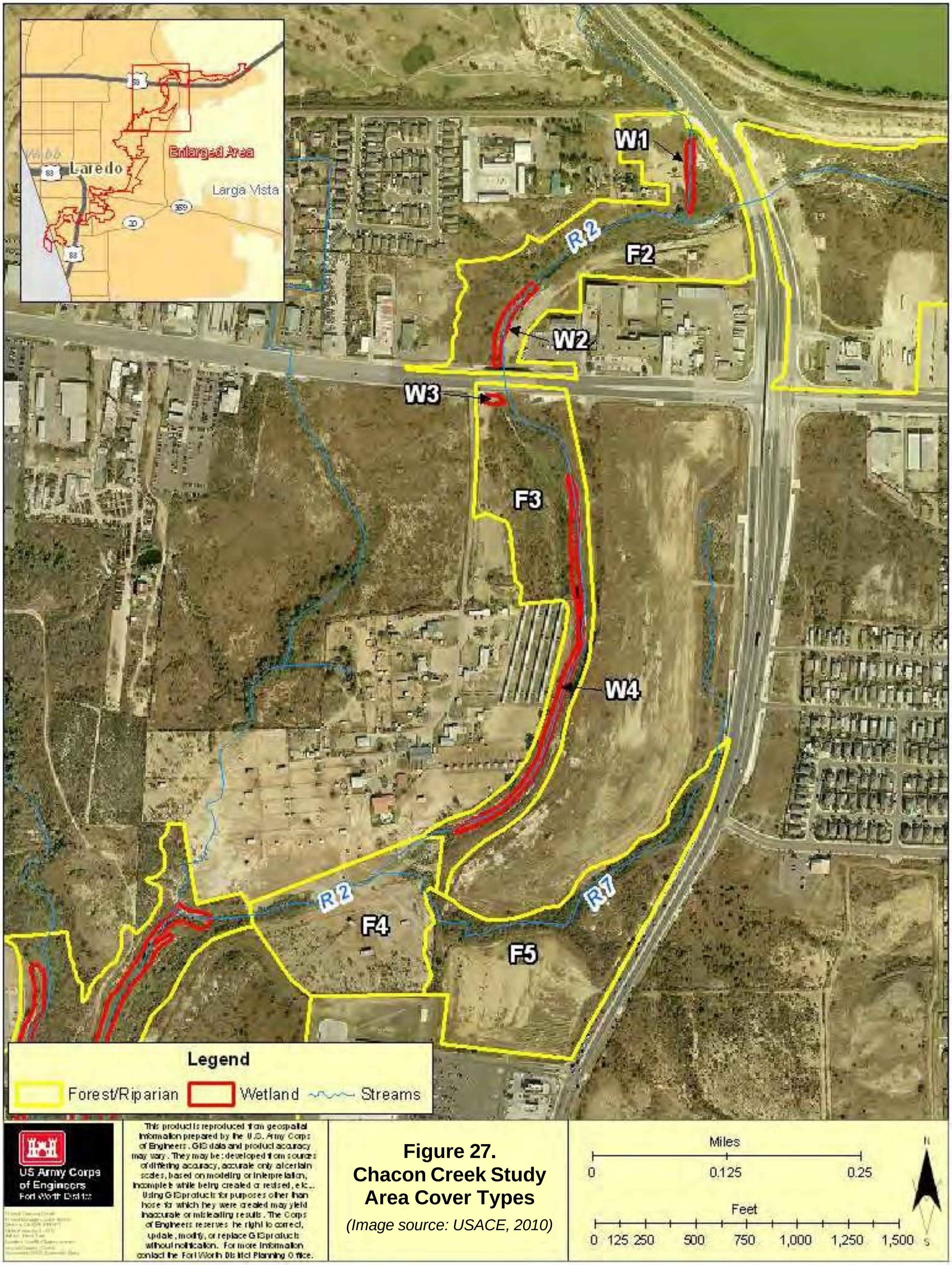

Figure 27. Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

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Figure 28.

Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

Miles: 0, 0.125, 0.25

Feet: 0, 125, 250, 500, 750, 1,000, 1,250

N
S

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Figure 29.

Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

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Figure 30.

Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

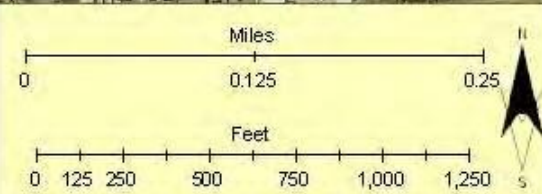

Figure 31. Study Area Cover Type Map 6

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Figure 31.

Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

Miles

0 0.125 0.25

Feet

0 125 250 500 750 1,000 1,250

N

S

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Figure 32.

Chacon Creek Study Area Cover Types

(Image source: USACE, 2010)

Miles: 0, 0.0625, 0.125

Feet: 0, 125, 250, 500, 750

N
S

Habitat Evaluation Methodology

For terrestrial habitats, the HEP method was used to evaluate the suitability of riparian and wetland habitat for wildlife in the study area as described in Section Two. A fisheries survey and an IBI was used to assess the aquatic habitat in the study area.

Evaluation Procedures

The HEP (USFWS, 1980, 1981) study was used to evaluate the suitability of existing riparian and wetland habitats for wildlife in the study area, and to quantify the amount of habitat currently available. HEP is a system that uses a habitat sampling approach to assess existing and future habitat suitability, compare study alternatives, and analyze mitigation measures to offset study impacts.

In a typical HEP study, a number of evaluation species are chosen for each cover type in the study area. Species are chosen because of their ecological, recreational, or economic value, or because they represent groups of species (guilds) that have similar habitat needs. The suitability of habitats is then quantified through the measurement of conditions described by an HSI model for each evaluation species. Habitat conditions for each HSI model are measured from maps, aerial photographs, or by on-site sampling and used to calculate an HSI value as described by the HSI models. The resulting HSI value represents the suitability of habitats on a scale from 0.0 (unsuitable) to 1.0 (suitable). The availability of habitats in the study area is quantified as Habitats Units (HU). To derive the HUs for evaluation species and cover type, the HSI value (suitability) of a given habitat or cover type is multiplied by the number of acres (area) in the study area.

The same four species identified for HEP analysis were also selected to perform an updated analysis in 2017. Habitat requirements for selected species are described in the subsection below. Species listed below were selected due to their likeliness to use small drainages in the southern Texas plains ecoregion:

- American coot (*Fulica americana*)
- belted kingfisher (*Ceryle alcylon*)
- red-winged blackbird (*Agelaius phoeniceus*)
- slider turtle (*Pseudemys scripta*)

Habitat Requirements for Terrestrial Species

American coot habitat requirements include a stable source of surface water and emergent vegetation to provide suitable reproductive habitat. Optimal habitat for the belted kingfisher provides clear and accessible water with abundant small and medium size fish for foraging.

Optimal habitat for the slider turtle is composed of abundant cover of emergent vegetation providing a forage base, and slow moving, deep, permanent water.

HABITAT ASSESSMENT PROCESS

This section further describes the components of the habitat assessment to determine habitat suitability indices for the Chacon Creek study area.

Fisheries Survey and Index of Biotic Integrity

On October 18, 2006, the U.S. Fish and Wildlife Service and City of Laredo Environmental Services Department personnel conducted a fisheries survey on Chacon Creek in Laredo. The purpose was to determine baseline fish community structure within the area of Chacon Creek that could be potentially impacted by stream modifications, development, and/or construction activities associated with possible future flood risk management projects and restoration opportunities.

Based on in-stream habitat characteristics, three sites were selected to sample fish on Chacon Creek.

- Site 1 was considered riffle habitat.
- Site 2 was characterized as stream run habitat.
- Site 3 was designated as pool habitat.

These sites were all downstream of Casa Blanca Reservoir. The drainage basin for these sites encompasses approximately 155 square miles.

Fish were collected from all three sites using a fine mesh seine. In addition, fine mesh dip nets were used at Site 1 as a supplement to the seine to collect fish from areas where the substrate was dominated by large cobble. A total of seven seine-hauls were performed at each site. After collection, fish were identified to species, counted, and any observed anomalies were recorded. All fish were then released back into the creek, with the exception of those fish preserved for voucher specimens.

An IBI provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these 11 metrics to define species richness, trophic composition, and abundance. Each of these metrics is scored with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric's score for a total score. Accounting for the high variability in fish assemblages in aquatic systems between various ecological regions (ecoregions) in Texas, Linam *et al*. (2002) developed regionalized IBIs. Chacon Creek is located in the region designated by Linam as the Southern Texas Plains, Ecoregion 31. Using a regional IBI, the data that resulted from the fisheries sampling were used to calculate aquatic life use values for each site and the overall area sampled.

Habitat Assessment Results

Data collected in the field were used to determine the average conditions found in each sampling area or stand. These average conditions for the aquatic and wetland cover types were then used to evaluate habitat suitability using the species-specific formulas and his models. The aquatic habitat type was assessed using IBI, which was then converted to a habitat index. The following sections describe the conditions that limit habit suitability in the study area and provide a summary of the HSIs provided by each area or stand.

Riverine Habitat

The American coot, belted kingfisher, and slider turtle species models were used to assess the habitat suitability of each riverine reach in the study area. These species are dependent upon the presence of standing or flowing water during most of the year. Habitat requirements for the three selected species are described in the section below. Thus, a majority of areas in the riverine cover type were not suitable for one or more of these species. For the purposes of analysis, sampled riverine areas were divided into sample reaches from north to south (R1, R2, R3, R4, R5, R6, R13). Stands were delineated and categorized into three major types: herbaceous wetland, deciduous shrubland, and deciduous forest. Chacon Creek Riparian habitat was determined to have an overall HSI of 0.28, as shown in Table 36.

Table 36. Chacon Creek Riverine HSI

	American Coot	Belted Kingfisher	Slider Turtle	Average HSI
HIS	0.43	0.18	0.22	0.28

The northernmost channel segment (R1), immediately south of the Casa Blanca Lake spillway is dominated by the deciduous shrubland habitat. Casa Blanca Lake is outside of the study area, but to determine the source of water for Chacon Creek, the lake was visited during the field surveys. The Chacon Creek channel from Casa Blanca Lake to at least U.S. Highway 59 is dry in most areas. There was extensive rainfall and localized flooding in the Laredo area in late May/early June of 2017, and Casa Blanca Lake appeared to be full. However, despite recent rains, most of the creek channel was dry, or nearly dry, and water, if present, was in a very narrow corridor less than 2 feet wide, and did not appear to be flowing. There were limited areas in this section of the creek that had ponded water.

One small pond was observed adjacent to U.S. Highway 59 (Photo 1), and the ponded area fringes were dominated by saltcedar, honey mesquite, Jerusalem thorn (*Parkinsonia aculeata*) and bushy seaside tansy (*Borrichia frutescens*). Any areas along the dry creek that retained water for a small portion of time had a fringe of salt cedar and some southern cattail (*Typha* spp.). Upland areas were dominated by honey mesquite, spiny hackberry and sweet acacia. A stand in R1was not accessible because there was no right-of-entry available, thus dominant species within the western end of the stand could not be verified.

South of U.S. Highway 59 (R2) is relatively narrow and there was no right-of-entry within most sections of this reach. A wetland was accessed from a parking lot. The wetland was dominated by salt cedar along the creek banks, but no herbaceous wetland vegetation was present. This area is degraded, and covered with salt cedar, flood debris, and trash. An additional wetland was observed from the bridge on Business U.S. Highway 59Z. There was water in the creek bed, but the water had no discernable flow, and the banks were dominated by salt cedar, buffelgrass, and other species included baccharis (*Baccharis* spp.), Jerusalem thorn, sweet acacia, and big sacaton (*Sporobolus wrightii*), all of which may occur in uplands and wetlands. Both observed wetlands are degraded and inundated with flood debris and trash. The remainder of the reach was not accessible.

The R3 segment of Chacon Creek was immediately north and south of Texas State Highway 400. Vegetation stands north of Clark Road and west of Chacon Creek were characterized by dense stands of shrubs dominated by honey mesquite, spiny hackberry, blackbrush and whitebrush (*Aloysia gratissima*). There were also a large number of shrub species present in smaller percentages and comparatively high species diversity. Chacon creek in this segment north of Clark Road included cattails in herbaceous wetlands and saltcedar along the banks of the creek.

Extensive restoration and wetland mitigation totaling approximately 18 acres has been performed in R3 south of Clark Road. The area was cleared of over 2000 tires, then replanted with herbaceous wetland species, including cattail (G. Cantu 2017, personal communication). Water is present throughout the year in the deeper part of this wetland restoration area (G. Cantu 2017, personal communication). During the field visits, ducks, American coots, and great egrets (*Ardea alba*) were observed. Shrubs, primarily salt cedar, were restricted to the fringes of the wetland restoration area. The average depth of water in the center of the wetland restoration area may be as much as four feet (G. Cantu, personal communication). Although standing water was present in the wetland area during October and November 2017 field surveys, at the outlet of the wetlands in there was no measurable creek flow, indicating that the water was pooled, but not flowing into Chacon Creek.

The R4 segment of Chacon Creek is immediately north and south of the railroad tracks that cross the City of Laredo from east to west. The surrounding stands of deciduous shrubland are similar to other stands observed. Sweet acacia is the dominant overstory species and shrub species include honey mesquite, spiny hackberry and coyotillo. The herbaceous layer in this area typically includes buffelgrass and big sacaton grass.

The segment of Chacon Creek identified as R5a and the tributaries that drain into segment R5a was north of Texas State Highway 359, and continued south and west to U.S. highway

83. The reach includes areas of deciduous shrubland cover types dominated by honey mesquite, sweet acacia, and spiny hackberry in the overstory and shrub layers. The herbaceous later in this area consists primarily of the introduced invasive kleingrass (*Panicum coloratum*) and some big sacaton grass. Within this reach, there were small areas identified as deciduous forest in 2007, but field observations indicated that these areas were more accurately classified as deciduous shrubland cover types, because the overstory tree cover was less than 50%, and the individuals were less than approximately 30 feet tall. Chacon Creek in this reach contained shallow water, in most places between 12 and 24 inches deep, but there was no measurable water flow. The banks of the creek adjacent to the riverine sample points had a narrow band of trees adjacent to the bank, including ash species (*Fraxinus* spp.), and salt cedar. In areas where woody species were not present, the banks of Chacon Creek are dominated by common reed. Within this reach, there were two small areas that are considered deciduous forest, totaling less than 1.5 acres. Forested areas are dominated by Mexican ash, spiny hackberry, and Jerusalem thorn. Invasive white leadtrees (*Leucaena leucocephala*) were present at low abundance. The herbaceous layer of the deciduous forest habitats included kleingrass and pigeonberry (*Rivina humilis*).

Riverine reach R6 from U.S. Highway 83 to just south of Meadow Road includes a narrow band of DS cover types on either side of Chacon Creek, and includes portions of the Chacon Bat Park at the southernmost end of the project area. The observed deciduous shrubland points in this reach were similar to other deciduous shrubland points in the project area, and dominated by honey mesquite, spiny hackberry, sweet acacia, Jerusalem thorn, and blackbrush. The herbaceous layer was dominated by species including Kleberg's bluestem (*Dichanthium annulatum*), buffelgrass, and kleingrass. The area along Chacon Creek within Chacon Bat Park is covered on both sides of the creek with stands of both common reed and giant reed.

The R13 riverine reach was a tributary of Chacon Creek and likely had similar deciduous shrubland cover types as observed throughout the project area. However, most of R13 was not accessible from either side and the banks of the tributary were too steep to determine the specific plants present in the area. R13 was evaluated only at the intersection of the tributary with Chacon Creek.

Wetland Habitat

The American coot, red-winged blackbird, and slider turtle species models were used to assess was used to assess the suitability of wetland stands. American coot habitat requirements include a stable source of surface water and emergent vegetation to provide suitable reproductive habitat. In general, dense stands of broadleaf monocots provide optimal nesting habitat for the red-winged blackbird. Slider turtles are predominantly aquatic turtles that inhabit virtually all water types, including rivers, ditches, lakes and ponds), but prefer waters that are between 3 and 10 feet deep, with a soft bottom, abundant vegetation, and suitable basking sites. Slider turtles are most commonly found in areas with aquatic vegetation such as algae and floating aquatic plants (e.g., milfoil and lily pads). The interspersion of open water among nesting areas, a lack of carp, and the presence of standing water through most of the year are assumed to result in an abundance of aquatic insect larvae and consequently provide optimal foraging habitat for red-winged blackbird. The suitability of stands that provide appropriate nesting areas but lack an aquatic forage base is determined by the quality of foraging habitats available within 600 feet of the stand.

The herbaceous wetlands adjacent to Chacon Creek provide suitable habitat for the wetland species evaluated in limited areas, but not throughout the length of the creek. The most suitable habitat for the species evaluated was in the area of the Clark Road wetland restoration. In general, wetland habitats were most suitable for American coots, slider turtles had some habitat areas available, and red-winged blackbirds had very little suitable foraging habitat available. For herbaceous wetlands, there were approximately 67 acres available, with a total of 59 HUs.

Sampling points were averaged and used as an overall HSI for the study area. As shown in

Table 37, the area of Chacon Creek Wetland habitat was determined to have an overall HSI of 0.31. Historically, this area would have been expected to have highly valued, functioning wetlands.
However, the dam that creates Lake Casa Blanca impedes water flow and inhibits wetlands from functioning in historical manner in the areas where wetland restoration is proposed.

Table 37. Chacon Creek Wetland HSI

	American Coot	Red-Winged Blackbird	Slider Turtle		Average HIS
	0.61	0.24	0.77		0.31

Aquatic Habitat

Results of the baseline fisheries survey conducted on October 18, 2006, characterized the fish assemblages that inhabit Chacon Creek as “limited to intermediate.” More than 50 percent of the total number of fish collected were considered tolerant to limited in-stream water conditions. Twenty-five percent of the total number of fish collected were omnivorous. However, fish communities at all three sites were dominated by insectivorous fish. No piscivorous fish species were collected from any of the sites during this survey. Anomalies such as lesions or tumors were observed on less than one percent of the fish collected.

A total of 422 fish, comprising 10 species from seven families, were collected from Chacon Creek, as shown in Table 38.

Table 38. Chacon Creek 2006 Fish Collection Summary

Collection Site	Number of Fish	Species per Site
1	199	10
2	71	5
3	152	6
Total	**422**	**10**

Five species (inland silverside, Mexican tetra, gizzard shad, western mosquitofish, and sailfin molly) were collected at all three sites. Cyprinids (blacktail and sand shiners), centrarchids (bluegill sunfish), and one *cichlid* species (Rio Grande cichlid) were collected from only one site (Site 1). On the next page, Table 39 shows the percentage of each species collected.

Table 39. Distribution of Fish Species Collected

Species	Percent
Inland silverside	27
Western mosquitofish	24
Blacktail shiner	16
Sailfin molly	15
Gizzard shad	8
Mexican tetra	5
Bluegill sunfish	2
Blue tilapia	2
Rio Grande cichlids and sand shiners	<1

For the fish species collected from all three sites, designated tolerance levels and associated trophic guilds were obtained from Linam el al. (2002). Blue tilapia was the only non-native species collected. No species considered intolerant to limited water conditions (such as poor water quality, fluctuating water levels, reduced flow) were collected at any of the sites. Only one of the 422 fish collected—a sailfin molly from Site 1—exhibited lesions.

The results demonstrated intermediate aquatic life use values for Sites 1 and 3, and a limited aquatic life use value for Site 2. The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages. The fish community within the overall study area was classified as "intermediate" with a total IBI score of 27, as shown in Table 40.

Table 40. Chacon Creek IBI Conversion to HSI

Collection Site	IBI Score	HSI
1	25	0.45
2	21	0.38
3	27	0.49
Total	**27**	**0.49**

To be used later for calculating HUs, the IBI was converted to HSI. The maximum possible IBI score for these 11 metrics is 55. Also shown in the table, the index values are achieved by dividing the IBI score by the maximum of 55.

The "limited–to-intermediate" characterization of the fish community in Chacon Creek could be attributed to nominal in-stream habitat, marginal water quality, and/or limited in-stream flow.
Consequently, it is recommended that future projects consider methods to restore in-stream structure and/or in-stream flow to provide suitable conditions for the improvement of the fish habitat within Chacon Creek.

Habitat Assessment Summary

In general, habitat suitability was less than optimal as assessed by each of the species models. Table 41 shows a summary of the study area HSI scores.

Table 41. Chacon Creek Habitat Suitability

Cover Type	HSI
Wetland	0.31
Riverine	0.28
Aquatic	0.49

PRELIMINARY INVESTIGATION OF ECOSYSTEM MEASURES AND SCALES

This section describes the specific ecosystem restoration measures that were investigated as possible means to address the ecosystem restoration planning objectives. A *measure* is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives related to ecosystem degradation. These measures are the building blocks of alternative plans. On the next page, Figure 33 shows the concept-level ecosystem restoration measures, which combine aquatic restoration, wetland creation, and riparian restoration.

Measures often include different sizes or scales. The scales can be in different dimensions or amounts, different materials or methods, different locations, or over different implementation time frames. Each ecosystem measure was evaluated in a range of scales.

The ecosystem restoration measures identified for consideration include selected areas of wetland development, riverine habitat improvement, and riparian reforestation.

- Initially five areas were investigated for wetland development.
- For riverine measures, Chacon Creek was separated into three linear reaches, with various lengths of riffle structures considered for each reach.
- The remainder of the study area was identified as forested and non-forested for the riparian measure.

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Figure 33.

Chacon Creek Conceptual Ecosystem Restoration

(*Image* source: USACE, 2010)

Miles: 0, 0.25, 0.5, 0.75, 1

Feet: 0, 2,500, 5,000

N

S

Wetland Measures

Wetland measures contribute to ecosystem restoration by increasing the quantity and quality of wetland habitat and improving water quality. The selected measure would create or expand existing wetland areas. This is accomplished by constructing a weir/riffle structure that holds a shallow pool of water upstream of the weir, to create or expand the area of existing wetlands.

The concrete weirs would consist of a wall that extends four feet below ground and one to six feet above ground, depending on the alternative selected. The concrete walls are two feet thick with variable lengths, depending on the channel width at the structure locations. Sheet piles would also be installed to extend five feet below the concrete weirs. Selected large native stones would be placed, drilled, anchored, and grouted in-place to the concrete walls.

Riffle structures are planned in conjunction with all proposed weirs. On the downstream side of the weir, a riffle structure would extend five feet downstream for every one-foot of weir height. The riffle structures would consist of colored stone, two feet thick. Beneath the colored stone will be nine inches of filter, nine inches of bedding, and one foot of clay material. Excavation for a temporary diversion around the weir/riffle structures would ensure water quality is maintained during construction. The riffle structures would help to oxygenate the waters and in turn improve water quality.

Five areas were initially considered for wetland development. After coordination and in agreement with USFWS, two sites were eliminated from further consideration, because the wetland enhancements added minimal habitat value improvement to the existing condition. Three wetland sites (A, B, and C) were studied in greater detail and carried forward as potential restoration alternatives.

- For Wetland A, a weir structure would be constructed in the main channel of Chacon Creek. Three scales or weir heights were considered, ranging from one to three feet, and the created wetlands would range from 3.56 – 7.93 acres accordingly. On the next page, Figure 34 depicts Wetland A.
- For Wetland B, a weir structure would be constructed in the main channel of Chacon Creek. Three scales or weir heights were considered, ranging from one to three feet, and the created wetlands would range from 3.65 – 8.69 acres accordingly. Figure 35 on page 135 depicts Wetland B.
- For Wetland C, a weir structure would be constructed off the main channel of Chacon Creek. This area has a small side channel and seasonal wetland. The weir would be located on the side channel and expand the area of the existing seasonal wetland. Rain events would be the source for water. Three weir heights were considered, ranging from one to three feet, and the created wetlands would range from 0.15 – 2.07 acres accordingly. Figure 36 on page 136 depicts Wetland C.

The design of each weir includes a downstream riffle structure to prevent scour, support the weir structure, and promote oxygenation.

Figure 34. Wetland Site A

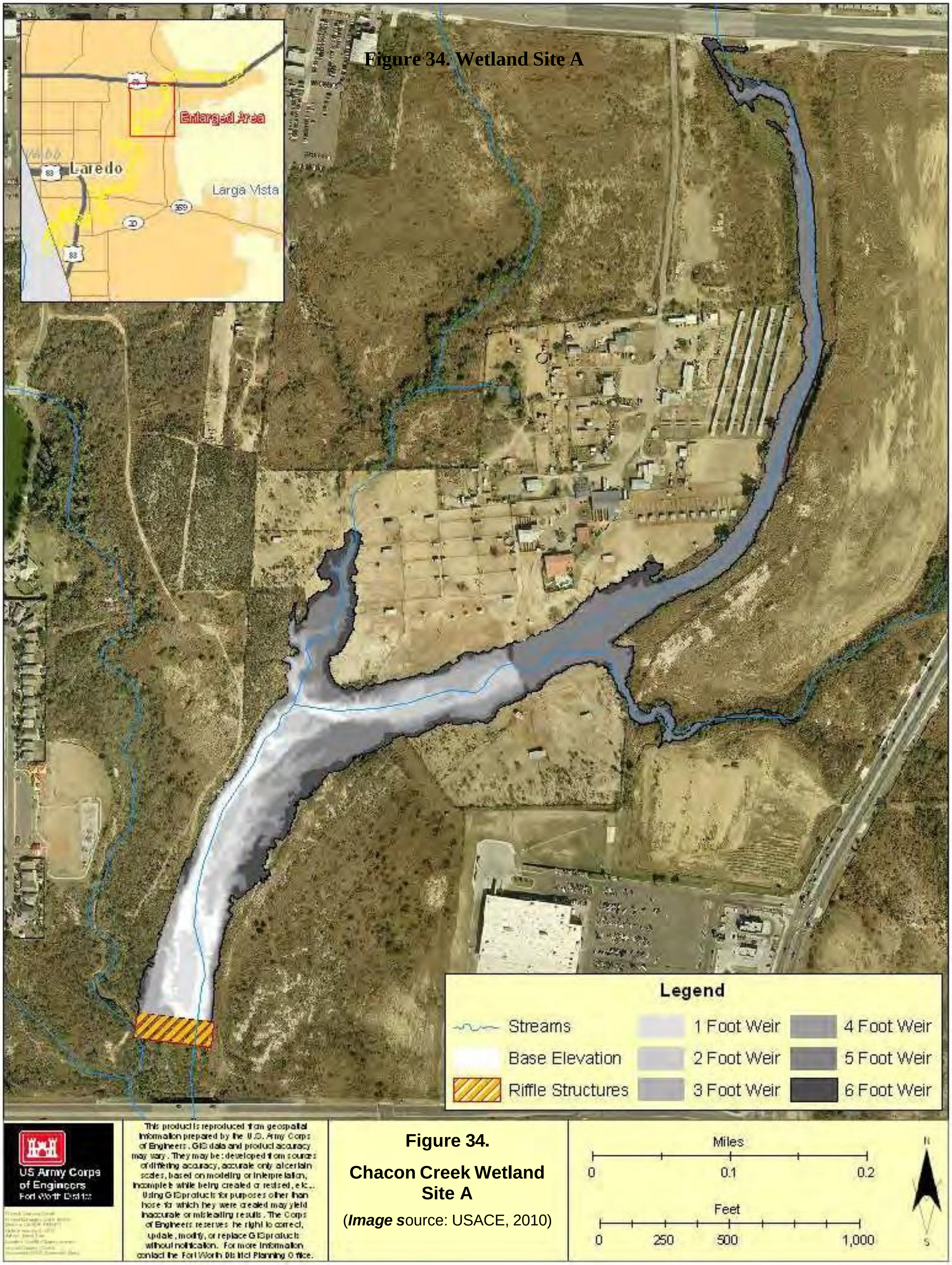

Figure 34.
Chacon Creek Wetland Site A
(***Image s***ource: USACE, 2010)

Figure 35. Wetland Site B

Figure 35.

Chacon Creek Wetland Site B

(Image source: USACE, 2010)

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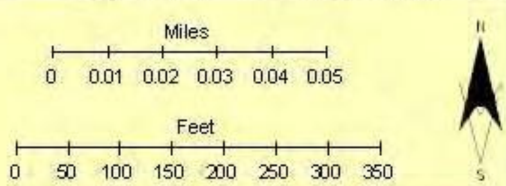
Figure 36.

Chacon Creek Wetland Site C

(Image source: USACE, 2010)



Riverine Measures

The length of Chacon Creek in the study area was initially separated into six river segments. These segments were considered for riverine measures. Three reaches were identified.

- Riverine Reach D includes river segment 2 (R2) and river segment 3 (R3). On the next page, Figure 37 shows reach D.
- Riverine Reach E includes river segments 4 and 5a (R4 and R5a). See Figure 38 on page 139.
- Riverine Reach F includes river segments 5b and 6 (R5b and R6). See Figure 39 on page 140.

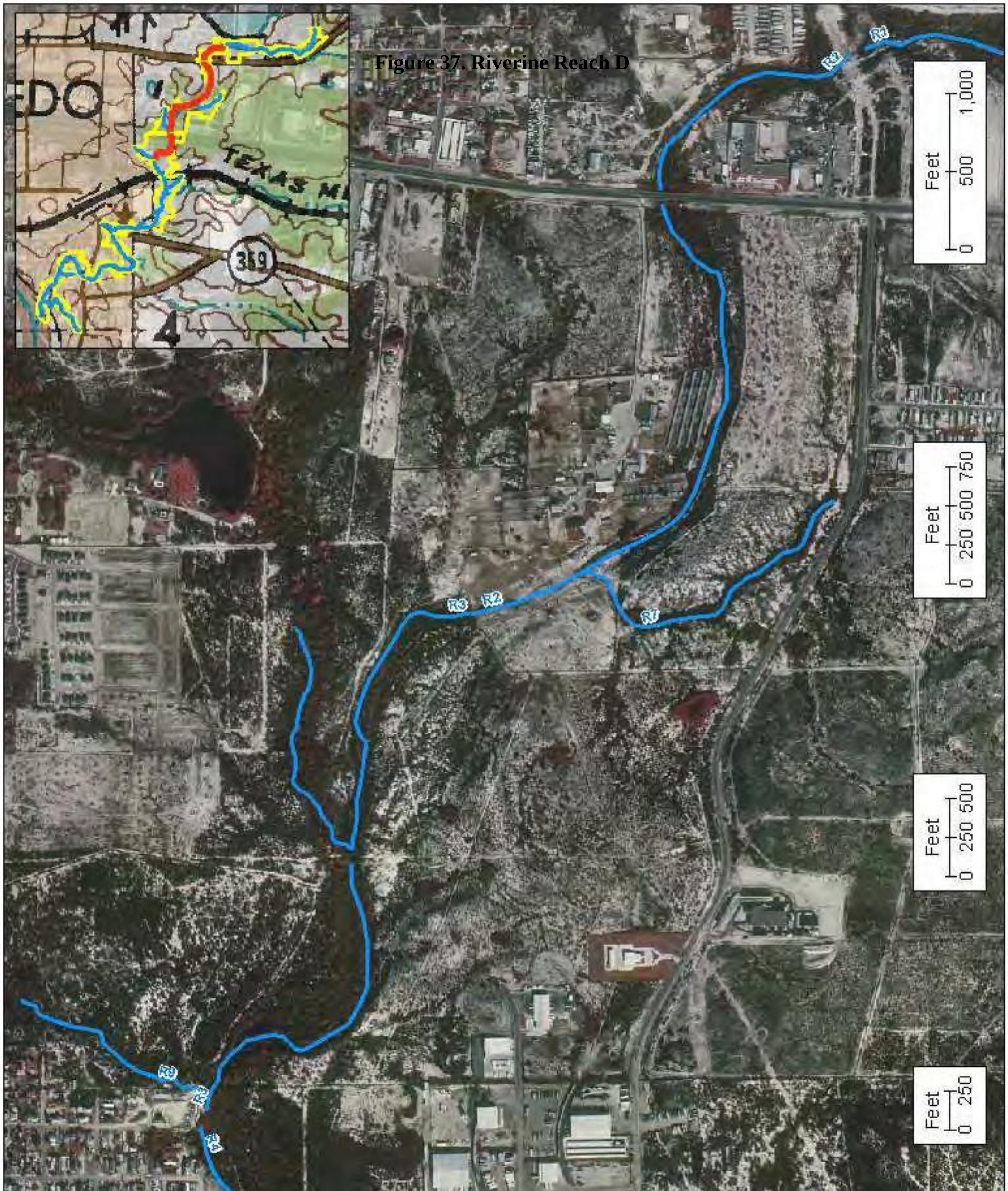
Riverine measures investigated entail placing varied lengths of riffle structure along Chacon Creek. Riffle would vary in width from approximately 11 to 25 feet, depending on the width of the channel at the placement location. Different total lengths of riffle structure to be placed were used as scales for this measure and ranged from 250–1,000 feet for each riverine reach.

Riparian Measures

The remainder of the study area, areas not included for Wetland or Riverine measures, was identified as Forested or Non-forested Riparian. The Riparian Measure G includes three scales that are mapped in Figure 40 on page 141. In the figure, the area labeled as “Non-Viable” is part of the flood risk management and recreation plans and does not include ecosystem restoration measures.

- For the area identified as Forested, the scale alternative G1 consists of the selective removal and control of salt cedar. The salt cedar would be removed by cutting down trees and applying herbicide to the cut stems. To prevent regrowth, cut vegetation would either be removed or chipped and left on-site.
- A maintenance road would be incorporated into the site to aid and lessen impacts from future monitoring and maintenance of the site. Because the study area is a relatively long, narrow corridor running approximately five miles with heavy urban development immediately adjacent, there are few areas to access the corridor for required future periodic maintenance. A maintenance roadway would allow access to treat and remove exotic species that would encroach on the restoration area if left unchecked and would allow maintenance activities to not adversely impact existing vegetation. It would eliminate the need to maintain a passable gravel roadway, which would provide areas for exotics to establish themselves. When not used for maintenance work, the roadway could be used as trails and could extend the proposed trail system.
- For the area identified as Non-Forested, the scale alternative G2 includes removal and control of buffelgrass, as well as planting native species and would include irrigation. First, the stands of buffelgrass would be cleared, grubbed, and treated with herbicide. Replanting would consist of native grass mix, as well native trees and shrubs. Species would be selected from the species list provided by USFWS and based on site condition.
- The third scale or alternative G3 is a combination of G1 and G2.

Figure 37. Riverine Reach D



US Army Corps of Engineers

Figure 37.

Chacon Creek – Aquatic Riverine Reach D

(Image source: USACE, 2010)

Chacon Creek

1 inch equals 800 feet

N

S

Figure 38. Riverine Reach E

US Army Corps of Engineers

Figure 38.
Chacon Creek – Aquatic Riverine Reach E

(Image source: USACE, 2010)

Chacon Creek

1 inch = 800 feet

Figure 39. Riverine Reach F

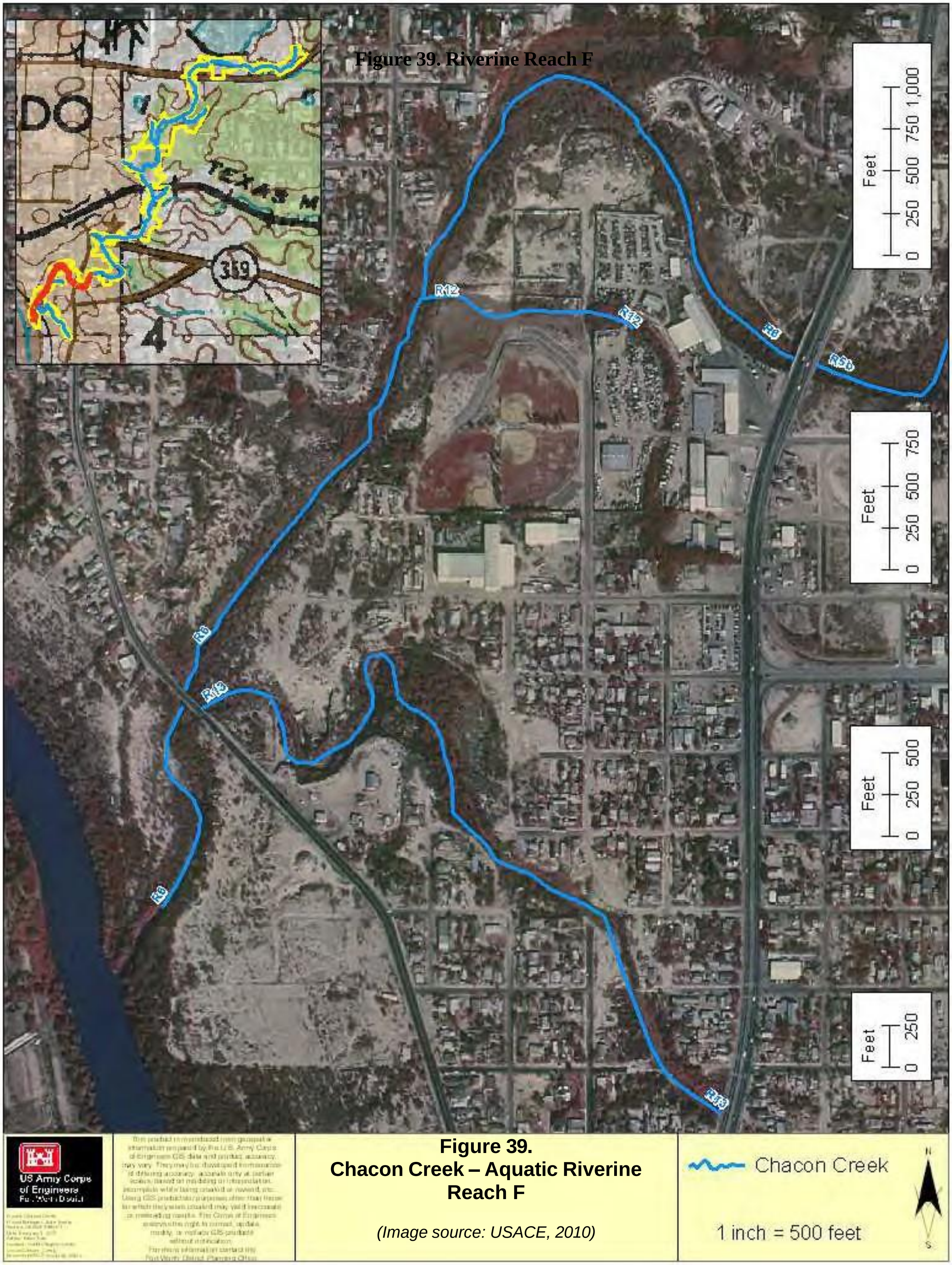


Figure 39.
Chacon Creek – Aquatic Riverine Reach F

(Image source: USACE, 2010)

Figure 40. Riparian Reforestation Reach G

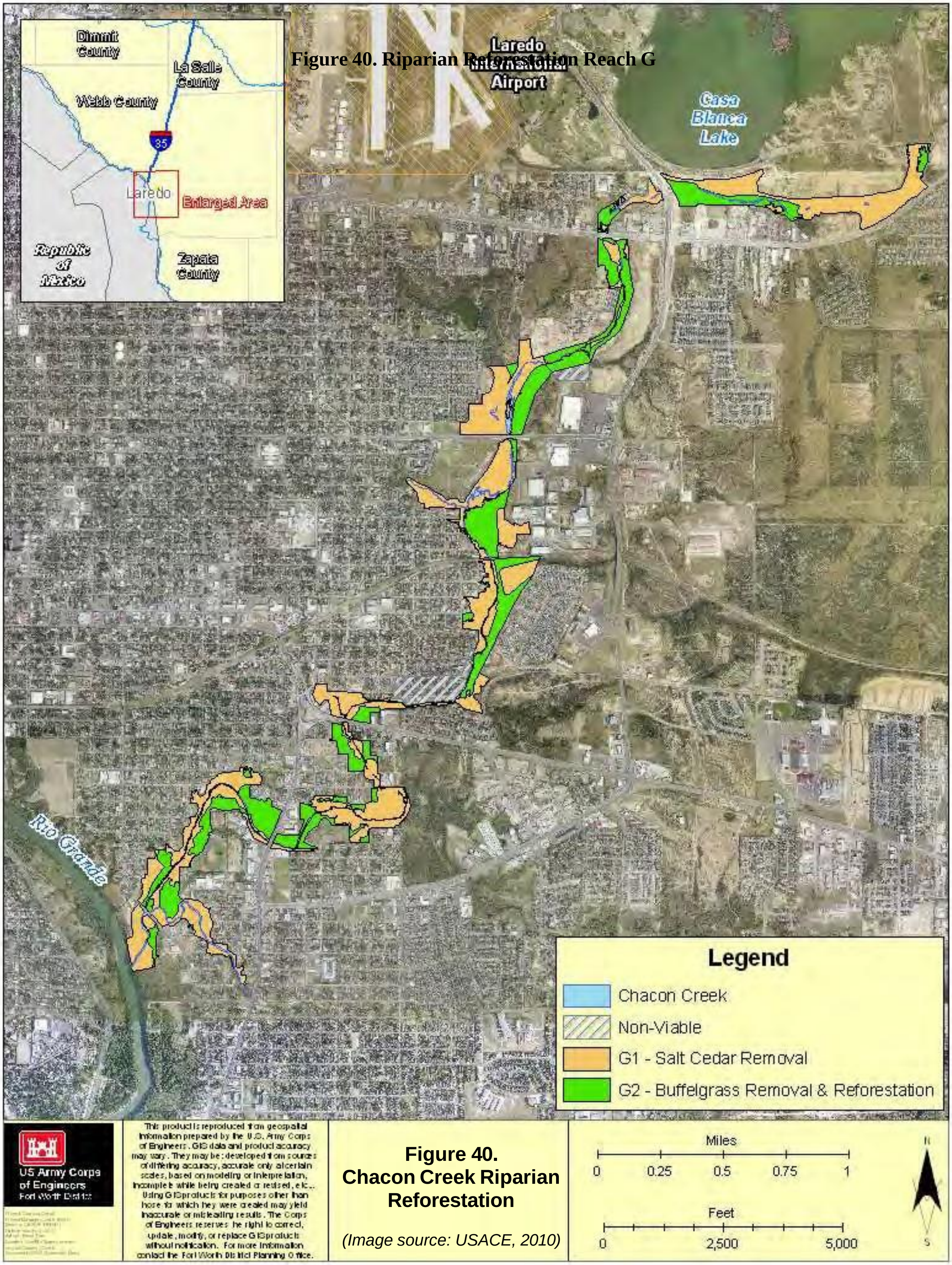


Table 42 provides a summary of measures and scales that were evaluated considered in the habitat assessment and carried forward to the cost effectiveness and incremental cost analysis.

Table 42. Ecosystem Restoration Summary

Measure	Scale	Description
Wetland Site A	A1	Weir height 1 foot, width 110 feet, to create approximately 3.56 acres of wetland
	A2	Weir height 2 feet, width 120 feet, to create approximately 5.99 acres of wetland
	A3	Weir height 3 feet, width 250 feet, to create approximately 7.93 acres of wetland
Wetland Site B	B1	Weir height 1 foot, width 55 feet, to create approximately 3.65 acres of wetland
	B2	Weir height 2 feet, width 150 feet, to create approximately 6.05 acres of wetland
	B3	Weir height 3 feet, width 190 feet, to create approximately 8.69 acres of wetland
Wetland Site C	C1	Weir height 1 foot, width 45 feet, to create approximately 0.15 acre of wetland, debris removal
	C2	Weir height 2 feet, width 55 feet, to create approximately 1.17 acres of wetland, debris removal
	C3	Weir height 3 feet, width 65 feet, to create approximately 2.07 acres of wetland, debris removal
Riverine Reach D	D1	Addition of a 250 x 25 foot riffle structure, to create a total of 0.93 acre of riffle benefit
	D2	Addition of a 500 x 25 foot riffle structure, to create a total of 1.51 acres of riffle benefit
	D3	Addition of a 750 x 25 foot riffle structure, to create a total of 2.08 acres of riffle benefit
	D4	Addition of a 1,000 x 25 foot riffle structure, to create a total of 2.66 acres of riffle benefit
Riverine Reach E	E1	Addition of a 250 x 15 foot riffle structure, to create a total of 0.58 acre of riffle benefit
	E2	Addition of a 500 x 25 foot riffle structure, to create a total of 0.93 acre of riffle benefit
	E3	Addition of a 750 x 25 foot riffle structure, to create a total of 1.27 acres of riffle benefit
	E4	Addition of a 1,000 x 25 foot riffle structure, to create a total of 1.62 acres of riffle benefit
Riverine Reach F	F1	Addition of a 250 x 11 foot riffle structure, to create a total of 0.63 acre of riffle benefit, removal of concrete structure partially obstructing flow
	F2	Addition of a 500 x 11 foot riffle structure, to create a total of 0.90 acre of riffle benefit, removal of concrete structure partially obstructing flow
	F3	Addition of a 750 x 11 foot riffle structure, to create a total of 1.17 acres of riffle benefit, removal of concrete structure partially obstructing flow
	F4	Addition of a 1,000 x 11 foot riffle structure, to create a total of 1.44 acres of riffle benefit

Measure	Scale	Description
Riparian G	G1	Reforestation of non-forested area, including buffelgrass control, planting, and irrigation
	G2	Removal of salt cedar from forested areas
	G3	G1 + G2

DETAILED INVESTIGATION OF ECOSYSTEM RESTORATION ALTERNATIVES

This section evaluates those ecosystem restoration alternatives identified from the preliminary alternatives for further, more detailed consideration.

This analysis includes a cost effectiveness and incremental cost analysis (CE/ICA) which utilizes the latest Corps-certified IWR Planning Suite II software (IWRPS) version 2.0.9 (IWRPS 2017) and the current interest rate of 2.75 percent (FY18). The analysis relies upon the results of the HEP analysis to estimate habituate output for each measure and scale. Planning level costs have been developed at current price levels (FY18). The following narrative describes the new CE/ICA and its results in detail.

Cost Effectiveness and Incremental Cost Analysis

Cost Effectiveness (CE) and Incremental Cost Analysis (ICA) techniques were used to determine the most cost-effective restoration alternatives or plans. In a CE/ICA analysis, restoration alternatives are comprised of a suite of measures. By selecting and combining different scales of each measure, the CE/ICA evaluates and compares all possible alternatives based on cost and habitat output.

The CE portion of the analysis refers to the process of identifying the subset of all possible alternatives which are cost effective, as only cost effective alternatives are carried forward. An alternative is cost effective when no other alternative can achieve the same level of habitat output at a lower cost, or a greater level of output at the same or less cost. Once cost effective alternatives have been identified, the ICA portion of the analysis is performed. The purpose of the ICA is to identify "best-buy" plans, or the horizon of cost effective plans which includes those alternatives that provide the greatest increase in habitat output for the least increase in cost per habitat unit, at each successive level of total output. The best-buy alternatives or plans are then evaluated using tabular and graphical summaries to consider cost and benefits not accounted for in the HEP and ICA analyses to determine the NER or recommended Ecosystem Restoration Plan for the study.

Cost and output were evaluated for each of the 32,000 possible combinations of the seven proposed management measures (A–G), including the no-action alternative for each measure.

Output was measured in average annual habitat units (AAHUs) as assessed using HEP analysis for a 50-year period of analysis. Benefits would be expected to increase and then level off over the period as habitats reach their full restoration potential. All plans were sorted by AAHU production to identify the cost-effective and non-cost-effective plans.

Cost was measured in Average Annual Cost, which includes total costs related to lands, easements, rights-of-way, relocation, and disposal areas (LERRDs); general construction; post project monitoring; support and administration (S&A); contingency; and operation, maintenance, repair, replacement, and rehabilitation (OMRRR) using a 50-year period of analysis with a 2.75 percent interest rate. Costs for each scale were escalated to current FY18 price level using the Civil Works Construction Cost Index System (USACE 2017).

Table 43 provides the input data that was fed into the IWRPS software. For each measure and scale, the key variables are average annual cost and AAHUs (net of the No Action). Based on the formulation of the measure and scales, all measures were combinable, and there were no dependencies.

The IWRPS software generated 32,000 total possible combinations (plans). From this set of all possible combinations of measures and scales, 259 cost effective plans were identified. The cost- effective plans were then compared based on incremental cost per unit output (incremental average annual cost divided by incremental AAHU) to identify the best-buy plans. Best-buy plans are those that have the lowest incremental cost per output at a given cost level. IWRPS generates graphs that illustrate where each of the plans falls in relation to each other plan, in a comparison of plan cost versus plan benefits or output in HUs. Figure 41 graphs all possible plans, including cost-effective, non-cost-effective, and best-buy. As shown in the figure, the No Action plan is at the origin (zero cost, zero output). This reflects that all plans are compared relative to the No Action in the CE/ICA. As such, AAHU’s for action alternatives are net of the AAHU’s that would be achieved under the No Action alternative.

Table 43. CE/ICA Input Data

Measure / Scale Code	Average Annual Cost $	Net AAHU
A0	0	0.000
A1	7,332	2.521
A2	11,500	4.394
A3	22,764	5.892
B0	0	0.000
B1	5,689	2.542
B2	12,771	4.389
B3	19,210	6.419
C0	0	0.000
C1	2,102	0.098
C2	4,046	0.833
C3	5,904	1.479
D0	0	0.000
D1	11,152	0.696
D2	21,405	1.178
D3	31,646	1.651
D4	41,899	2.131
E0	0	0.000
E1	7,422	0.425
E2	14,279	0.715
E3	21,127	0.993
E4	27,986	1.282
F0	0	0.000
F1	6,153	0.437
F2	11,670	0.658
F3	17,189	0.878
F4	22,706	1.102
G0	0	0.000
G1	873,581	113.918
G2	425,174	26.874
G3	942,855	151.624

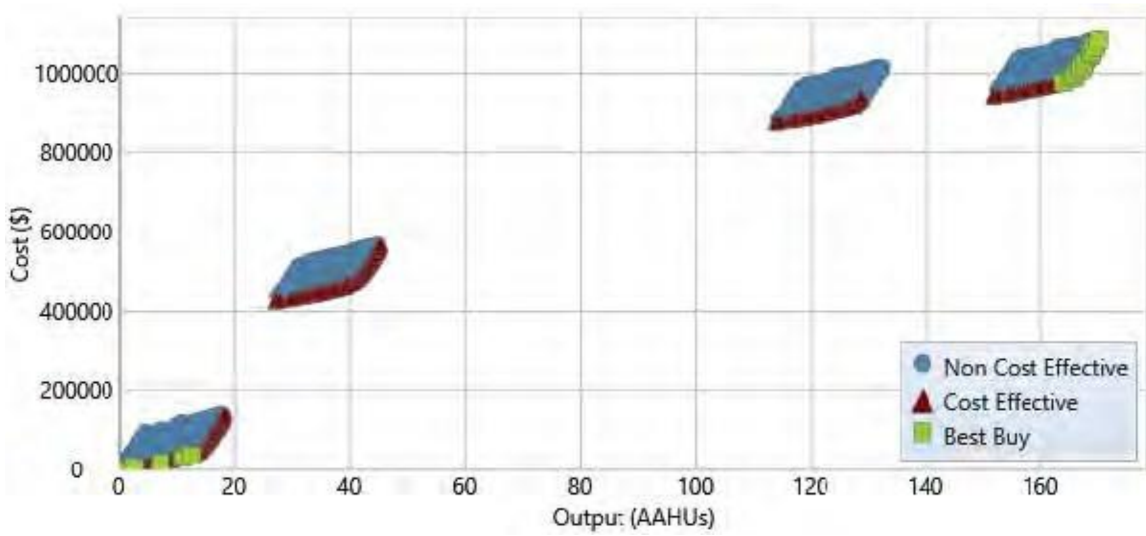


Figure 41. All Possible Plans Differentiated

Because the No-Action Plan has no associated cost, it is identified as the first best-buy plan. The next best buy is then identified as the plan which achieves the next largest total output at the least cost per unit of additional output. Plans that produce less output than the best-buy plan are removed from the analysis, and the last identified best-buy plan becomes the baseline for comparison of successive plans. Selected best-buy plans can then be evaluated using tabular and graph summaries such as those shown in Table 43 and Figure 42 to consider costs and benefits not accounted for in the HEP and ICA assessments.

The ICA procedure identified 15 best buy plans. For each best-buy plan, Table 44 on the next page provides an outline of the plan's restoration components (measures and scales), along with the Total Cost, Total Output, Average Annual Cost, Incremental Average Annual Cost, Incremental Output, and Incremental Average Annual Cost per Output.

NER Plan Selection

While there is no rule for selecting the most cost-effective plan, decisions are generally based on output targets, output thresholds, cost limits, or breakpoints. Because there is no maximum or minimum required output and the most expensive plan is within the budget constraints, the first three criteria for decision making are not applicable to this project. However, in the Best-buy Plan graph below, Plan 6 is seen to be preceded by and followed by breakpoints, as represented in Figure 42.

Table 44. Best-buy Plans Cost/Output Summary

Plan	Measure and Scale A	B	C	D	E	F	G	Output	Cost Annual	Cost Average ($/HU)	Incremental … Annual Cost	Incremental … Output (HU)	Incremental … Cost per Output
1	0	0	0	0	0	0	0	0	$0	$0	$0	0	$0
2	0	1	0	0	0	0	0	2.542	$5,689	$2,238	$5,689	2.542	$2,238
3	2	1	0	0	0	0	0	6.936	$17,189	$2,478	$11,500	4.394	$2,617
4	2	3	0	0	0	0	0	10.813	$30,710	$2,840	$13,521	3.877	$3,487
5	2	3	3	0	0	0	0	12.292	$36,614	$2,979	$5,904	1.479	$3,992
6	**2**	**3**	**3**	**0**	**0**	**0**	**3**	**163.916**	**$979,469**	$5,975	**$942,855**	**151.624**	**$6,218**
7	3	3	3	0	0	0	3	165.414	$990,733	$5,989	$11,264	1.498	$7,519
8	3	3	3	0	0	1	3	165.851	$996,886	$6,011	$6,153	0.437	$14,080
9	3	3	3	1	0	1	3	166.547	$1,008,038	$6,053	$11,152	0.696	$16,023
10	3	3	3	1	1	1	3	166.972	$1,015,460	$6,082	$7,422	0.425	$17,464
11	3	3	3	2	1	1	3	167.454	$1,025,713	$6,125	$10,253	0.482	$21,272
12	3	3	3	4	1	1	3	168.407	$1,046,207	$6,212	$20,494	0.953	$21,505
13	3	3	3	3	2	1	3	168.697	$1,053,064	$6,242	$6,857	0.29	$23,645
14	3	3	3	4	4	1	3	169.264	$1,066,771	$6,302	$13,707	0.567	$24,175
15	3	3	3	4	4	4	3	169.929	$1,083,324	$6,375	$16,553	0.665	$24,892

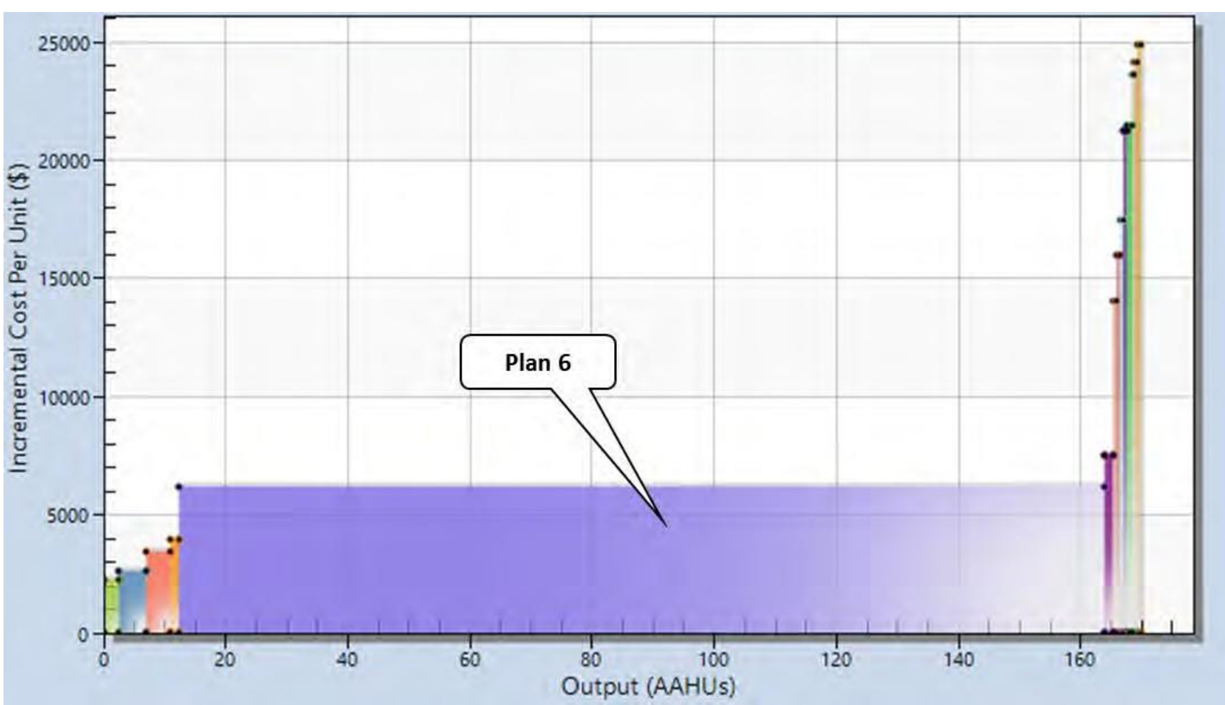


Figure 42. Best-buy Plans Incremental Cost Breakpoints

To guide the decision process, the question "*Is it worth it*?" is used to focus on the plans that cause abrupt changes in the incremental cost curve as shown in the previous graph. This analysis compared the best-buy plans in succession.

Beginning with Plan 1, the No-Action Plan, each successive plan requires additional cost over the previous plan. Plan 1 is the future without a project alternative. Under this alternative, none of the proposed restoration measures would be implemented. Study area conditions would remain in their degraded status. The No-Action Plan would not meet any of the stated goals and objectives for this study.

Plan 2 provides an additional 2.54 AAHUs over the No-Action Plan, at an incremental cost per incremental output of $2,238. These additional AAHUs would be due to implementation of Wetland Site B Scale 1, which includes a 1-foot high weir. Thus, the study team found that the 2.54 additional AAHUs provided by implementation of Plan 2 for the improvement of wetland habitat are worth
$2,238 per unit. This plan addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 2 with Plan 3, Plan 3 provides an additional 4.39 AAHUs at an average incremental cost per incremental output of $2,617. These additional AAHU gains come from Wetland Site A Scale 2, which includes a 2-foot high weir. The addition of another wetland site furthers pursuit of the planning objectives. Thus, the study team found that the 4.39 additional AAHUs provided by implementation of Plan 3 for additional wetland restoration are worth $2,617 per unit. This plan, in addition to Plan 2, addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 3 with Plan 4, Plan 4 provides an additional 3.88 AAHUs at an average incremental cost per incremental output of $3,487. These additional AAHU gains come from a change in the selected scale for Wetland B, choosing Scale 2 instead of Scale 1, which would increase the weir size to 2-feet high, furthering pursuit of the planning objectives by creating additional wetland acreage. Thus, the study team found that the 3.88 additional AAHUs provided by implementation of Plan 4 for additional wetland restoration are worth $3,487 per unit. This plan, similar to Plan 3, addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 4 with Plan 5, Plan 5 provides an additional 1.48 AAHUs at an average incremental cost per incremental output of $3,992. These additional AAHU gains come the addition of Wetland Site C Scale 3, which includes a 3-foot high weir. The addition of the third wetland site helps to meet planning objectives which address wetland restoration. Thus, the study found that the 1.48 additional AAHUs provided by implementation of Plan 5 for additional wetland restoration at Site C are worth $3,992 per unit. This plan, in addition to Plan 4, addresses most of the wetland restoration potential, but still does not completely fulfill the planning objectives.

When comparing Plan 5 with Plan 6, Plan 6 provides an additional 151.62 AAHUs at an average incremental cost per incremental output of $6,218, corresponding to the large horizontal purple rectangle in Figure 42. These additional AAHU gains come from the addition of the Scale 3 of the Riparian Measure G, which includes implementation of both the Scale 1 and Scale 2. This addition would provide for reforestation of non-forested areas, including buffelgrass control, planting, and irrigation, as well as removal of salt cedar from forested areas. The combination of applying several restoration measures, including creating and restoring three wetland sites with riffle structures, debris removal, removal of exotic species, and revegetation, creates a continuous corridor from Lake Casa Blanca to the Rio Grande. These measures provide a more systemic restoration by providing and improving aquatic, wetland, and riparian habitats. The measures would improve water quality and stream function, as well as reduce risk of fire from invasive buffelgrass. Thus, the study team found that the 151.62 additional AAHUs provided by implementation of Plan 6 for riparian restoration are worth $6,218 per unit. This plan, in addition to Plan 5, implements wetland restoration at all sites and maximizes riparian restoration potential, and meets the planning objectives.

When comparing Plan 6 with Plan 7, Plan 7 provides an additional 1.498 AAHU at an average incremental cost per unit of $7,519. These additional AAHU gains come from applying a larger scale for Wetland A. While this plan would provide some additional benefit to wetland and aquatic habitat and meets the planning objects, the small gains cost approximately 21 percent more per output unit what the previous plan would cost for only a 1% increase in total output. Therefore, the study team found that the 1.498 additional AAHUs provided by implementation of Plan 7 are not worth the cost of $7,519 per unit.

In summary, the No-Action Plan, Plan 1, does not address any of the restoration objectives. Plan 6 has the greatest potential to improve habitat conditions and achieve the bulk of the potential benefits. The potential to control invasive species, improve water quality, increase the quality and quantity of aquatic, wetland, and riparian habitats makes Plan 6 worth the additional cost. Though Plan 7 is within the budget constraints and meets restoration objectives, the minimal additional benefit for Plan 7 is not considered worth the higher incremental cost per incremental output. Therefore, Plan 6, depicted in Figure 43 on the next page is identified as the National Ecosystem Restoration Plan or recommended NER Plan in this study.

Alternative 9: The NER Plan

Plan 6, the NER Plan alternative, includes no flood risk management measures, only the recommended Ecosystem Restoration plan. As discussed in detail in Section Five “Tentatively Selected Plan,” the NER Plan consists of two principal components. The first component of this plan is the restoration of all three wetland sites, with weir heights of one to three feet. The second component of the NER Plan is the riparian restoration measures, including reforestation of non-forested area, buffelgrass control, planting and irrigation, and removal of salt cedar from forested areas. Overall, the NER Plan restores over 400 acres of habitat and provides 163.9 AAHUs at an average annual cost of $979,469 or $5,975 per AAHU. Figure 43 on the next page includes the measures and scales for the recommended NER plan.

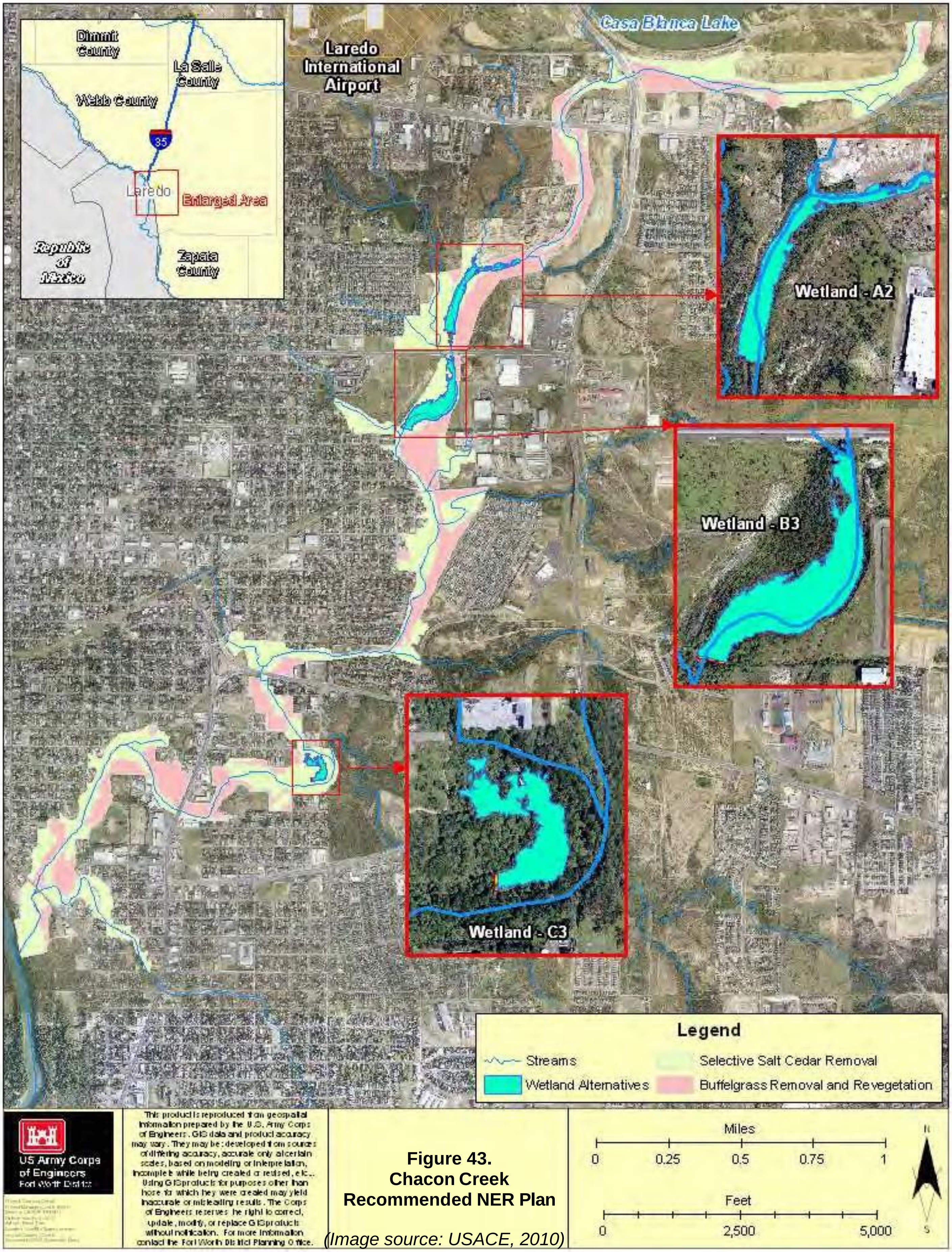


Figure 43.
Chacon Creek
Recommended NER Plan

(Image source: USACE, 2010)

Alternative 10: NED/NER Plan

This alternative consists of a combination of the recommended NED plan (see Figure 23) and the recommended NER plan (Alternative 9) discussed in the previous section. As stated, this alternative includes the permanent evacuation of 73 residential structures generating $629,000 in EAD benefits. Recreational amenities added to the evacuated areas add $911,300 in recreation benefits. The total investment cost of the NED component of the plan is $21,218,200 including interest during construction, with net benefits of $345,900 and a benefit/cost ratio of 1.29-to-1.00.

The NER component of the plan would restore three wetland sites and implement riparian restoration to produce a net increase of 163.9 AAHUs compared to the No Action alternative. The overall restoration would result in the restoration of over 400 acres of aquatic habitat at an average annual cost of $979,469 or $5,975 per AAHU.

SELECTION OF THE TENTATIVELY SELECTED PLAN

This section compares and contrasts each of the alternatives discussed during the detailed investigation of alternatives to determine how each addresses the objectives laid out earlier in this section under “Resource Planning” on page 74.

Under Alternative 1, the No-Action Plan (future without-project condition), none of the objectives would be addressed. Flooding would continue along Chacon as would the associated risk to life, health, and safety. Degradation of the ecosystem would continue, including erosion, the presence of invasive species, lost habitat, and reduced habitat values in wetlands and the riparian corridor. It would also do nothing to restore and maintain the natural character of the floodplain. This alternative would not maximize opportunities for public use of the floodplain. Additionally, this alternative does not address the goals of contributing to National Economic Development (NED) Or National Ecosystem Restoration (NER). This alternative would, however, meet the goal of minimizing the use of concrete or other hard surfaces as well as avoiding sites that might contain or are suspected of containing hazardous, toxic, and radioactive waste.

Under Alternative 2, the Structural Plan, some of the planning objectives would be addressed, namely those associated with reducing flood damages and the risk to life, health, safety and emergency costs. While it would reduce flooding and the associated risks to health and safety, it would neither address the ecosystem degradation along Chacon Creek nor provide for a diverse and sustainable ecosystem. This alternative would also alter the channel itself, thereby changing the natural character of the floodplain. It would, however, minimize the use of concrete and hard surfaces and avoid areas containing HTRW. While the plan does address the goal of contributions to NED, it does not provide for environmental benefits toward NER.

Under Alternatives 4, 5, and 6, the 10-Year Buyout plan with Recreation, Partial 25-Year Buyout with Recreation, and VDS Plan, respectively, some of the planning objectives would be addressed, namely those associated with reducing flood damages and the risk to life, health, safety, and emergency costs. It would also work toward maximizing the opportunities for public use of the floodplain with park facilities along Chacon Creek. Because these plans are absent an NER component, degradation of the ecosystem would continue, and therefore the plans would not address the objectives aimed to restore and provide a diversity and sustainability along Chacon Creek. These alternatives, like the others previously mentioned, would avoid areas suspected of being contaminated with and/or containing HTRW. While these alternatives address the goal of achieving benefits under NED, they only incidentally work toward achieving some semblance of NER benefits due to the presence of recreational amenities in these plans, which could provide slight ecosystem benefits merely with more open space.

Under Alternative 9, the NER Plan, only those objectives geared toward ecosystem restoration would be addressed, such as providing a diverse and sustainable ecosystem and restoring and maintaining the natural character of the floodplain. This alternative would also minimize the use of concrete and other hard surfaces and would avoid known or suspected HTRW areas. This alternative would not speak to any of the objectives aimed at reducing flood damages or the risk life, health, and safety, nor would it reduce emergency costs associated with the occurrence of large flood events. Neither would this alternative maximize opportunities for public use in the floodplain through the park facilities.

Alternative 10, the NED/NER Plan, would not only meet the objectives aimed at addressing issues associated with reducing flooding and the risk to life, health, and safety, but it would also address those objectives aimed at restoring the ecosystem and providing diversity and sustainability. This alternative would also help restore and maintain the natural character of the floodplain and maximize public use opportunities through the provision of park facilities. The alternative would also avoid known or suspected HTRW sites and would minimize the use of concrete and other hard materials in the channel. Additionally, this alternative would not only seek to minimize impacts to threatened and endangered species, but would also restore habitat. This alternative also addresses the goal of contributions to NED through economic benefits, as well as addressing the goal of achieving environmental benefits through contributions to NER. Thus, Alternative 10 is the tentatively selected plan.

Section Five provides further details on the TSP.

ENVIRONMENTAL CONSEQUENCES

This section relates directly to the NEPA requirements to assess the impacts of the alternatives' flood risk management and ecosystem restoration measures on the environmental resources in the study area.

ALTERNATIVES SUMMARY

The following outlines the alternatives discussed during the detailed investigation of alternatives as described in Section Three.

- **Alternative 1**: No-Action Plan (Future Without-Project). This alternative describes the most likely future conditions if no Federal action is taken to solve the water resource problems and opportunities. No action implies acceptance of the existing and future adverse impacts caused by increased erosion, persistence of invasive species, and continued flow of non-point source pollution that result in further environmental degradation. The No-Action Plan would result in 64 AAHUs.
- **Alternative 2**: Reach 2 Structural Plan. This channel configuration requires buyout of 31 residential structures. Benefits are estimated to be $642,300. Costs total $7,509,800, which would annualize to $450,500yielding $220,300 in net benefits and a 1.49-to-1.00 benefit/cost ratio.
- **Alternative 3**: Reach 1 10-Year Buyout Plan with Recreation. This alternative would buy out 11 structures in the 10% ACE (10-year frequency event). Total costs would be $3,486,300annualizing to $213,900 with annual benefits of $225,100 and net benefits of $11,200 for a benefit/cost ratio of 1.05-to-1.00.
- **Alternative 4**: Reach 2 10-Year Buyout Plan with Recreation. This alternative would buy out 42 residential structures that are mostly within the 20% ACE (5-year frequency event) in Reach 2 of the main stem of Chacon Creek. Flood risk reduction benefits are estimated at $516,800 with additional recreation benefits of $448,600 for a total of $965,400 in benefits. Total costs are $11,895,800, which annualizes to $714,100. This produces $251,300 in net benefits with a 1.35- to-1.00 benefit/cost ratio. The recreation plan associated with this alternative includes good quality, basic amenities found in most neighborhood parks, and would cover approximately three acres.
- **Alternative 5**: Reach 2 Partial 25-Year Buyout Plan with Recreation. This alternative would buy out 62 residential structures that are mostly within the 10% ACE (10-year frequency event) in Reach 2 of the main stem of Chacon Creek. Flood risk reduction benefits are estimated at $561,500, with another $628,800 in recreation benefits for a total of $19,190,300. Costs total $16,756,900, which annualizes to $977,300. This produces $213,000 in net benefits with a 1.22- to-1.00 benefit/cost ratio. Benefits from the recreation plan for this alternative are derived from an increase in open fields for

general and reserved use, as well as a large group shelter.

- **Alternative 6**: Reach 2 “VDS Plan.” This alternative is virtually the same as Alternative 5 with the only difference being the number and location of recreational amenities. This plan generates
  $674,900 in recreational benefits with a total project cost of $,16815,400 and total annual charges of $980,500. This plan, however, generates $255,900 in net benefits and a benefit/cost ratio of 1.26-to-1.00.
- **Alternative 7**: Reach 2 25-Year Buyout Plan with VDS Recreation. This alternative would buy out 111 structures in the 4% ACE (25-year event) and apply the same recreational amenities as Alternative 6 - the VDS Plan. Flood risk reduction benefits are $693,200 with recreation benefits of $674,900 for a total $1,368,100. The total cost for this alternative is $23,910,000 which annualizes to $1,351,700 with net benefits of $16,300 and a benefit/cost ratio of 1.01-to-1.00.
- **Alternative 8**: VDS Plan with Small Channel. This alternative would take Alternative 6, the VDS Plan, and apply the small channel alternative investigated in the preliminary round of alternatives. Flood risk reduction benefits would be $685,500 with recreation benefits of $674,900 for a total of $1,360,400 in combined benefits. Total costs would be $19,406,800 which would annualize to $1,144,100. Net benefits would be $216,300 for a benefit/cost ratio of 1.19-to-1.00.
- **Alternative 9**: NER Plan. This alternative is the recommended National Ecosystem Restoration plan with no flood risk management measures. The plan includes restoration of three wetland sites totaling 16.75 acres to create a net increase of 12.3 AAHUs, and restoration of 401 acres of riparian habitat by removal of salt cedar, buffelgrass control, reforestation of non-forested area, planting, and irrigation, producing another 151.6 AAHUs. This produces a net increase of 163.9 AAHUs. The total NER Plan restores 418 acres of aquatic habitat with a total first cost of $25,982,000 and an average annual cost of $979,500. The average annual cost per AAHU is $5,975.
- **Alternative 10**: Tentatively Selected Plan (Alternatives 3, 6, and 9 combined). The flood risk management component includes permanent evacuation of 60 residential structures with recreation facilities built on the vacated lands to generate net benefits of $859,700 with a benefit/cost ratio of 1.35-to-1.00. The total first cost of the flood risk management component is $25,071,600. The ecosystem restoration component would restore 401 acres of aquatic habitat to produce 248 AAHUs at an average annual cost per AAHU of $4,600.

As the alternatives are discussed throughout this section, refer to this list if needed as a reminder of alternative descriptions.

RESOURCE IMPACT CONSIDERATIONS

This section describes the impacts for the various resource categories for each alternative. For easier comparison, Table 44 provides a summary of alternative impacts.

Table 44. Chacon Creek Study Area Resources Impact Analysis

Impacted Resources	Alternatives					
	1	2	3 – 7	8	9	10
	No Action	Structural	Buyouts with Recreation	Combo Plan	NER Plan	NED/NER Plan
Land Use	0	0	+	+	+	+
Air Quality	0	-	-	-	-	-
Groundwater	0	0	0	0	+	+
Hydrology and Hydraulics	-	+	0	+	0	0
Terrestrial, Riparian and Aquatic Resources						
Vegetation	-	-	-	-	+	+
Wildlife	-	-	-	-	+	+
Aquatic Habitat	-	-	-	-	+	+
Study Area Habitat Value	0	0	0	0	+	+
Water Quality	0	0	0	0	+	+
Jurisdictional Waters Including Wetlands						
Section 10	0	0	0	0	0	0
Section 404	0		0	0	-	-
Threatened and Endangered Species	-	-	-	-	0	0
Cultural Resources	0	-	0	-	0	0
Hazardous, Toxic, Radioactive Waste						
Recreational Resources	+	+	+	+	+	+
Other Social Concerns						
Socioeconomics	0	+	+	+	0	+
Environmental Justice	0	-	-	-	0	-
Noise	0	0	0	0	0	0
Light	0	0	0	0	0	0
Public Facilities and Services	-	-	-	-	0	+
Human Health and Safety	-	-	+	+	+	+

Legend: 0 = No effect; **-** = Slight adverse impact; **+** = Beneficial impact

Land Use Impacts

- **Alternative 1**. Under the No-Action Plan, land use patterns and zoning in the study area based on the city’s Comprehensive Plan, are projected to change substantially in the coming years. High- density residential will be eliminated from the study area in the future as will heavy industrial uses and parks, and recreational open space will increase dramatically to make up 55 percent of the study area.

- **Alternative 2**. This alternative would not impact current and future land use in the city, because the channelization and acquisition of structures to accommodate the channelization are not large enough to warrant such a change. The footprint of the widened channel will cover approximately twelve acres and will require mitigation and a staging area.
- **Alternatives 3 – 7**. Each of these alternatives involves the permanent evacuation of from 11 to 111 structures, covering nine to 109 parcels. Similar to the TSP (Alternative 10), these five plans propose the permanent evacuation of single-family residences and converting the vacated lands to recreational use covering areas anywhere from 2.5 to 10 acres. The city's current future land use plans call for these areas to remain classified as low-density residential area or as park/recreation open space and retail/office for the area fronting the south side of Hwy. 359.
- **Alternative 8**. This combination alternative combines a structural component with the recreational features of Alternative 7.
- **Alternative 9**. This alternative includes only the recommended NER measures, which would be compatible with the future land use plans of the city. The city has already acquired 197 acres of land and will acquire another 186 acres of vacant residential land and another 21 for utility and pipeline easement.
- **Alternative 10** would have both positive and negative impacts to existing and future land use for the City of Laredo. Under the city's proposed future use, the area targeted for flood risk management measures is currently classified as low-density residential, park/open space, and retail/office. Under the city's future land use plan, these classifications would remain intact. The recommended ecosystem restoration measures were designed to be compatible with and to help implement the city's land use plans. Through zoning, the city would endeavor to eliminate high- density residential and heavy industrial in the study area. Additionally, institutional uses would increase by 1.5 acres, light industrial would increase by 12.3 acres, but park and open space would increase dramatically by 325 acres. Land uses that would see decreases are retail/office (by 57.5 acres), medium-density residential (by 142.4 acres), and low-density residential (by 96.5 acres).

Air Quality Impacts

- **Alternative 1**. Under the No-Action Plan, current air quality conditions are expected to continue. Webb County, the study area location, is currently in attainment for all criteria pollutants.
- **Alternative 2**. The implementation of Alternative 2 does not include ecosystem restoration measures, and is expected to have less impact on air quality than Alternative 10, the TSP.
- **Alternatives 3 – 7**. Implementations of Alternatives 3, 4, 5, 6, or 7 do not include ecosystem restoration measures, and are expected to have less impact on air quality than the TSP (Alternative 10), but more impact than Alternatives 1 and 2. Minimal short-term impacts would primarily consist of emissions of carbon monoxide, hydrocarbons,

and nitrous oxides from vehicles entering and exiting the site, along with the operation of necessary equipment, as well as fugitive dust during the demolition and clearing of properties purchased for flood risk reduction and during construction of the recreation plan. Of the five alternatives, Alternative 3 would have the least impact, Alternative 7 the greatest impact. In a regional context, the daily equipment emissions associated with project construction and O&M activities, even during maximum-intensity work periods, would be relatively minor and temporary. Impacts on air quality would not be significant.

- **Alternative 8**. The implementation of Alternative 8 would have air quality impacts similar to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Impacts of the implementation of Alternative 9, which includes only measures for ecosystem restoration, would be similar to but less than the air quality impacts of the TSP, Alternative 10. In a regional context, the daily equipment emissions associated with project construction and O&M activities, even during maximum-intensity work periods, would be minor and temporary. Impacts on air quality would not be significant.
- **Alternative 10**. Construction and O&M activities associated with the TSP are expected to have only short-term impacts on local air quality. Such impacts would be primarily caused by increased emissions of carbon monoxide, hydrocarbons, and nitrous oxides from vehicles entering and exiting the site along with the operation of necessary equipment. Vehicle travel along unpaved road surfaces and excavation of bare ground surfaces would create fugitive dust emissions. All construction-related activities on unpaved roadways and bare, dry soil would employ dust- suppression measures, such as watering, to limit fugitive dust emissions. In addition to fugitive dust, project construction activities would generate tailpipe emissions from mobile heavy equipment and increased vehicular traffic. In a regional context, the daily equipment emissions associated with project construction and O&M activities, even during maximum-intensity work periods, would be minor and temporary. Impacts on air quality would not be significant.

Groundwater Impacts

- **Alternative 1**. Under the No-Action Plan, there would be no impact to groundwater and current conditions are expected to continue.
- **Alternative 2**. No significant impact to the groundwater is anticipated, but short-term pollution could be a potential with construction activities and should be addressed using preventive Best Management Practices (BMP) and enforced cleanup should hazardous spills occur.
- **Alternatives 3 – 7**. No direct impacts to groundwater resources would occur as a result of Alternatives 3, 4, 5, 6, or 7.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to those from Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Impacts to groundwater for Alternative 9 would be similar to the impacts of Alternative 10, the TSP.
- **Alternative 10**. Potential long-term benefits of the removal of salt cedar include potential water savings, though it should be noted that potential water savings can

depend significantly on local physical variables. An increase in wetland habitat would benefit the potential ground water – surface water interaction within the project area.

Hydrology and Hydraulics Impacts

- **Alternative 1**. Under the No-Action Plan, the hydrology remains the same and the hydraulics under existing conditions continue to flood the homes in the Villa Del Sol area, with continuous erosion problems.
- **Alternative 2**. This alternative would reduce the water surface elevation on most structures within the Villa Del Sol area and would have negligible impacts on the water surface elevations upstream and downstream of the design.
- **Alternatives 3 – 7**. Each of these alternatives would have negligible impacts on the hydraulics for the area upstream and downstream due to the flood risk management component.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. This alternative includes only the recommended ecosystem restoration component and as such, would have negligible impacts on the hydrology and the hydraulic flood frequency events from increased roughness.
- **Alternative 10**. This alternative would have negligible impacts on the hydraulics for the areas upstream and downstream due to the flood risk management component. The increasing roughness caused by the ecosystem restoration measures for this alternative would have negligible, insignificant impacts on the hydrology and hydraulic flood frequency events.

Terrestrial, Riparian, and Aquatic Resources Impacts

Vegetation

- **Alternative 1**. Under the No-Action Plan, the invasive, introduced species would be expected to persist and habitat quality would continue to degrade over time, with an AAHU of 0.507 for wetland habitat and an AAHU of 181.3 for riparian habitat.
- **Alternative 2**. Minor, short-term, localized adverse impacts on vegetation would occur where construction and need for access necessitate removal or disturbance of vegetation. These impacts would be minimized as much as possible by requiring the construction contractors to limit the number of access points and locate them in areas with the least amount of desirable vegetation. Long-term impacts of Alternative 2 would include removal of two to three acres of riparian forest, which have an AAHU of 0.211 and would require mitigation. Without the environmental restoration, the invasive, introduced species would be expected to persist and habitat quality would continue to degrade over time, with an AAHU of 0.507 for wetland habitat and an AAHU of 181.3 for riparian habitat.
- **Alternatives 3 – 7**. Because these alternatives are limited to the removal of houses, impacts to vegetation would be minimal. There would be some impacts to landscaping, but major trees would be avoided if possible. There would be long-term benefits by removal of houses and non-native species, creating 18.7 acres of park in areas where

houses are removed, and maintaining buffers between the creek and recommended park facilities. Without the environmental restoration, invasive, introduced species would be expected to persist and habitat quality would continue to degrade over time, with an AAHU of 0.507 for wetland habitat and an AAHU of 181.3 for riparian habitat.

- **Alternative 8.** The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Impacts for Alternative 9 would be similar to those for Alternative 10, the TSP, with possibly slightly less short-term impacts due to the smaller footprint and exclusion of alternatives for flood risk management and recreation.
- **Alternative 10**. Short-term, localized adverse impacts on vegetation would occur where construction and need for access necessitate removal or disturbance of vegetation. These impacts would be minimized as much as possible by requiring the construction contractors to limit the number of access points and to the extent possible, locate them in areas with the least amount of desirable vegetation. Further precautions would include the thorough decontamination of all equipment to prevent the dispersal of invasive seeds. Non-native vegetation outcompetes native vegetation, therefore aggressive reseeding and monitoring would be necessary to promote the recovery of native vegetation. Implementing the TSP would primarily have moderate, long-term, beneficial impacts on vegetation. Vegetation treatments would also reduce the threat for uncharacteristic fire in the riparian area and conversion of vegetation to fire-adapted grass species, such as buffelgrass. Salt cedar would be selectively removed from 251 acres, and buffelgrass would be removed from 150 acres within the study area. In return, 150 acres of native species of trees, shrubs, and herbaceous vegetation would be planted in the riparian area. This would ultimately result in 401 acres of restored riparian habitat and 16.75 acres of wetlands, which would increase the quantity and diversity of vegetation in the project area and have indirect beneficial effects on the other resources, especially wildlife habitat. This alternative would result in a net increase in AAHU of 12.29 for wetland habitat and net AAHU of 151.62 for riparian habitat.

Wildlife Impacts

- **Alternative 1**. Under the No-Action Plan, the invasive, introduced species are expected to persist and wildlife habitat quality is expected to continue to degrade over time. The no-action plan produces 182.03 AAHUs.
- **Alternative 2**. Construction activities for Alternative 2 would temporarily disturb and displace wildlife as a result of noise, human presence, and physical disturbance of habitat. This alternative does not include measures for ecosystem restoration and would also result in the loss of two to three acres of riparian forest that provides wildlife habitat. The long-term impacts of Alternative 2 on wildlife would be similar to Alternative 1 due to mitigation.
- **Alternatives 3 – 7**. Adverse impacts due to construction of any of these five alternatives would be limited to minor, localized, temporary impacts, which could disturb and displace wildlife due to noise, human presence, and physical disturbance of habitat. Of these five, Alternative 3 with the smallest footprint would have the least impact, while Alternative 7 with the largest footprint would have the greatest impact. These alternatives would have some minor long-term benefits to wildlife by removing houses from the floodplain.

Although the structures would be replaced by recreation facilities, wildlife would still have more open space to traverse the riparian corridor. However, invasive species along the creeks would be expected to persist, and wildlife habitat quality would be expected to continue to degrade over time. These alternatives would still produce at least the 182.03 AAHUs that are produced under the No-Action Plan.

- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Impacts for Alternative 6 would be similar to the TSP (Alternative 10), with possibly slightly less short-term impacts due to the smaller footprint and exclusion of alternatives for flood risk management and recreation. Long-term benefits to wildlife would be similar to the TSP.

Alternative 10. Adverse impacts would be limited to minor, localized, temporary impacts from construction activities, which could disturb and displace wildlife from noise, human presence, and physical disturbance of habitat. These impacts would be offset by the long-term beneficial effects generated by this alternative. No significant adverse impacts would occur. Implementing the TSP would have several long-term, beneficial impacts on wildlife and their habitat. These impacts range from negligible to moderate, depending on species. Proposed removal of invasive species, as well as planting of native species in the riparian area would provide 151.62 AAHUs over the existing conditions for species using the riparian corridors.

Threatened and Endangered Species Impacts

There are no Federally designated critical habitats in Webb County for the Federally listed species that potentially occur in Webb County.

- **Alternative 1**. Without implementation of the project, there would be no direct impacts to threatened and endangered species that might occur in the area. Current conditions and trends would be expected to continue and any habitats that currently support protected species would continue to degrade.
- **Alternative 2**. The activities of this alternative would not be expected to directly impact threatened and endangered species. Current conditions and trends would be expected to continue and any habitats that currently support protected species would continue to degrade.
- **Alternatives 3 – 7**. The recreation component of these alternatives, particularly the trails portion, could bring additional human activities within the action area. No adverse impacts to threatened and endangered species would be expected with the implementation of any of these alternatives. Any of these species would be affected similar to other wildlife in the project area.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. This alternative would have similar impacts as the TSP.
- **Alternative 10**. No adverse impacts to threatened and endangered species would be expected with the implementation of the TSP. The Texas hornshell, Mexican fawnsfoot, and salina mucket would benefit from water quality improvements resulting from wetland restoration and expanded vegetated buffers along the Chacon Creek waterway. As such, the USACE has determined the proposed project may affect, but is not likely to adversely

affect the Texas hornshell. If the Mexican fawnsfoot and Salina mucket were listed prior to construction, the proposed project may affect, but is not likely to adversely affect both those species as well. Adverse affects would be avoided as USACE would survey for and relocate the mussels species mentioned above out of the project area prior to construction.

Aquatic Habitat

- **Alternative 1**. Under the No-Action Plan, erosion and sedimentation are expected to continue, which would further degrade the aquatic habitat.
- **Alternative 2**. This alternative would create a larger channel, and construction could displace and affect reproduction and the forage base of resident fish. This alternative does not include measures for ecosystem restoration. Therefore, long-term conditions are expected to be similar to Alternative 1.
- **Alternatives 3 – 7**. Each of these three alternatives includes no aquatic habitat restoration. With proper erosion control during construction/demolition and best management practices, there should be no significant short-term impact to aquatic habitat. Long-term conditions would be expected to be similar to Alternative 1.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3**–**7.
- **Alternative 9** aquatic impacts would be similar to the TSP, with possibly slightly less short-term impacts due to the smaller footprint and exclusion of alternatives for flood risk reduction and recreation. Long-term benefits to aquatic habitat would be similar to the TSP.
- **Alternative 10**. Construction activities in and adjacent to the river could cause silt to temporarily accumulate in Chacon Creek, which could affect reproduction and the forage base of resident fish. These impacts would be largely reduced by the use of erosion control measures including silt fencing and planting of native grasses. The results of the proposed restoration measures under this alternative are expected to have long-term beneficial effects on fish in the project area. In-stream structures, such as rock weirs with riffles, would increase habitat diversity for fish, which would likely increase the diversity of fish species present in the project area. Species whose habitat requirements include more structure, moving water, or dissolved oxygen would be the most likely to benefit. Improvements to the riparian area, including tree planting, would indirectly benefit fish by decreasing erosion and long-term sedimentation problems. Increasing the quantity of woody vegetation along the river would increase the amount of woody debris in the river in the long term, which is generally beneficial to many species as it provides escape cover. Such proposed restoration measures would also benefit the Federally endangered Texas hornshell.

Study Area Habitat Value Impacts

- **Alternative 1**. The AAHUs for the No-Action Plan would be 182.03 for the study area.
- **Alternative 2**. The study area habitat value for this alternative would be similar to the value for Alternative 1.
- **Alternatives 3 – 7**. The study area habitat value for any of these alternatives would be similar to that for Alternative 1.
- **Alternative 8**. The implementation of Alternative 8 would have impacts similar to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. The study area habitat value for this alternative would be similar to the TSP, Alternative 10.
- **Alternative 10**. The Tentatively Selected Plan would result in a net increase in the study area of 163.92 AAHUs over the No-Action Plan.

Water Quality Impacts

- **Alternative 1**. For the No-Action Plan, current conditions would be expected to continue. The current trend of development would continue to contribute increasing storm water runoff and NPS pollution, and also contribute to high turbidity, which leads to increased water temperature and limits growth of aquatic plants, both of which reduce dissolved oxygen in the aquatic system.
- **Alternative 2**. Water quality conditions for this alternative are expected to be similar to Alternative 1.
- **Alternatives 3 – 7**. Water quality conditions for any of these alternatives are expected to be similar to Alternative 1.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Water quality impacts for this alternative would be expected to be similar to Alternative 10, the TSP.
- **Alternative 10**. Several components of the TSP would reduce erosion and improve water quality of Chacon Creek. The establishment of native vegetation throughout the corridor would be expected to reduce erosion and decrease turbidity. The additional wetland areas, with small riffle structures, would contribute to an overall improvement of water quality in Chacon Creek. These restoration measures would benefit mollusks such as the Federally endangered Texas hornshell.

Section 404 Jurisdictional Waters Impacts

- **Alternative 1**. With no project implementation, there would be no impacts related to a Federal action under Section 404.
- **Alternative 2**. Implementation of Alternative 2 would result in partial impacts to 2,500 linear feet of the right bank of the creek. This would be considered impacts to Waters of the United States and would require mitigations as such.
- **Alternatives 3 – 7**. None of these five alternatives have existing Waters of the United States within their project footprints. The activities for implementing any of these alternatives would not impact existing Waters of the United States.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2, in regard to the structural component, and similar impacts to Alternatives 3–7 for the non- structural features.
- **Alternative 9**. Impacts would be similar to those of the TSP, Alternative 10.
- **Alternative 10**. Implementation of the TSP would result in modifications to existing Waters of the United States, as regulated by Section 404 of the Clean Water Act. Minimal fill might occur during construction of weir-riffle structures. Dewatering might not be necessary, if construction occurs during periods of low flow. In areas where invasive vegetation is removed, erosion would be minimized with the placement of erosion control fencing, as well as seeding areas with native grass mix. This alternative meets the criteria for Nationwide Permit (NWP) 27 "Stream and Wetland Restoration Activities," which authorizes activities in Waters of the United States associated with the creation and restoration of wetland and riparian areas.

  The operation and maintenance components of the project (trail within the riparian corridor and potential bridge crossings over Chacon Creek) are expected to be below the impact threshold criteria for NWP 14 "Linear Transportation Projects." Because TCEQ has already issued a Section 401 Water Quality Certificate for all NWPs, no additional Section 401 coordination is necessary, as long as impact thresholds and conditions in the NWPs are not exceeded.

Cultural Resources Impacts

- **Alternative 1**. Under the No-Action Plan, none of the project alternatives would be implemented and no impacts to cultural resources in the study area would be expected.
- **Alternative 2**. Under the structural alternative, channel modifications could result in impacts to yet unknown, deeply buried cultural resources.
- **Alternatives 3 – 7**. None of these five alternatives includes implementation of measures for ecosystem restoration. None of the alternatives is expected to have impacts on cultural resources. None of the residences that would be impacted by these alternatives have historical significance, and the recreation features would be constructed upon lands already disturbed from residences being removed.

- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3**–**7.
- **Alternative 9**. The NER alternative consists of a variety of ecosystem restoration activities that could impact surface and subsurface archaeological deposits. The extent of the impacts would depend directly on the methods of restoration used in specific areas, and as such, impacts would be limited. Avoidance of NRHP-eligible sites could be incorporated into in-field management practices so that the alternative has no impacts on such sites. In the area between US 83 and the Rio Grande, further survey is required to identify cultural resources. The survey will be conducted during the Preconstruction, Engineering and Design phase of the project. In the unlikely event that any NRHP-eligible sites are discovered along this portion of the project corridor, the potential for impacts will be assessed in consultation with the State Historical Preservation Officer (SHPO). If avoidance of any NRHP-eligible site is impossible along the corridor, a Memorandum of Agreement (MOA) will be developed with the SHPO and executed to mitigate for impacts prior to implementation of the restoration activities.
- **Alternative 10** combines the largest buyout and recreation plan combined with ecosystem restoration measures. As in the NER Alternative (9), the greatest potential for impacts to cultural resources results from the ecosystem restoration methods. These impacts would be isolated and could be mitigated or even avoided through in-field management practices. The proposed project calls for the buyout of 73 structures that date from mid-1960s through the 1970s. While some of these homes meet the age requirement for assessment, none of the structures in the study area meet age and/or integrity requirements to qualify for the NRHP based upon association with significant people, events, architectural design, or information potential. The proposed plan does not require alteration of the creek bank or removal of, or other impacts to, any bridges or structures other than the buyout area, therefore eligibility of the bridges or other structures that would not be impacted is not relevant and was not assessed.

Hazardous, Toxic, and Radioactive Waste Impacts

- **Alternative 1**. Under this alternative, no HTRW issues would be encountered.
- **Alternative 2** would potentially encounter HTRW issues related to real estate acquisition and associated demolition and disposal of residential structures, along with construction of an approximately 3,000-foot channel modification upstream of the Highway 359 bridge over Chacon Creek. Where asbestos containing materials are either confirmed to be present by an inspection or otherwise presumed to be present, asbestos abatement would be required prior to the demolition and disposal of the residential structures impacted by this alternative. If present in the structures, other regulated materials, examples of which include fluorescent light tubes and ballasts, mercury bulb thermostats, and air conditioning units, would also require removal prior to demolition for proper disposal. To indicate the suitability of excavated soil for reuse as fill material and for construction worker protection, soil and groundwater sampling along the proposed channel excavation area would be recommended to characterize the following media for disposal: Resource Conservation and Recovery Act (RCRA) metals (which include

arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene, and xylenes (BTEX), pesticides, and herbicides.

- **Alternatives 3 – 7**. Each of these alternatives would potentially encounter HTRW issues related to real estate acquisition and associated demolition and disposal of 42 to 62 residential structures situated in the 5-year, 10-year, and 100-year floodplain areas extending approximately 3,000 feet upstream of the Highway 359 bridge over Chacon Creek. If asbestos-containing materials are either confirmed or presumed to be present in the structures, asbestos abatement would be required, along with removal and proper disposal of other regulated materials where present. Although no channel modification and associated construction activities are proposed under these alternatives, soil sampling for RCRA metals, pesticides, and herbicides would be recommended in the areas proposed for conversion to recreational use.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to those from Alternative 2 and Alternatives 3–7.
- **Alternative 9** could potentially encounter HTRW issues in three wetland sites proposed for construction. An April 2007 report titled *Existing Conditions for Chacon Creek - Laredo, Texas*, prepared by the Fort Worth District Corps of Engineers, listed sites that were identified in an environmental database search of the area along the Chacon Creek corridor and watershed to the east. Among the sites indicated by the report to be most significant, a Resource Conservation and Recovery Information System - Small Quantity Generator (RCRIS-SQG) site, which received five Notices of Violation (NOV), is located adjacent to proposed Wetland Site 2. Due to this proximity, soil and groundwater sampling for RCRA metals, TPH, BTEX, and pesticides would be recommended, at a minimum along the east side of the proposed construction area within this wetland site. Two leaking underground storage tank (LUST) sites referenced in the report that were still undergoing monitoring, along with one other LUST site that was being required to develop and implement a Corrective Action Plan (CAP), might warrant further investigation depending upon their location with respect to the three proposed wetland sites. If any of these LUST sites are situated adjacent to and up-gradient of the proposed wetland sites, soil and groundwater sampling for TPH and BTEX would be recommended.

  A Phase I Environmental Site Assessment (ESA) along Chacon Creek, conducted in 2001 by Carter and Burgess, Inc., identified 18 large dump sites, three areas of discarded 55-gallon steel drums, and an apparent CAFO. These sites had been cleared of surface waste and visibly contaminated surface soil by the time of the March 2006 site visit by Corps of Engineers and City of Laredo personnel, as documented in the 2007 existing conditions report. If any of these sites are within or adjacent to the proposed wetland sites, soil and groundwater sampling for RCRA metals, TPH, BTEX, pesticides, and herbicides would be recommended in proposed construction areas.

  A Phase II ESA, which included collection of soil and groundwater samples for RCRA metals, TPH, and BTEX analyses, was subsequently conducted by Carter and Burgess at two sites along Chacon Creek identified in their Phase I ESA. TPH and BTEX were not detected in any Phase II samples, and RCRA metals concentrations were all below Protective Concentration Levels (PCL) established by the Texas Commission on Environmental Quality (TCEQ) under the Texas Risk Reduction Program (TRRP). These results could be used to modify sampling recommendations if the Phase II sample locations were located within or adjacent to any of the proposed wetland sites.

- **Alternative 10** incorporates Alternatives 3 and 6, as the National Economic Development (NED) Plan recommendation, and Alternative 9, as the National Ecosystem Restoration (NER) Plan recommendation, into the TSP. Corresponding requirements and recommendations with respect to HTRW issues should be implemented as outlined individually for each alternative. Because this alternative identifies specific locations for proposed project sites, a supplemental review of the environmental database search, referenced in the 2007 existing conditions report and the Phase I and Phase II ESA reports, should be conducted to determine if recognized environmental conditions have been identified within or adjacent to any of the properties that would be acquired.

Recreational Resources Impacts

- **Alternative 1**. With the No-Action Alternative, the City of Laredo would continue to actively acquire lands for trails and parks as stated in their Recreation Master Plan. However, the city would continue to experience a considerable shortage of recreational facilities and there would continue to be increased demand for recreational amenities. The city will continue to work toward its goal of approximately five miles of trails running along Chacon Creek from Lake Casa Blanca to the Rio Grande. The city will continue to pursue partnerships with Federal and State agencies, such as USACE and TxDOT, with the expectation that these funding and partnership opportunities will allow them to achieve their recreational objectives. Therefore, the No-Action Alternative would have impact on recreation resources.
- **Alternative 2**. No additional recreation amenities are proposed in the Structural Plan, but the City would continue to pursue trail-building activities and maintain Villa Del Sol Park should it continue to exist. If this alternative is constructed, there could be some impact to the Villa Del Sol Park. The mitigation for disturbed recreation amenities and landscape enhancement should be included in the cost and impact analysis of this alternative.
- **Alternatives 3 – 7**. Recreational impacts are similar to, but expected to be less than, Alternative 10, due to a smaller footprint. Increased amenities are limited in this alternative and confined to the lower terrace, which is the most frequently flooded area, or to land currently used as residential, consisting of areas anywhere from 2.5 to 10 acres. Trail linkage is assumed to be included in this plan without the ecosystem component, because a multiuse trail is highly desired by the City, and they have actively pursued funding from various sources to purchase and build a trail. Little additional benefits would be received above those currently received in the No-Action Plan other than for trail linkage.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to implementation of Alternative 2 or Alternatives 3–7.
- **Alternative 9**. Recreational benefits would be lower for the NER Plan than for the TSP and non- structural plans. The parks associated with the non-structural alternatives would be the primary generators of benefits from recreation.

- **Alternative 10**. The TSP recreation impacts are predominantly beneficial. The plan would impact the existing Villa Del Sol Park by removing the parking lot, playground, basketball court, and sports field with its associated lighting. These features would be moved to the higher terrace that is available with the buyout of the larger footprint. The existing walk and picnic area would remain in the lower terrace. Revegetation with trees and native shrubs is planned in this area, which presently is almost all unshaded open space. A trail connection with the multiuse trail corridor is planned and would include two pedestrian bridges. In this plan the existing parking and gated access would be removed and the gate reinstalled on new parking areas. Sports lighting for use of the park's open areas would be reinstalled in the upper terrace's multiuse area.

Regional Economic Development and Other Social Effects

Socioeconomics Impacts

- **Alternative 1**. Under the No-Action Plan, economic damages from flooding would continue throughout all of the reaches of Chacon Creek. Current annual damages are estimated at $887,600.
- **Alternative 2** would have similar impacts to the TSP, but on a smaller scale. This alternative involves the removal of fewer properties from the tax rolls, but excludes the recreational amenities associated with the TSP. Because this alternative is absent the ecosystem restoration component, this alternative would have the same impacts environmentally as the No-Action Plan.
- **Alternatives 3 – 7**. From a flood risk management standpoint, each of these alternatives would have impacts similar to the TSP, with Alternatives 6 and 7 having the greatest, because they include the flood risk management component of the TSP but with different degrees of recreational amenities. From an ecosystem restoration standpoint, all five alternatives would have the same impacts as the No-Action Plan. From a regional economic development standpoint, the implementation of these alternatives would result in expenditures related to the construction of a $40+ million project. With the multiplier effect, this monetary investment in the region would be substantial, thus having a positive impact on the local economy.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9** includes only the measures pertaining to the ecosystem restoration. Any impacts for any flood risk management measures would be the same as the No-Action Alternative. From a regional economic development standpoint, the implementation of this alternative would result in expenditures related to the construction of a $22.2 million project. The multiplier effect would mean that this monetary investment in the region would be substantial, thus having a positive impact on the local economy.
- **Alternative 10**. Overall, there would be positive and negative effects to socioeconomics as a result of implementation of the TSP. The long-term annual savings from the reduction of $629,000 in expected annual damages occurring in the area would be a

positive impact. Short-term employment opportunities would be associated with the project construction, which would stimulate increased demand for construction materials and services. These expenditures would be expected to have a positive multiplier effect on the local community over the period of construction, which is estimated at 24 months. The reduction in the number of properties located in the study area would result in a decrease in the local tax base as a result of taking property off of the tax rolls. This loss is expected to be offset by higher valued properties being built elsewhere in the study area, partially due to the increased availability of nearby environmental and recreational amenities offered by the project. From a regional economic development standpoint, the implementation of this alternative would result in expenditures related to the construction of a $40+ million project. The multiplier effect would mean that this monetary investment in the region would be substantial, thus having a positive impact on the local economy.

Environmental Justice Impacts

- **Alternative 1**. Under the No-Action Plan, there would be no impacts to environmental justice.
- **Alternative 2**. Impacts under this alternative would be similar to those under the TSP, but on a smaller scale given the smaller number of residences to be evacuated.
- **Alternatives 3 – 7**. Impacts under each of these alternatives would be the same as those under the TSP.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Because this alternative includes only ecosystem restoration measures, any environmental justice impacts should be the same as for the No-Action Alternative.
- **Alternative 10**. The permanent evacuations in the TSP do not disproportionately target or impact minority populations within the project area. There could be potential implications to low-income populations, because median income is just over $4,000 for the census block within which the permanent evacuation would occur. Comparable housing availability is not an issue because the city has experienced considerable growth since the advent of NAFTA. However, housing of last resort, which could involve the use of replacement housing payments that exceed Uniform Act amounts or other methods of providing comparable decent, safe, and sanitary housing within a person’s financial means, might be necessary to provide adequate replacements for those being permanently evacuated.

Noise Impacts

- **Alternative 1**. Under the No-Action Plan, noise levels would not be impacted.
- **Alternative 2**. Implementation of this alternative would impact noise similarly to the TSP, Alternative 10.
- **Alternatives 3 – 7**. Implementation of any of these alternatives would impact noise similarly to the TSP.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to noise as Alternative 2 and Alternatives 3–7.

- **Alternative 9**. Implementation of this alternative would impact noise similarly to the TSP.
- **Alternative 10**. Implementation would result in temporary, minor to moderate, adverse noise impacts from heavy machinery during construction. Noise would be limited to daytime hours, which would reduce potential impacts to ocelot and jaguar use of corridor. These impacts would likely only affect visitors to the parks adjacent to the project area. Some residences near Chacon Creek are close enough to hear construction, but distance is viewed as sufficient so that these impacts would be negligible. After construction is complete, no changes from existing conditions are anticipated to occur.

Lighting Impacts

- **Alternative 1**. Under the No-Action Plan, there would be no impacts to lighting.
- **Alternative 2** implementation would impact light similarly to Alternative 10, the TSP.
- **Alternatives 3 – 7**. Implementation of any of these alternatives would impact light similarly to the TSP.
- **Alternative 8**. Implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Implementation would impact light similarly to the TSP.
- **Alternative 10**. Construction would take place during daylight hours and would not be expected to impact light in the project area. Human health conditions should improve with the creation of healthier habitats, higher water quality, and amenities to promote exercise, albeit these benefits would be less than other alternatives that contain the park.

Public Facilities and Services Impacts

- **Alternative 1**. Under the No-Action Plan, risks to public facilities and service would continue as they currently exist, due to the fact that if no action is taken as a result of this study, the city of Laredo would likely not implement any flood risk management projects in the area.
- **Alternative 2**. Implementation would result in the modified channel being directly adjacent to Espana Street. While the risk of flooding to the road would be reduced, the street would still be damaged by lesser frequency events.
- **Alternatives 3 – 7**. Implementation of Alternative 3 would have no impact to public facilities and services as it involves no street closures. Implementation of Alternative 4 would require that Espana Street remain open for public use, because houses would remain on one side of the street. Implementation of Alternatives 5, 6, and 7 would allow Espana Street to be closed for public use, and therefore, reduce the flood risk to public facilities. However, recreational facilities would be at risk due to flooding.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.

- **Alternative 9**. Implementation would not impact public facilities and services.
- **Alternative 10**. Implementation would allow Espana Street to be closed for public use, and therefore, the flood risk to public facilities would decrease. However, the new recreational facilities would be at risk due to flooding. The trail feature could facilitate patrolling by local police and Border Patrol, which could also improve safety within this area.

Human Health and Safety Impacts

- **Alternative 1**. Under the No-Action Plan, risks to human health and safety would continue as they currently exist, due to the fact that if no action is taken as a result of this study, the city of Laredo would likely not implement any flood risk management projects in the area. In addition, the risks of fire as a result of the invasive buffelgrass would continue.
- **Alternative 2**. Implementation would result in a reduction to the risk of flooding from greater frequency flood events. However, less frequent events would still pose a risk to public health and safety for the remaining houses in the floodplain.
- **Alternatives 3 – 7**. Implementation of Alternative 3 would result in the removal of 11 structures from flooding at the most frequent flood events. Alternative 4 would result in the removal of 42 structures, and 5 and 6 would result in the removal of 62 structures at the most frequent flood events. Alternative 7 would result in the removal of 111 structures. This would completely resolve the risk of flooding to these structures, which would reduce the overall risk to public health and safety in the Villa Del Sol area. Because these alternatives would only result in buyouts, the risk to the remaining structures would continue, but because the structures being bought out are at the highest risk of flooding, the overall risk is substantially reduced.
- **Alternative 8**. The implementation of Alternative 8 would have similar impacts to Alternative 2 and Alternatives 3–7.
- **Alternative 9**. Human health conditions should improve with the creation of healthier habitats, better water quality, and amenities to promote exercise, albeit these would be less than with other alternatives that contain the park. Additionally, the removal of buffelgrass would reduce the danger of wildfires, which can potentially threaten private residences and commercial establishments as well as the general public.
- **Alternative 10**. Implementation would result in the removal of 73 structures at the most frequent flood events. This would completely resolve the risk of flooding to these structures, which would reduce the overall risk to public health and safety in the Villa Del Sol area. Because these alternatives would only result in buyouts, the risk to the remaining structures would continue, but because the structures being bought out are at the highest risk of flooding, the overall risk is substantially reduced.

CUMULATIVE IMPACTS

The White House Council on Environmental Quality (CEQ) defines cumulative impacts as: *the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions* (40 CFR 1508.7). The CFR continues, *Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*.

Irreversible or Irretrievable Commitment of Resources

The following ongoing activities and proposed projects near Chacon Creek contribute to the cumulative environmental impacts.

- City of Laredo. The Texas Water Development Board approved more than $48 million in American Recovery and Reinvestment Act money to invest in the Jefferson Water Treatment Plant. About $35 million will go specifically to upgrades of the north section of the water treatment plant, while $8.34 million will go to upgrade 14 booster stations, and the remaining dollars will repair 69,000 linear feet of deteriorated water lines.
- The City of Laredo implemented the Laredo Riverbend Section 206 Aquatic Ecosystem Restoration Project (USACE, 2013) downstream of the study area. This project implemented ecosystem restoration features along the Rio Grande by removing invasive plants, restoring hydrologic connection, creating wetland and nesting habitat for avian species, and reducing sediment across 77 acres.
- U.S. Department of Homeland Security/Customs and Border Patrol (DHS/CBP). Currently, a project is underway along the Rio Grande in Laredo, Texas to remove exotic Arundo cane from the banks of the river, enabling the border patrol agents to more effectively conduct their mission. These areas are just up river from where the Chacon Creek connects with the Rio Grande. Where cane is removed, native vegetation will be planted.
- U.S. Department of Agriculture (USDA). Separate from the efforts of DHS/CBP, the USDA is implementing a project to release biological control agents and study the relative effectiveness to control Arundo cane along the Rio Grande. The first biological control agent to be approved, the Arundo wasp (*Tetramesa romana*), is established in the Laredo area and would heavily impact the cane if distributed on a larger scale.
- Lake Casa Blanca was built primarily for recreation and water supply, but it does provide minimal flood risk reduction benefits. It would also work in concert with any proposed flood risk management features.

Identification of Reasonably Foreseeable Projects

The following activities qualify as “reasonably foreseeable actions” that contribute to the cumulative environmental impacts.

- The Laredo Section 206 Aquatic Ecosystem Restoration Project proposed by the City of Laredo and USACE would take place along the Rio Grande up river from the confluence with Chacon Creek. This restoration project would remove invasive species and revegetate the Riverbend area with native plant species.
- City of Laredo Hike and Bike trail activities with the Texas Department of Transportation. The City's goal is to have a wide variety of trails to reach destinations within and outside of the city. Construction on the phase 1 trails began in 2007 with TxDOT funding. Funding for other phases is being pursued in partnership with USACE and/or TxDOT. *The city will continue to pursue funding and partnership opportunities that will allow them to achieve their recreational objectives*.

Cumulative Impacts Assessment

The rest of this section describes the cumulative environmental impacts of the TSP on the study area's resources, in combination with the foregoing resource commitments and foreseeable projects. *Thresholds of significance* are used to determine whether a project might have a significant environmental effect on resources. The significance threshold for a given environmental effect is that level at which the study team finds the effects of the project to be significant, based on a quantitative or qualitative standard or a given set of criteria.

Land Use

The TSP and the listed reasonably foreseeable projects are consistent with land use plans for the City of Laredo. Therefore, this action would not have any adverse cumulative impacts on land use in the city.

Air Quality

Impacts on air quality would be considered significant if the action results in a violation of air quality standards, obstructs implementation of an air quality plan, or exposes sensitive receptors to substantial pollutant concentrations. The emissions generated during construction of the TSP would be short-term and minor as would any reasonably foreseeable projects. No violation of air quality standards, obstruction of air quality plans, or exposure of sensitive receptors would occur. This action would not have cumulative adverse effects on land use.

Groundwater

The significance threshold for water resources includes any action that substantially depletes groundwater supplies or interferes with groundwater recharge. There would be no cumulative impact on groundwater resources because groundwater would not be withdrawn due to implementation of the TSP. When combined with other proposed cane removal and control projects in the region, the TSP alternative would have a negligible beneficial cumulative impact on groundwater recharge.

Hydrology and Hydraulics

The TSP, along with the other reasonably foreseeable projects, would have negligible cumulative impacts to hydrology and hydraulics within the study area. These actions are not expected to have cumulative impacts on hydrology and hydraulics within Chacon Creek or the Rio Grande, because the TSP would not directly impact the channel, and the other projects are not in a close enough proximity to impact Chacon Creek.

Vegetation

The significance threshold for native vegetation includes a substantial reduction in ecological processes, communities, or populations that would threaten the long-term viability of a species or result in the substantial loss of a sensitive community that would not be offset or otherwise compensated. Removal and control of non-native plant species (as identified in the TSP and other proposed projects in the region) would have a significant and beneficial cumulative impact on vegetation, due to the removal of invasive species from the system, revegetation of native species, and reduced fire potential. The conversion of vegetation types from native riparian species to fire-adapted grasses is possible. Disturbance driven spread of invasive vegetation is possible if proper measures are not established. Eradication of native vegetation would require a sustained effort using chemical and mechanical methods. Thorough cleaning of equipment would be required to prevent the spread of seeds and further colonization of invasive plant species. Aggressive revegetation of restoration areas would be necessary to prevent invasive species from re-establishing in treated areas.

Wildlife

The significance threshold for wildlife includes a substantial reduction in ecological processes or populations that would threaten the long-term viability of a species or result in the substantial loss of a sensitive habitat that would not be offset or otherwise compensated for. Removal of invasive plant species within the study area as part of the TSP as well as control of giant reed throughout Webb County for reasonably foreseeable projects, would have a positive cumulative impact on habitat for native wildlife species. Wildlife habitat value would also increase due to revegetation of native species.

Threatened and Endangered Species

While there is no Federally designated critical habitat for Federally Listed species potentially occurring in Webb County, the ecosystem restoration component would have temporary adverse effects but long-term benefits for Mexican fawnsfoot, salina mucket, and Texas hornshell habitat. The short-term effects would be due to construction activities and removal of stands of buffelgrass and other invasive species but the effects of revegetation with native species would be long-term. The removal of fire-adapted buffelgrass would prevent compositional shifts from native vegetation to this fire adapted grass dominated vegetation type. This action, when combined with other existing and proposed projects in the region, would not have a significant cumulative impact on endangered, threatened, or rare species, nor jeopardize the continued existence of any species, and could provide overall benefits.

Aquatic Habitat

Implementing the TSP in addition to the Laredo Riverbend Section 206 Aquatic Ecosystem Restoration Project would beneficially impact the habitat, and provide both near and long-term benefits. The use of erosion control measures, such as silt fencing and planting of native grasses to serve as stream buffers, would affect the reproduction and forage base of resident fish, while in-stream structures, such as rock weirs with riffles associated with the TSP would increase habitat diversity for fish in the project area. Species whose habitat requirements include more abiotic structural complexity (different types of sediment, and rock), adequate minimum water flow, or dissolved oxygen would be the most likely to benefit. Improvements to the riparian area, including tree planting, would indirectly benefit fish by decreasing erosion and long-term sedimentation problems. Increasing the quantity of woody vegetation along the river would increase the amount of woody debris in the river in the long term, generally benefiting many species by providing escape cover and a cooling effect in the littoral zone. Other projects in the region would not be within a close enough proximity to have additional cumulative impacts to the project area.

Water Quality

The TSP is expected to have no adverse impacts to water quality within the study area due to the establishment of native vegetation which would reduce erosion and turbidity. Additional wetland areas would also contribute to improved water quality. Other existing and reasonably foreseeable projects in the region would not be expected to have any cumulative adverse impacts to water quality in the project area.

Jurisdictional Waters

Implementation of the TSP would result in modifications to existing Waters of the U.S., as regulated by Section 404 of the Clean Water Act. The proposed restoration activities meet the criteria for NWP
27. Impacts would be temporary and would be minimized through the use of best management practices. No net decrease to Waters of the U.S. are expected. No cumulative adverse impacts to Waters of the U.S. would be expected with the TSP and the existing and reasonably foreseeable projects in the project area.

Cultural Resources

The TSP would have isolated impacts to archaeological resources due to the ecosystem restoration methods. However, all of these impacts would be mitigated or avoided through in-field management practices. None of the structures in the study area meet age and/or integrity requirements to qualify forthe NRHP based upon association with significant people, events, architectural design, or information potential. This action, when combined with other existing and proposed projects in the region, would not have a significant cumulative impact to cultural resources in the project area.

Hazardous Materials

The TSP may result in hazardous materials impacts during the demolition and disposal of residential structures and excavation of potentially contaminated soil. Protection of the environment, nearby populations, and project construction workers will be required during these actions. These impacts would be temporary, however, and removal of hazardous materials from the area would be beneficial for existing and proposed projects in the region.

Recreation Resources

Implementation of the TSP along with other recreation master plan features would have a positive cumulative benefit toward meeting previously unmet recreation demand in the City of Laredo. The TSP and reasonably foreseeable projects are not expected to accumulate any negative impacts to recreation resources.

Socioeconomics and Regional Economic Development

The significance threshold for socioeconomic impacts on the national and regional economy, such as employment and income, impacts to housing characteristics, and demand and availability for government and other basic services. The TSP along with other projects in the region would result in only temporary, minor impacts on the region’s economy, both positive and negative. Long-term annual savings from the reduction of flooding damages in the area, as well as short-term employment opportunities associated with the project construction are seen as positive impacts. Reductions in the number of properties located in the study area resulting from permanent evacuations would decrease the local tax base however, this would be offset by higher valued properties being built elsewhere in the study area due to the increased availability of nearby environmental and recreational amenities offered by the project.

Environmental Justice

The significance threshold for environmental justice is characterized by displacement and relocation of residences or commercial buildings, increases in long-term demands for public services in excess of existing and projected capacities resulting in a disproportionate impact on minority and low-income families. The TSP along with existing and reasonably foreseeable projects are not expected to result in significant cumulative adverse impacts on minority populations within the project area. There would be minor short-term potential implications to low-income populations due to the permanent evacuation of some structures in the project footprint. Despite this, impacts associated with having displaced minority and low-income residents is expected to be short-term and minor due to availability of suitable and comparable housing available throughout the city of Laredo. permanently evacuated.

Other existing and reasonably foreseeable projects in the region would not be expected to have any cumulative adverse impacts to environmental justice in the project area.

Noise

Actions would be considered to cause significant impacts if they permanently increase ambient noise levels over 65 dBA. Most of the noise generated by the Tentatively Selected

Plan would occur during removal and control activities, would be temporary, and thus would not contribute to cumulative impacts on ambient noise levels. Routine maintenance would result in slight, temporary, and sporadic increases in noise levels that would continue to occur over the long term. Potential sources of noise from other projects in combination with routine maintenance would not increase ambient noise levels above the 65 dBA threshold. Thus, the noise generated by the Tentatively Selected Plan, when considered with the other existing and proposed projects in the region, would not have a significant cumulative adverse impact to existing noise levels.

Lighting

Construction would take place during daylight hours and would not impact light in the project area. Additional lighting generated by the Tentatively Selected Plan The TSP, when considered with the other existing and proposed projects in the region, would not have a cumulative adverse impact to lighting.

Public Facilities and Services

The TSP would require Espana Street to be closed for public use, resulting in a reduced need for some types of public facilities, (i.e. water, sewage, gas, and electricity and services such fire and police).
However, a greater number of recreational facilities would be at risk of flooding though these facilities are suitable in areas prone to flooding than the residential structures they replaced. This would increase the need for park and patrol services but would result in a net decrease in the need for public services overall. In general, the TSP along with existing and other reasonably foreseeable projects would not have an adverse cumulative impact on public services.

Human Health and Safety

The TSP would result in the removal of 73 structures at the most frequent flood events. This would completely resolve the risk of flooding to these structures, which would reduce the overall risk to public health and safety in the Villa Del Sol area. Because this plan would result in buyouts, the risk to the remaining structures would continue therefore the overall cumulative impact is substantially beneficial. Additionally, the management of invasive species proposed in the TSP and other existing and reasonably foreseeable projects would reduce the risk of wildfires and have a beneficial cumulative impact.

TENTATIVELY SELECTED PLAN

Section Five provides further details on the Tentatively Selected Plan (TSP). The TSP is selected for recommendation pending the determination by USACE Headquarters that the Fort Worth District has indeed selected the appropriate plan, and that there is no Locally-Preferred Plan that is selected for implementation. As noted in Section Three, the flood risk management and ecosystem restoration components of the TSP are identical to the National Economic Development (NED) and National Ecosystem Restoration (NER) Plans.

From this point on, the TSP (Alternative 10) is discussed with a higher level of confidence and with more detail in design. As a result of more detailed design planning, costs were further refined. The TSP has been re-analyzed to update costs and benefits to 2018 dollars, and a current discount rate of 2.75 percent. This Section presents the TSP costs, as categorized in the Corps' Cost Engineering System, and the Federal and non-Federal cost share apportionment responsibilities for the plan.

PLAN DESCRIPTION

This section describes the TSP using the updated data for the NED and NER components. All costs and benefits are in February 2018 dollars. Recent analysis has noted that several structures have already been removed from the floodplain since the 2010 study was completed. Therefore the NED TSP costs and benefits have been updated to reflect the change in structure inventory. See Appendix A for more detail into other changes to the TSP analysis, as the alternatives analysis remained constant except for escalation. A brief list of key changes to the TSP analysis compared to that of the 2010 report is provided below.

- Used Marshal & Swift escalation factors to update structure inventory values to current price levels. Also, re-sampled structures to verify significant structure depreciation has not occurred in the study area. No significant depreciation was found.
- Used 2010 study depth damage functions and hydraulic data.
- Eleven (11) structures have been removed since 2010, and are no longer included in either the costs or benefits for the TSP.
- Increased recreation visitation estimates by two percent to account for population growth in the region.
- Escalated construction and real estate costs to current prices.

Flood Risk Management

The flood risk management component of the TSP, Alternative 10 (A10) which consists of the combination of Alternative 3, Reach 1 10-Year Buyout with Recreation and Alternative 6, VDS Plan, includes the permanent evacuation of 60 residential structures and using the vacated lands for local recreation facilities. The NED Plan would help alleviate the risk of flooding in an area known to have had significant events in recent years and provide additional recreational amenities where they are sorely needed. The TSP generates $594,200 in EAD benefits, with recreational amenities replacing the evacuated areas and adding $859,700 in annual benefits. Total annual benefits for the project are $1,453,900. The total first cost of the flood risk management and recreation components of the TSP is $25,071,600. Total annual costs would be $1,075,100 with net benefits of $378,800. The benefit/cost ratio for the TSP is 1.35-to-1.00.

Recreation

The TSP addresses the goal first stated in Section One to provide recreational amenities. The primary recreation component of the TSP consists of a park that would comprise approximately 18.7 acres in Reach 2 in the Villa Del Sol neighborhood. A city-owned park already exists in the area behind residential structures on the south side of Espana Street. The TSP would relocate existing park features and provide room for the ecosystem restoration buffer zone. The environmental maintenance road provides added utility as a walking trail that extends the city’s proposed and existing trail system.
Many of the amenities considered as part of the recreation component would help alleviate the city’s shortfall in recreation facilities: two multiuse open space fields, playground, large domed group shelter (with basketball goals), small pavilion, 32 picnic tables, 32 trash receptacles, 19 picnic shelters, 23 grills, 19 benches, seven drinking fountains, two water-borne restrooms, amphitheater, horseshoe and ring toss pit, nine disc (Frisbee) golf baskets, 6,850 linear feet of five-foot-wide sidewalk, 89,000 square feet of parking lots and drives, and other associated infrastructure. Current regulations do not allow the Corps to cost share in certain recreational features that are considered betterments. The non- cost shareable items—disc golf, basketball courts, and horseshoe pits—total $458,008 at 100% local cost for the TSP.

A secondary recreation component in Reach 1, designated Areas A and B (as described in Section Three), would remove homes from the 10-year floodplain downstream of the Villa Del Sol Park and State Highway 359.

- Area A would only contain parking for trailhead use with minimal picnic facilities, in the form of six single tables with three grills, three trash cans, 7,452 square feet of parking, two water fountains, one bike rack, and security lighting for the parking lot.
- Area B would contain a playground, six picnic tables, six benches, three grills, four trash cans, one bike rack, 7,452 square feet of parking, and restrooms with associated facilities, including two water fountains, lighting, and water and wastewater linkages. 1,572 linear feet of five-foot-wide walk is planned to link the playground and picnic tables, as well as linkage to the nature trail/boardwalk planned for the ecosystem restoration and

wetland site. Linkage is also provided to the multiuse trail system.

Approximately 50 shade trees are planned for use in both areas. Turfing and some irrigation would be planned for Area B. Area A would be minimalistic in its landscaping, but would include some vegetative screening of the road on the northwest corner.

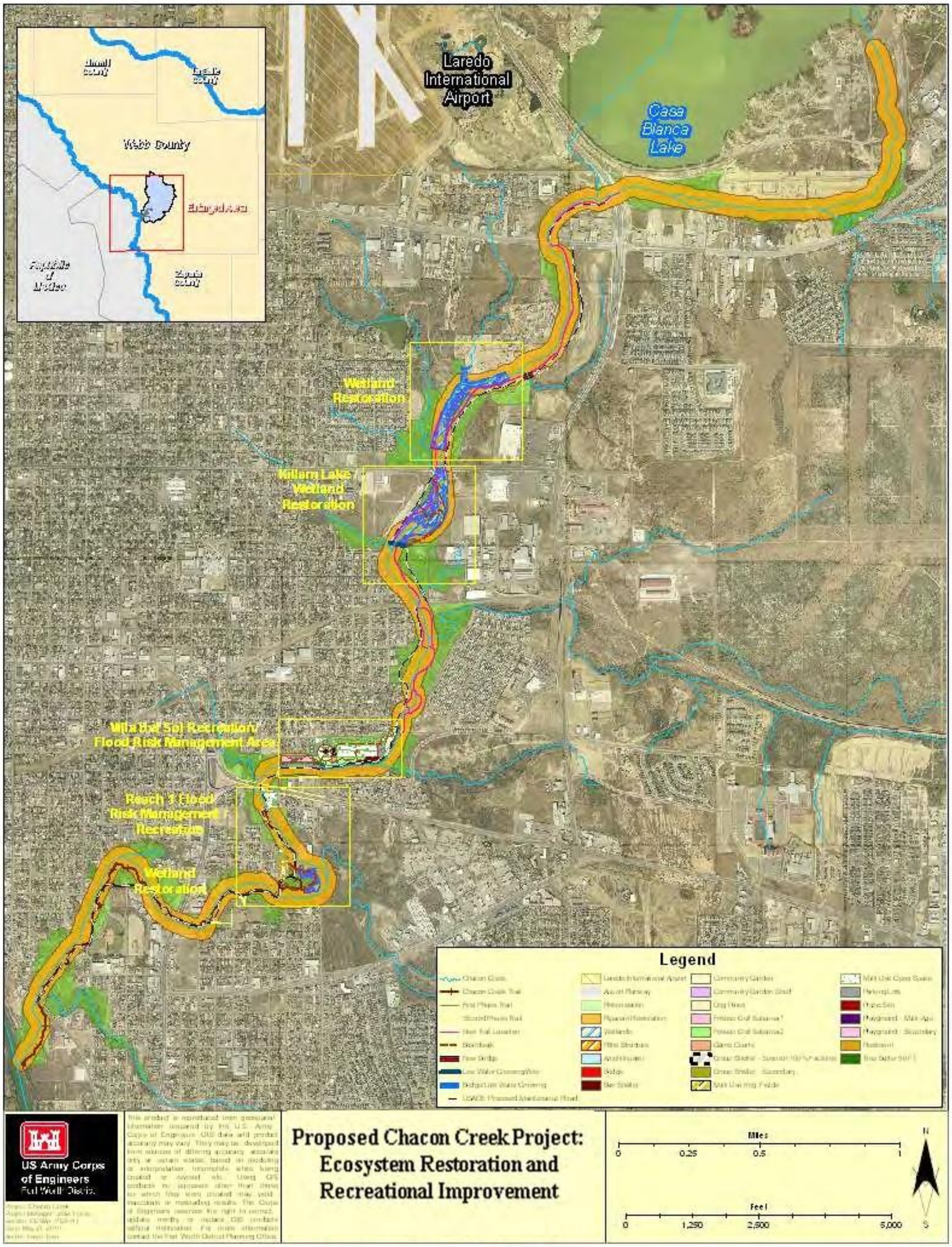
Ecosystem Restoration

Figure 44 depicts the location of the aquatic ecosystem restoration (ER) component of the TSP. The ER component would restore three wetland sites totaling 16.75 acres and produce a net increase of 5.9 AAHUs. It includes riparian measures that would restore 401 acres of riparian habitat providing 241 AAHUs, by removing buffelgrass and planting native species with temporary irrigation until plants are established. Additional riparian measures include the removal and control of salt cedar. The TSP would produce a net increase of 248 AAHUs at an annual cost of $4,600 per unit gained. The TSP would also include the removal of debris as well as a concrete barrier from the streambed.

Table 45 provides an overview of the outputs for the TSP. The TSP would result in the overall increase of 248 AAHUs with an average annual cost of $4,600 per unit gained over the No-Action Plan.

Table 45. TSP Outputs

Flood-Risk Management	
Estimated First Cost	$11,520,000
Benefits	$539,000
Total Annual Cost	$497,000
Recreation	
Estimated First Cost	$9,394,000
Benefits	$730,000
Total Annual Cost	$591,000
Ecosystem Restoration	
Estimated First Cost	$22,238,000
Output (AAHUs)	248
Total Annual Cost	$1,133,000



(Image source: USACE, 2010)

Figure 44. Ecosystem Restoration and Recreational Improvement

ENVIRONMENTAL EFFECTS OF THE TENTATIVELY SELECTED PLAN

The environmental effects of the TSP are the combined effects as characterized in detail for Alternative 10, in Section Four "Alternative Impact Assessment."

In general terms, the implementation of the TSP would impact a number of environmental resources including air quality, vegetation, aquatic habitat, and water quality, in the short term. Construction and O&M activities would have minor adverse impacts to such resources as air quality, vegetation, and aquatic habitat, but these impacts would see significant improvement after the TSP begins to take hold and as construction activities begin to diminish. After invasive species are removed, the quantity and diversity of vegetation and wildlife habitat would increase, resulting in indirect benefits to other resources with the implementation of the TSP. The TSP would also reduce erosion and turbidity, with the establishment of native vegetation throughout the corridor thereby improving water quality.

Environmental Compliance Status

Table 46 presents the TSP's status of compliance with applicable environmental laws, Executive Orders, and other environmental concerns. Where compliance issues were encountered (indicated by *), more detailed descriptions of environmental compliance are provided.

Table 46. Plan Relationship to Environmental Protection Statutes and Other Environmental Requirements

Policies	Compliance of Plan
Public Laws	
Archeological and Historic Preservation Act, 1974, as amended	n Full Compliance
Archeological Resources Protection Act, 1979, as amended	n Full Compliance
Clean Air Act, 1977, as amended	n Full Compliance
Clean Water Act, 1972, as amended	n Full Compliance
Coastal Zone Management Act, 1972, as amended*	Not Applicable
Endangered Species Act, 1973, as amended*	n Full Compliance
Farmland Protection Policy Act	Not Applicable
Fish and Wildlife Coordination Act, 1958, as amended*	n Progress
Magnuson Fisheries Conservation and Management Act	Not Applicable
Migratory Bird Treaty Act, 1918, as amended	n Full Compliance
National Environmental Policy Act, 1969, as amended	n Full Compliance
National Historic Preservation Act, 1966, as amended*	n Full Compliance
Native American Graves Protection and Repatriation Act, 1990	n Full Compliance
Rivers and Harbors Act, 1899	Not Applicable
Wild and Scenic Rivers Act, as amended	Not Applicable
Executive Orders	
Environmental Justice (E.O. 12898)*	n Full Compliance
Flood Plain Management (E.O. 11988)	n Full Compliance
Protection of Wetlands (E.O. 11990)	n Full Compliance
Protection of Children from Environmental Health Risks (E.O.	n Full Compliance

13045)	
nvasive Species (E.O. 13112)	n Full Compliance
Others	
FAA Advisory Circular 150-5200-33*	n Full Compliance

* For additional information, see the following sections.

Clean Water Act, Section 404 - Nationwide Permit 27

NWP 27 pertains to “activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.” NWP 27 is not to be used to authorize mechanisms for controlling storm water runoff for the purpose of reducing downstream erosion, water quality degradation, and flooding. General conditions applicable to the TSP include impacts to aquatic life movements, management of water flows, and fills within the 100-year floodplains, equipment, soil erosion and sediment controls, endangered species, and water quality. The TSP meets these conditions as follows:

- Will not substantially disrupt the life cycle movements of indigenous species.
- Will not restrict or impede the passage of normal or high flows.
- Complies with FEMA-approved floodplain management requirements.
- Best management practices will be implemented to minimize soil disturbance and erosion.
- Will not directly or indirectly jeopardize the existence of threatened and endangered species. Coordination with USFWS will occur prior to project implementation. TCEQ conditionally certifies that the activities authorized by NWP 27 should not result in a violation of established Texas Surface Water Quality Standards as required by Section 401 of the Federal Clean Water Act and pursuant to Title 30, Texas Administrative Code, Chapter 279. This certification also requires soil and sediment controls which will be implemented as a best management practice.

Regional Conditions applicable to NWP 27 and the TSP require compensatory mitigation at a minimum one-for-one ratio for all special aquatic site losses that exceed 1/10 acre and require pre- construction notification (PCN), and for all losses to streams that exceed 300 linear feet and require PCN. Best management practices are also required where practicable to reduce the risk of transferring invasive plant and animal species to or from project sites. The TSP would not result in the loss of aquatic sites or streams therefore no mitigation would be required. Best management practices would be implemented to reduce the risk of spreading invasive species.

Floodplain Management, Executive Order 11988

The objective of this Executive Order is the avoidance, to the extent possible, of long-and short-term adverse effects associated with the occupancy and modification of the base floodplain (1 in 100 annual event) and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative. Under the Order, if this becomes a Federal project, USACE is required to provide leadership and take action to:

a. Avoid development in the base flood plain unless it is the only practicable alternative;
b. Reduce the hazard and risk associated with floods;
c. Minimize the impact of floods on human safety, health and welfare; and
d. Restore and preserve the natural and beneficial values of the base flood plain.

The proposed project does not contribute to increased development in the floodplain and does not increase flood risk, but rather it restores "natural and beneficial values" and thus is in compliance with the Executive Order.

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in USACE ER 1165-2-26, require an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The eight steps reflect the decision-making process required in Section 2(a) of the EO. The eight steps and project-specific responses to them are summarized below.

1. **Determine if a proposed action is in the base floodplain (that area which has a one percent or greater chance of flooding in any given year).** The proposed action is located within the Chacon Creek channel and immediate overbank areas and therefore is within the base floodplain.

2. **If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain**. Section 3 of this document presents an analysis of alternatives. Practicable measures and alternatives were formulated, and potential impacts and benefits were evaluated in Section 4. As the primary objective of the project is flood risk management, there are no practicable alternatives completely outside of the base floodplain that would achieve this objective.

3. **If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments**. Because the primary objective of the project is flood risk management, the action must be in the flood plain. Once this document is approved as a public draft, it will be fully coordinated with the general public, governmental agencies, organizations, and interested stakeholders.

As described in Section 6 of this document, public outreach had been conducted periodically prior to 2007 as part of City Council meetings, review of the City Master Plan, and Recreation Master Plan in the project area. In these meetings, the major concern expressed by the residents was that they did not want the remaining natural creeks in the City to be destroyed. This helped guide formulation of alternatives that would maintain the natural integrity of the floodplain while relieving the residents offlood risks. Although USACE has not conducted documented public meetings as a part of the study while it was under USACE development, the TSP was presented to the city's Citizen Environmental Advisory Committee in March 2010.

4. **Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain but will affect the base flood plain, impacts resulting from these actions should also be identified**. The anticipated impacts associated with the TSP are summarized in Section 5 of this document. Implementation of project features would impact a number of environmental resources including air quality, vegetation, aquatic habitat, and water quality, in the short term. Construction and O&M activities would have minor adverse impacts to such resources as air quality, vegetation, and aquatic habitat, but these impacts would see significant improvement after the TSP begins as construction activities begin to diminish. After invasive species are removed, the quantity and diversity of vegetation and wildlife habitat would increase, resulting in indirect benefits to other resources with the implementation of the TSP. The TSP would also reduce erosion and turbidity, with the establishment of native vegetation throughout the corridor thereby improving water quality.

5. **If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists**. An evaluation of practicable measures and alternatives is presented in Section 3 of this document. The project will not induce development in the floodplain. Rather, the TSP removes development through buyout and associated relocation assistance, thereby helping to increase the natural values of the floodplain.

6. **As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values**. **This should include reevaluation of the "no action" alternative**. For each resource analyzed in Section 4, wherever there is a potential for adverse impacts, appropriate Best Management Practices or other environmental commitments were identified and listed at the end of each section. As there is a net benefit to biological resources, no biological mitigation is required for the TSP. The project would not induce development in the floodplain. The project would restore natural and beneficial floodplain values by widening the river and flood plain within the project footprint without increasing flood risk to adjacent areas.

7. I**f the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings**. The Draft Report would be circulated along with an associated public meeting, when appropriate. Comments received will be responded to and incorporated into the Final Report.

8. **Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order**. The Tentatively Selected Plan is the most responsive to all of the study objectives described in Section 3, and it is consistent with the requirements of EO 11988.

Environmental Justice, Executive Order 12898

The permanent evacuations in the TSP do not disproportionately target or impact minority populations within the project area. There could be potential implications to low-income populations because median income is just over $4,000 for the census block within which the permanent evacuation would occur. However, comparable housing availability should not be an issue because the city has experienced considerable growth since the advent of NAFTA. Housing of last resort, which may involve the use of replacement housing payments that exceed Uniform Act amounts or other methods of providing comparable decent, safe, and sanitary housing within a person's financial means, might be necessary however, to provide adequate replacements for those being permanently evacuated.

NHPA, Section 106 Compliance

During the feasibility study, coordination was initiated with the State Historic Preservation Officer (SHPO). Further coordination will be conducted after a cultural resources survey has been completed in accordance with 36 CFR 800. Based upon the results of the survey and in consultation with the SHPO, a Programmatic Agreement will be executed between the SHPO and the Corps to comply with Section 106.

Advisory Circular - Hazardous Wildlife Attractants on or Near Airports

The TSP has been coordinated with the Federal Aviation Administration (FAA) in accordance with the Memorandum of Agreement between the FAA, U.S. Department of Agriculture, and the Corps. An initial advisory meeting with U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) was conducted in San Antonio on August 27, 2009. Initial coordination with the FAA began on September 3, 2009, when maps and descriptions of the wetland restoration sites were provided. The District received a letter from the FAA on October 15, 2009 stating that the FAA had no objection to the project from a wildlife hazard standpoint. For the coordination letters, see Appendix H "Correspondence."

Fish and Wildlife Coordination Act

Coordination with the U.S. Fish and Wildlife Service began in July 2006 when the Corps and the Service negotiated a scope of work to perform fish and wildlife studies in relation to the Chacon Creek Feasibility Study. A coordination letter requesting Federal Resource Agency participation was sent out on March 10, 2023. A subsequent Resource Agency coordination meeting was held on June 16, 2023. It is anticipated that USFWS completed a final Fish and Wildlife Coordination Act Report with the updated version of this document.

Endangered Species Act

The Corps determined that the project would not likely adversely affect any Federally-listed threatened or endangered species. For the freshwater mussel species (Mexican fawnsfoot, Salina mucket, and Texas hornshell) either listed or proposed, USACE has determined that the activities planned in the action area, with the inclusion of all the conservation measures listed in Appendix E, **may affect but is not likely to adversely affect the species.** Additionally, activities within the action are **not likely to destroy or adversely modify proposed critical habitat** for the freshwater mussel species (Mexican fawnsfoot, Salina mucket, or Texas hornshell). During the planning process, the Corps has coordinated with the USFWS. It is anticipated that USFWS will concur with the plan and that the plan is in full compliance with the Endangered Species Act.

Safety Assurance Review

In accordance with Section 2035 of Water Resources Development Act (WRDA) of 2007, Engineering Circular (EC) 1165-2-209 requires that all projects that address flooding or storm damage reduction undergo a safety assurance review of the design and construction activities. The decision document phase of the Feasibility Study is the initial design phase for construction. Therefore, EC 1165-2-209 requires that safety assurance factors be considered in all decision document reviews prior to initiation of physical construction. Further, until construction activities are completed, safety assurance reviews shall be conducted periodically on a regular schedule sufficient to inform the Chief of Engineers on the adequacy, appropriateness, and acceptability of the design and construction activities for the purpose of assuring public health, safety, and welfare. The safety assurance factors to be considered as part of flood risk management studies include the quality and quantity of the surveys, investigations, and engineering sufficiencies of conceptual designs; model hazard assessments; and uncertainties associated with potential loss of life.

Flood Resiliency

Although the magnitude of increased creek discharges due to climate change is unpredictable, the project's resiliency to future, higher discharges needs to be considered. Categories include the threat to life safety, flood damages to structures and contents, sustainability of habitat, and damage to lands and vegetation. Resiliency to these threats is due to several factors:

- The channel is entrenched, so unlike leveed flood risk management, there is no condition where immediate and catastrophic damages would occur with increased channel flow caused by climate change. While high flows could occur, there would typically be an opportunity for flood warning compared to what would occur during structural failure of a flood risk management project.
- The majority of parcel buyouts occur within the 10-year and 25-year floodplains due to the projected, more frequent occurrence of those events and how that translates to a higher value of damages prevented compared to costs. If those frequencies recalibrate to a higher discharge due to climate change, no additional damage would take place to the removed structures following implementation of the project. The same is true for those parcels subject to the less frequent events such as the 50-year and 100-year floodplains. For the structures that have not been removed, increased vulnerability to discharges due to climate change could occur compared to current conditions. Justification of a Federally-justified project would have to consider that likelihood under climate change assumptions.
- Under future climate change scenarios, the general assumption is that water would continue to flow within Chacon Creek, but the timing, duration and peak of those flows

could be more variable than currently exists. For habitat sustainability, resilience to a more drought condition is important, and, since the restoration features were not designed nor are dependent upon extremely wet conditions, climate change would not be expected to have an adverse effect.

- Land erosion and vegetation damage would occur more frequently with increased flooding caused by climate change. The TSP is less resilient to these damages compared to a more structural, channelized alternative, but structural alternatives were evaluated as having less Federal justification.

ECONOMIC ANALYSIS

Project First Cost

The project first cost includes estimates for lands and damages; demolition and disposal of structures; construction of fish and wildlife and recreational facilities; engineering and design; and construction management (support and administration).

Contingencies were added to these items in accordance with the level of confidence associated with the item. Construction cost data were developed using material, equipment, and labor costs typical for work of this nature in the Laredo area. Real estate costs were developed after the Gross Appraisal was completed. Table 47 gives a summary of the estimated project first cost, for the TSP.

Table 47. Cost Estimate Summary for the TSP (Feb. 2018 Dollars)

Project Cost Items	First Cost
Lands and Damages	$19,880,000
Ecosystem Restoration Construction	$14,191,000
Flood Risk Management Construction, Demolition	$2,110,000
Recreation Facilities Construction	$9,615,000
Engineering, Design, and Construction S&A	$4,896,000
Monitoring and Adaptive Management	$1,281,000
Total First Cost	**$51,973,000**

Annualized Cost

Using a 50-year amortization period and the current applicable Federal interest rate of 2.75 percent, the estimated first cost was converted to an annual basis. Accrued interest during the construction period was calculated and added to the first cost to produce a total investment cost. The annualized costs for the TSP were used to compute the benefit-to-cost ratio (BCR) for each plan.

Cost Summary

Table 48 presents the cost summary for the flood risk management and recreation components of the TSP.

Table 48. Economic Summary for TSP (February 2018 Prices; 2.75%)

Project Cost Items	Values
Flood-Risk Management	
Lands and Damages	$6,983,800
Relocation Assistance	$2,368,000
Construction	$2,110,000
Engineering and Design	$189,900
Construction Management	$189,900
Real Estate Contingency	$1,884,800
Total Flood-Risk Management Cost	$13,726,300
Interest During Construction	$382,700
Total Investment Cost	$14,109,000
Annual Investment Cost	$522,600
Flood Risk Benefits	$594,200
Benefit-to-Cost Ratio (Flood Risk Management)	**1.14**
Recreation	
Construction	$9,615,000
Engineering and Design	$865,100
Construction Management	$865,100
Total Recreation Cost	$11,345,300
Interest During Construction	$316,300
Total Investment Cost	$11,661,600
Annual Investment Cost	$432,000
OMRR&R**	$120,500
Total Annual Cost	$552,500
Recreation Benefits	$859,700
Benefit-to-Cost Ratio (Recreation)	**1.56**
Flood Risk Management and Recreation Summary	
FRM and Recreation First Cost	$25,071,600
Interest During Construction	$699,000
Total Investment Cost	$25,770,600
Annual Investment Cost	$954,600
OMRR&R**	$120,500
Total Annual Costs	$1,075,100
Total Annual Benefits	$1,453,900
Net Annual Benefits	$378,800
Benefit-to-Cost Ratio (FRM and Recreation)	**1.35**
Ecosystem Restoration	

Project Cost Items	Values
Construction	$14,191,000
Engineering and Design	$1,393,000
Construction Management	$1,393,000
Lands and Damages	$8,643,000
Monitoring and Adaptive Management	$1,281,000
Total Ecosystem Restoration	**$26,901,000**
Project Total First Cost	**$51,973,300**

** For OMRR&R breakdown, see Table 48.

The TSP would have annual costs allocated to flood risk management and recreation of $1,075,100, total annual economic benefits of $1,453,900 annual net benefits of $295,200, and a BCR of 1.28-to- 1.00.

Ecosystem restoration benefits are not included in this table, because the outputs of an ecosystem restoration plan are non-monetary in nature. In addition, and as reflected in the table, ecosystem restoration costs are not used in the calculation of benefit-cost ratios to determine economic feasibility of the project. However, ecosystem restoration costs are used in the cost effectiveness/incremental analysis to justify the ecosystem restoration component of the TSP. Furthermore, in accordance with current regulations, costs for real estate relocation assistance are not considered economic costs in the determination of economic feasibility, but are appropriately shown as financial costs of the project in Table 48.

Table 49 displays the economic summary of the ecosystem restoration component. The ecosystem restoration would have a first cost of approximately $26,901,000 and total annual charges of about
$1,010,000. The proposed plan would result in a gain of about 248 AAHUs over the No-Action Alternative, which would result in an average annual cost of approximately $4,020 per AAHU gained.

Table 49. Economic Summary for Ecosystem Restoration (February 2018 Prices)

Project Cost Items	Cost
First Cost	$26,900,000
Annual Interest Rate	2.75%
Project Life	50 years
Construction Period	24 months
Interest During Construction	$749,900
Investment Cost	$27,650,900
Annual Investment	$1,024,200
Annual O&M	$5,000
Total Annual Charges	$1,029,200
With-Project AAHU	311.23
No-Action AAHU	63.62

Project Cost Items	Cos t
Plan AAHU Gain	247.61
With-Project Acres	417.87
Average Annual Cost per AAHU Gain	$4,160
With-Project Acres	$2,460
First Cost per Acre	$64,400

Cost Apportionment

Table 50 shows the cost apportionment performed for the TSP. The total cost of the TSP, including relocation assistance, is estimated at $51,972,800 in 2018 dollars. Of this amount, $30,887,700 (59.4 percent) would be a Federal responsibility, while $21,085,100 (40.6 percent) would be a non-Federal sponsor responsibility.

Note that per the Section 203 study authority—and once the project is authorized following the Secretary submitting the report to Congress—the non-Federal sponsor would receive credit towards their share of the construction cost equal to their portion of the cost of developing the feasibility study up to the amount of $1.5 million. For this Chacon Creek Feasibility Study, the currently estimated non-Federal study cost currently equals $TBD. A more detailed accounting will take place prior to project implementation.

Table 50. Cost Apportionment for TSP (February 2018 Prices)

Feature	Federal	Non-Federal	Total
Flood Risk Management			
Engineering and Design	$189,900		$189,900
Construction S&A	$189,900		$189,900
Lands, Structures		$6,983,800	$6,983,800
Relocation Assistance		$2,368,000	$2,368,000
Demolition, Removal	$2,110,000		$2,110,000
HTRW			$0
Real Estate Contingency		$1,884,800	$1,884,800
Unadjusted Total	$2,489,800	$11,236,600	$13,726,400
Adjustment to achieve 65/35	-$6,432,400	$6,432,400	$0
Subtotal Flood-Risk Management	**$8,922,200**	**$4,804,200**	**$13,726,400**
Recreation			
Engineering and Design	$432,600	$432,600	$865,200
Construction S&A	$432,600	$432,600	$865,200
Facilities, Federal 50/50 Cost Share	$3,614,300	$3,614,300	$7,228,600
Facilities, Adjusted Non-Federal Cost in Excess of Federal Responsibility (see		$537,100	$537,100

item “d” in the next section on Non-Fed Responsibilities)			
Facilities, Adjusted Non-Federal Cost – Non FRM Buyout Lands (see page F-50 in the Recreation Appendix)		$1,849,300	$1,849,300
Recreation Cost Share	**$4,479,500**	**$6,865,900**	**$11,345,400**
Ecosystem Restoration			
Engineering and Design	$1,393,000		$1,393,000
Construction S&A	$1,393,000		$1,393,000
Restoration Facilities (excluding lands)	$14,191,000		$14,191,000
Lands		$7,049,300	$7,049,300
Real Estate Contingency		$1,593,800	$1,593,800
Monitoring and Adaptive Management		$1,281,000	$1,281,000
Unadjusted Total	$16,977,000	$9,924,100	$26,901,100
Adjustment to achieve 65/35	-$508,700	$508,700	$0
Subtotal Ecosystem Restoration	**$17,485,700**	**$9,415,400**	**$26,901,100**
Total Cost Apportionment	**$30,887,700**	**$21,085,100**	**$51,972,800**
Cost Percentage	**59.4%**	**40.6%**	**100%**

Non-Federal Responsibilities (Items of Local Cooperation)

Federal implementation of the TSP project is subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to the following:

a. Provide 35 percent total non-structural flood risk management costs as further specified:

1. Provide 25 percent of design costs allocated by the Government to non-structural flood risk management in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to non-structural flood risk management;
3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the non-structural flood features;

4. Provide, during construction, any additional funds necessary to make its total contribution for non-structural flood risk management equal to 35 percent of total non-structural flood risk management costs;

b. Provide 35 percent of total ecosystem restoration costs as further specified:

   1. Provide 25 percent of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
   2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to ecosystem restoration;
   3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;
   4. Provide, during construction, any additional funds necessary to make its total contribution for ecosystem restoration equal to 35 percent of total ecosystem restoration costs;

c. Provide 50 percent of total recreation costs as further specified:

   1. Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
   2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to recreation;
   3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;
   4. Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

d. Provide, during construction, 100 percent of the total recreation costs that exceed an amount equal to 10 percent of the sum of the Federal share of total structural flood risk management costs and the Federal share of total ecosystem restoration costs; or 100 percent of the total recreation costs that exceed an amount equal to the sum of 50 percent of the Federal share of total non-structural flood risk management costs and 10 percent of the Federal share of total ecosystem restoration costs; depending on the nature of the flood risk management features in the particular sub-plan;

e. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

f. Not less than once each year, inform affected interests of the extent of protection afforded by the flood risk management features;

g. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

h. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the flood risk management features;

i. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

j. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood risk management features afford, reduce the outputs produced by the ecosystem restoration features, hinder operation and maintenance of the project, or interfere with the project's proper function;

k. Shall not use the ecosystem restoration features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any another project;

l. Keep the recreation features, and access roads, parking areas, and other associated public use facilities, are open and available to all on equal terms;

m. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91 646, as amended (42 U.S.C. 4601–4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights of way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

n. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

o. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

p. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

q. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

r. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88 352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600 7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141–3148 and 40 U.S.C. 3701–3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

s. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96 510, as amended (42 U.S.C. 9601–9675), that may exist in, on, or under lands, easements, or rights of way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non Federal sponsor with prior specific written direction, in which case the non Federal sponsor shall perform such investigations in accordance with such written direction;

t. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights of way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

u. Agree, as between the Federal Government and the non-Federal sponsor, that the non Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that would not cause liability to arise under CERCLA; and

v. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986,
Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

SPONSOR SELF CERTIFICATION OF FINANCIAL CAPABILITY

The non-Federal sponsor, the City of Laredo, Texas, is to provide a statement that attests to their capability to meet their financial responsibilities related to this project as agreed and described in this report. This section will contain that information as soon as the City provides it to USACE.

FULLY FUNDED COST ESTIMATE

The fully funded cost estimate is intended to provide an indication of total project costs when inflation is taken into account. Inflation rates are based on rates developed as part of the Corps budgeting process. The estimated first cost is $51.37 million, and the fully funded cost estimate for the TSP is $55.941 million. The escalation values are calculated within the Total Project Cost Summary (TPCS), which is presented in the Cost Appendix.

MONITORING AND ADAPTIVE MANAGEMENT

ER 1105-2-100 allows for project monitoring and adaptive management. Adaptive management for complex, specifically authorized projects may be recommended. The cost of adaptive management is limited to three percent of the total project cost excluding monitoring costs. The Federal Government is responsible for monitoring and adaptive management. The restoration measures will be periodically surveyed to provide feedback on the response of the ecosystem to the management measures taken. By connecting the ecosystem response to the restoration as well as the management measures, potential beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project.

Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (USACE, 2009) also provides guidance on Monitoring Ecosystem Restoration. Per this guidance, a plan for monitoring and evaluating the success of ecosystem restoration as well as a plan for adaptive management, shall be developed and described in the decision document. For projects conducted under the Continuing Authorities Program, monitoring will not exceed five years after the end of the construction phase. A Draft Monitoring and

Adaptive Management Plan is provided in Appendix J.

Periodic monitoring of the restoration measures by the Government will be conducted during project implementation prior to the project being turned over to the non-Federal sponsor for operation and maintenance, and will be cost-shared between the Government and the non-Federal sponsor as part of the total project cost. The total first cost of the ecosystem restoration plan without adaptive management is $25.6 million. The proposed monitoring cost is $214,000. The proposed adaptive management cost is $757,000.

OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION

The major Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) items include the following:

- Regular maintenance of park facilities
- Restriping access areas
- Debris cleanup
- Selective trimming in restoration areas
- Invasive species control

The tasks required under the TSP OMRRR will involve a modest increase in the types of maintenance activities the city is already accustomed to. Recreation maintenance requirements, such as grounds and equipment maintenance and debris cleanup, are things the city already does to maintain the parks it has. In the case of the TSP, the city would have a larger facility to maintain than what is currently present in the Villa Del Sol neighborhood, as well as additional facilities in Reach 1 south of Hwy.
359. The ecosystem restoration maintenance activities of selective trimming and invasive species control are already activities the city does as well, particularly the control of salt cedar. Table 51 provides a breakdown of these costs.

After completion of the project, an Operation and Maintenance Manual for the city would be prepared by the Corps, and periodic inspections would be conducted to ensure that all required maintenance was being performed.

Table 51. Annual OMRR&R Costs for the TSP (Feb. 2018 Prices)

Project Cost Items	Cost
Recreation	
Lighting	$18,500
Regular Maintenance (Debris Cleanup)	$18,500
Grounds Maintenance	$23,500
Equipment Maintenance	$30,000
Parking Lots, Drives, Curbs, Sidewalks, Gutters	$30,000
Total Recreation O&M	**$120,500**
Ecosystem Restoration	
Wetland Measures	$2,000
Riparian Measures	$3,000
Total Ecosystem Restoration	**$5,000**
Total O&M	**$125,500**

COORDINATION

This section documents the activities conducted during this study to coordinate and communicate with the local sponsor, resource agencies, and the public. For more information about specific communications, see Appendix H "Correspondence."

VIEWS OF THE LOCAL SPONSOR

The City of Laredo is the non-Federal sponsor for this study. The City of Laredo supports the TSP and intends to participate in its implementation. A Letter of Intent stating their support and their intention to participate in the project implementation will be included in the final report.

RESOURCE AGENCY COORDINATION

The proposed project has a prolonged history of resource agency coordination. Early coordination was conducted with the Environmental Protection Agency (EPA), USFWS, and TPWD. In addition to their participation in a site visit on 14–15 September 2006, these agencies have participated as key members of the Project Delivery Team and have engaged in general correspondence with the Corps to gather information about the study area.

After project re-initiation began, a coordination letter requesting Federal Resource Agency participation was sent out on March 10, 2023. A subsequent Resource Agency coordination meeting was held on June 16, 2023. Resource agencies in attendance included the Environmental Protection Agency, The U.S. Fish and Wildlife Department, the Texas Commission on Environmental Quality, the Texas Parks and Wildlife Department, and the Natural Resources Conservation Service.

USFWS has made significant recommendations and has worked extensively with the District in the development of the wetland and riparian measures, vegetation management, and the determination of the impacts on endangered species. Two wetland sites were eliminated from further consideration following coordination with USFWS, along with development of buffelgrass removal methods and native species planting from a list provided by USFWS. The District also coordinated with the USFWS for concurrence that the TSP is in full compliance with the Endangered Species Act.

The USFWS and TPWD generally support the TSP due to the fact that it recommends non-structural buyouts and it restores degraded aquatic ecosystems.

PUBLIC INVOLVEMENT

ER 1105-2-100 and ER 200-2-2 require that the public participate in and review planning and NEPA documents. This section documents public involvement activities for the Chacon Creek Feasibility Study.

Public Participation

In 2004 the City of Laredo sought assistance from the Corps to reduce flooding risks and restore degraded ecosystems. In coordination with the Corps, the city staff went before the City Council, which is open to the public for comment, to get the Council's approval for city involvement with the Chacon Creek Feasibility Study.

The city followed the City Council meetings with public meetings for their City Master Plan. In these meetings, the major concern expressed by the residents was that they did not want the remaining natural creeks in the city to be destroyed. This helped lead the city to establish a City Master Plan that includes greenbelts and parks with the existing natural creeks in the city.

The Corps will conduct a public draft IFR/EA review. The city has conducted public meetings as recently as 2007 as part of the development of the Chacon Creek Master Plan and Recreation Master Plan in this area. The meetings revealed that residents in this area desire to be bought out to relieve their stress from flooding. The TSP was presented to the city's Citizen Environmental Advisory Committee in March 2010.

Public Review

A Notice of Availability (NOA) to officially release the draft report for a 30-day public comment period from May 8 – June 8, 2024 was prepared. A copy of the draft report will be posted online on the Fort Worth District Website for public review.

Comments and Responses

As noted, the 30-day public comment period occurred May 8 – June 8, 2024.

DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

This Section provides further details on the discussions, conclusions, and recommendations of the results of this Feasibility Study and the TSP.

DISCUSSIONS

The following discussions relate how implementing the TSP meets or complies with certain policies and guidelines of the Corps.

Policies and Guidelines

On December 3, 2009, The White House Council on Environmental Quality (CEQ) released a proposal for review to the National Academy of Sciences (NAS) that would significantly change the principles and guidelines governing the nation's water resources planning. The proposed changes would require projects to help the economic well-being of the nation for present and future generations, better protect communities from the effects of floods and storms, help communities and individuals make better choices about where to build based on an understanding of the risk, and protect and restore the environment.

This project addresses many of the new considerations outlined in the proposed principles and guidelines by evacuating 60 residences from the floodplain, thereby reducing damages to property and reducing the risk to life, health, and safety. The project would also provide a diverse sustainable ecosystem along Chacon Creek that would restore and maintain the natural character of the floodplain.

Planning Goals and Objectives

The TSP meets the goals and objectives as outlined in Section Three of this report. The plan would not only speak to the objectives aimed to address issues associated with reducing flooding and the risk to life, health, and safety, but it would also address those objectives aimed at restoring the ecosystem and providing for its diversity and sustainability. This plan would help restore and maintain the natural character of the floodplain and maximize public use opportunities through the provision of park facilities. The alternative would also avoid known or suspected HTRW sites and would minimize the use of concrete and other hard materials in the channel. Additionally, this alternative would not only seek to minimize impacts to threatened and endangered species, but would also restore habitat. This plan satisfactorily addresses the goal of contributions to NED through economic benefits, as well as the goal of achieving environmental benefits through contributions to NER.

Environmental Operating Procedures

The Corps has reaffirmed its commitment to the environment by formalizing a set of Environmental Operating Principles (EOP) applicable to all its decision-making and programs. The principles are intended to "foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that employees consider conservation, environmental preservation, and restoration in all Corps activities." Of the seven EOPs, the TSP seeks to address at least three, including environmental sustainability, to seek balance and synergy among human development activities and natural systems, and to assess and mitigate cumulative impacts to the environment.

Campaign Plan

The intent of the Campaign Plan for the U.S. Army Corps of Engineers is that, through its execution, the Corps will become a great organization by delivering superior performance, setting the standard for professionalism, making a positive impact on the nation, and being "built to last" by building a strong "bench" at all levels. The Plan recognizes the necessity of the Corps to transform and evolve to meet the changing needs of the nation. Goals 2 and 3 of the Campaign Plan are the most applicable when discussing how the TSP helps achieve the Campaign's purposes.

Goal 2, "Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders," is accomplished through partnering with the local sponsor and through collaborative efforts with agencies such as the U.S. Fish and Wildlife Service, Federal Aviation Administration, and Texas Parks and Wildlife. Goal 3, "Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation," is directly supported by the TSP's implementation of a diverse and sustainable ecosystem restoration for Chacon Creek, which reduces the risk to life, health, and safety, and provides recreational opportunities through the alternative use of evacuated floodplain land. The TSP will include dynamic independent review, focus on sustainability, effectively communicate risk, and review and inspect completed works.

CONCLUSIONS

The following conclusions were reached based on the results of the investigations conducted for this study.

1. A significant need exists to provide flood risk management measures, ecosystem restoration features, and recreation amenities within the Chacon Creek study area.

2. The TSP offers a multi-objective solution consisting of buyouts, ecosystem restoration features, and recreation facilities compatible with a larger, regional recreation master plan. The total TSP has an estimated first cost of approximately $43.2 million, with a Federal cost share of approximately $26.4 million (61 percent) and a non-Federal cost share of approximately $16.8 million (39 percent).

3. The City of Laredo has agreed to serve as the local sponsor for the construction of the project. Approximately $459,000 of the recreation costs would not be cost shared but would be 100 percent non-Federally funded due to the type of recreation features.

4. According to an Environmental Assessment, no significant environmental impacts would occur as a result of implementation of the TSP. Therefore, a Finding of No Significant impact (FONSI) was prepared as part of the District

Engineer's recommendation, which is included in the next section.

5. Additional evaluation, including Value Engineering, will be conducted during the preconstruction, engineering and design phase. The results of these studies may alter the project materials, design, costs, and cost apportionment or the amount of Federal participation in the project.

RECOMMENDATION

Therefore, I recommend that the flood risk management, ecosystem restoration, and recreation measures identified as the TSP for the Chacon Creek study area be considered for implementation and authorized for construction by the US Army Corps of Engineers as a Federal project.

This recommendation is made with the understanding that prior to project implementation, the City of Laredo shall enter into a binding Project Partnership Agreement (PPA) with the Secretary of the Army to perform the items of local cooperation, as specified under "Non-Federal Responsibilities (Items of Local Cooperation)"

The recommendations contained herein reflect the information available at this time and current USACE policies governing formulation of individual projects. They do not reflect program and budgetary priorities inherent to the formulation of a National Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the City of Laredo understands that the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded the opportunity to comment fu her.

Horacio A. De Leon, Jr.
City Manager

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APPENDIX A

SOCIOECONOMIC ANALYSIS

SOCIOECONOMIC ANALYSIS

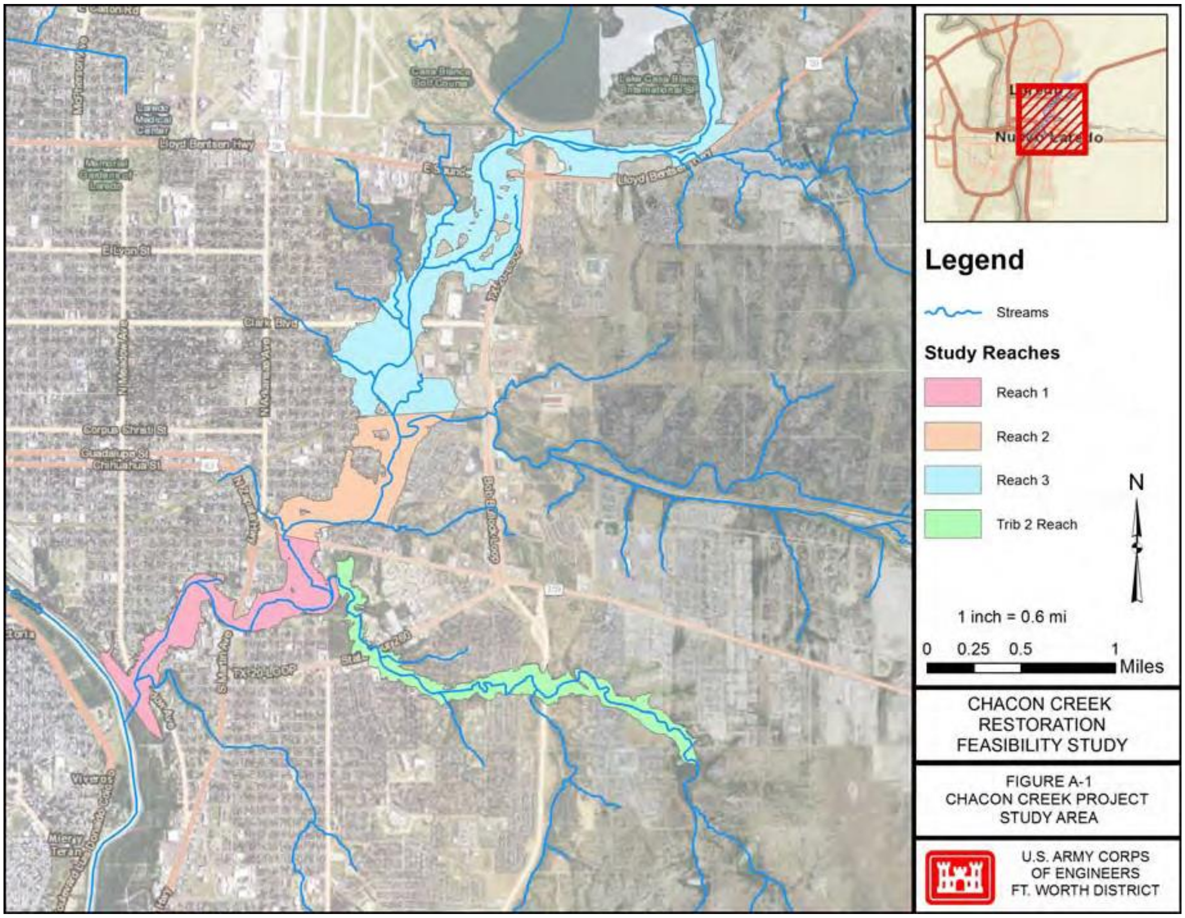
INTRODUCTION

This appendix provides socioeconomic and flood risk management analysis in support of the feasibility study for Chacon Creek in Laredo, Webb County, Texas. In updating this study, only the socioeconomic data and the costs and benefits for the tentatively selected plan have been updated to current values. The alternatives analysis has remained constant from the study completed in 2010.

Study Area Description

The study area is located in Laredo, Webb County, Texas, in the northern border of the Rio Grande River. Located in the eastern half of the city, Chacon Creek originates north of Lake Casa Blanca and flows about five miles to the southwest emptying into the Rio Grande. The stream provides flood conveyance, but it also serves as a local natural resource with recreational, educational, and economic potential. In prior years, Chacon Creek has been adversely impacted by illegal dumping and other detrimental activities including a confined animal feeding operation (CAFO).

The study area encompasses the lands along Chacon Creek within the 500-year floodplain and contains about 1,006 acres along the main stem and Tributary 2. Tinaja and Tex Mex Creeks were not included in the study area because no structures existed in the 500-year floodplain. Tributary 3, while outside the city limits when the floodplain was originally delineated, has not been an area that has historically had flooding issues. The city has on file Conditional Letters of Map Revisions (CLOMR) issued by FEMA for modification of existing regulatory floodways for this area.



(Image source: USACE, 2010)

Figure A-1. Chacon Creek Study Area Reaches

Flooding History

The average annual precipitation for Laredo is 19 inches. Recent floods that hit much of the State of Texas in June of 2007 also impacted the City of Laredo, resulting in significant property damage and the first flooding death in the City's history. The City received 5 to 8 inches of rain in a four-hour period. A total of 18 homes were reported to have received major damage and 50 more received minor damage.

Chacon Creek has historically flooded homes and businesses that lie along the creek. This has been exacerbated by the explosive growth in the upper portions of the watershed. Flood events in 2002 prompted the city to permanently evacuate three houses along Chacon Creek.

The worst floods in Laredo involved the Rio Grande and rains that fell upstream, causing the river to rise. The following is a list of the worst flood events in the city's history in inverse order of magnitude:

1. 1865 – The Rio Grande rose to an estimated 63 feet.

2. June 29, 1954 – The river rose to 61.35 feet, flooding much of downtown for days, as well as many homes and businesses along Zacate and Manadas Creeks.
3. September 3–4, 1932 – The river rose to 52.2 feet. Fifty blocks of Nuevo Laredo were under water.
4. June 20, 1922 – The river rose to 43.9 feet.

Land Use

Table A-1 breaks down the total number of acres within the study area and their associated existing land use. More than 23 percent of the of the classified land uses area is listed as single family residential, and the remaining residential land uses comprise and additional 25 percent. The community business land use consists of 24 percent of land in the study area.

Table A-1. Chacon Creek Existing Land Use

Classification	Acres	Percent of Total
Highway Commercial	38.32	4.6%
Light Manufacturing	115.56	13.8%
Mixed Residential	103.83	12.4%
Single Family Residential	193.65	23.2%
Community Business	200.47	24.0%
Limited Business	6.92	0.8%
Multi-Family Residential	28.82	3.5%
Agricultural	64.38	7.7%
Single Family Reduced Area	78.58	9.4%
Single Family Manufactured Housing	3.03	0.4%
Heavy Manufacturing	1.47	0.2%
Highway Commercial	38.32	4.6%
Total	**835.02**	**100%**

Source: City of Laredo GIS Division, 2017

STUDY AREA DEMOGRAPHICS

The socioeconomic characteristics of the study area are important to understand in the process of alternative formulation and making choices among the alternatives. This section provides data that describes the socioeconomic makeup of the study area and surrounding county.

Race and Ethnicity

Table A-2 breaks down the total population, as well as the racial and ethnic makeup, for Webb County and the study area for the years 1990, 2000 and 2015.

Table A-2. County and Study Area Racial Composition

	Webb County					
	1990		2000		2015	
Population	Number	Percent	Number	Percent	Number	Percent
Total	133,239	100.0	193,117	100.0	263,251	100.0
Male	63,959	48.0	93,039	48.2	128,182	48.7
Female	69,280	52.0	100,078	51.8	135,069	51.3
Hispanic	125,084	93.9	182,296	94.4	250,899	95.3
White	7,551	5.7	9,258	4.8	9,641	3.7
Asian, Hawaiian, Pacific Islander	394	0.3	764	0.4	1,540	0.6
Black	37	0.0	360	0.2	728	0.3
Other	173	0.1	241	0.1	275	0.1
American Indian	0	0.0	198	0.1	168	0.1

Source: U.S. Bureau of the Census for 1990 and 2000 data, and 2016 American Community Survey for 2015 columns.

Table A-3. Study Area Racial Composition

	Study Area	
	2010	
Population	Number	Percent
Total	19,360	100.0
Male	9,491	49.0
Female	9,869	51.0
Hispanic	18,900	97.6
White	330	1.7
Asian, Hawaiian, Pacific Islander	47	0.2
Black	39	0.2
Other	34	0.2
American Indian	10	<0.1

Source: 2010 U.S. Census Data from HAZUS

Webb County's population increased by almost 45 percent between 1990 and 2000, and then an additional 36 percent increase occurred between 2000 and 2015. The overall population increase over the last 25 years equals approximately 97% growth. The study area represents approximately around 21 percent of the total county population in the year 1990 and around 22 percent in 2000. Minority population comprised 94.3 percent of the population for Webb County in 1990 and 95.6 percent in 2000. The data from 2015, shows that the study area has an even higher percentage of minorities than the county as a whole, and this is likely increasing currently. The study area statistics show an even greater level of minority representation in the area. The population is approximately 97.6 percent Hispanic within the study area.

Income

On the next page,

Figure A-2 illustrates the income distribution based on household income for Webb County and the study area in 2010.

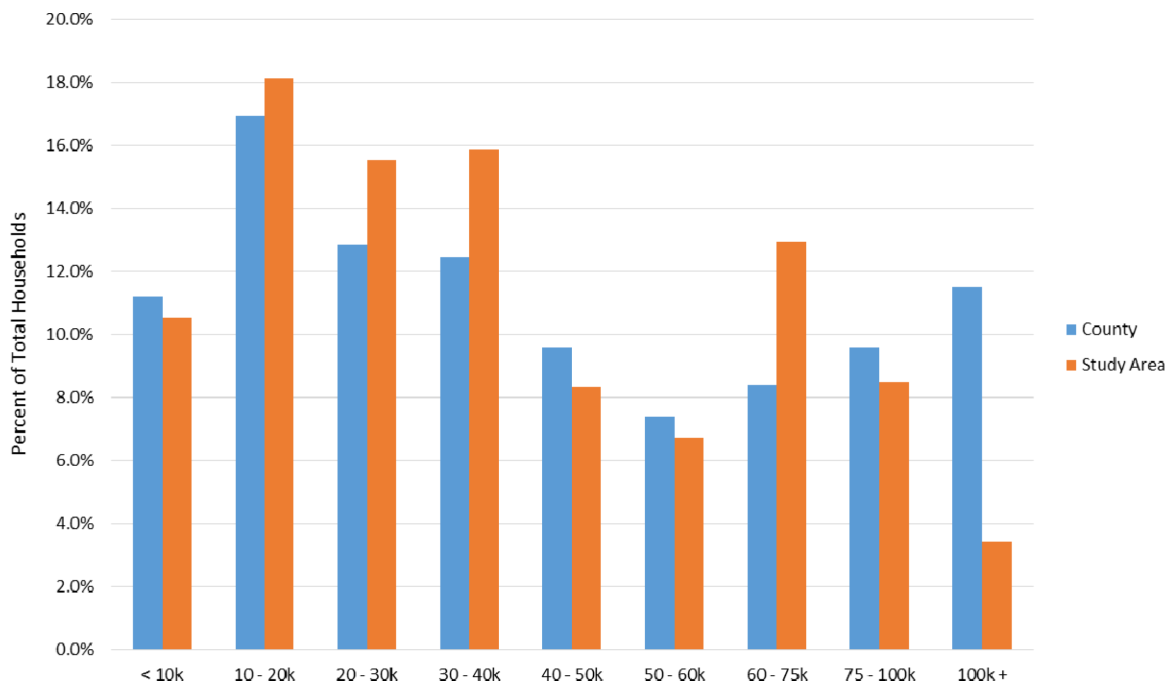


Figure A-2. 2010 Income Distribution

Source: U.S. Bureau of the Census, 2010

As the chart illustrates, the distribution of income of the County is similar to that of the study area. Both have relatively higher percentages of households with lower levels of income (less than $40K). The number of households dips between $40K and 60K, but picks back up for the levels between $60K and $100K. The study area has a relatively low number of households earning over $100K per year compared to the county.

Table A-4 displays the number of households, aggregate household income, and average household income for Webb County and the study area in 2000 and 2015.

Table A-4. Household Income

	2000	2015	
Household Characteristic	Webb County	Webb County	Study Area
Total Households	50,647	74,775	4,693
Aggregate Income	$2,049,513,400	$3,995,955,200	$239,098,964
Average Income	$40,467	$53,440	$50,948

Source: U.S. Bureau of the Census, 2000, and American Community Survey 2015

Figure A-2, average income for the study area is similar to that of Webb County. Regarding poverty, Table A-5 illustrates the poverty status of both Webb County and the study area from 2010 Census data. Table A-5 describes the poverty status of both Webb County and the study area.

Table A-5. Poverty Status

Household Characteristic	Webb County	Study Area
Total for Poverty Determination	67,106	4,693
Total Above Poverty Level	43,898	2,983
Total Below Poverty Level	23,208	1,710
Percent Above Poverty Level	65.4%	63.6%
Percent Below Poverty Level	34.6%	36.4%

Source: U.S. Bureau of the Census, 2010

The percentage of the households in the study area and the County that live below the poverty level is over 34 percent, as compared to over 36 percent for households within the study area.

Education

Figure A-3 depicts educational attainment for Webb County and the study area for 2015.

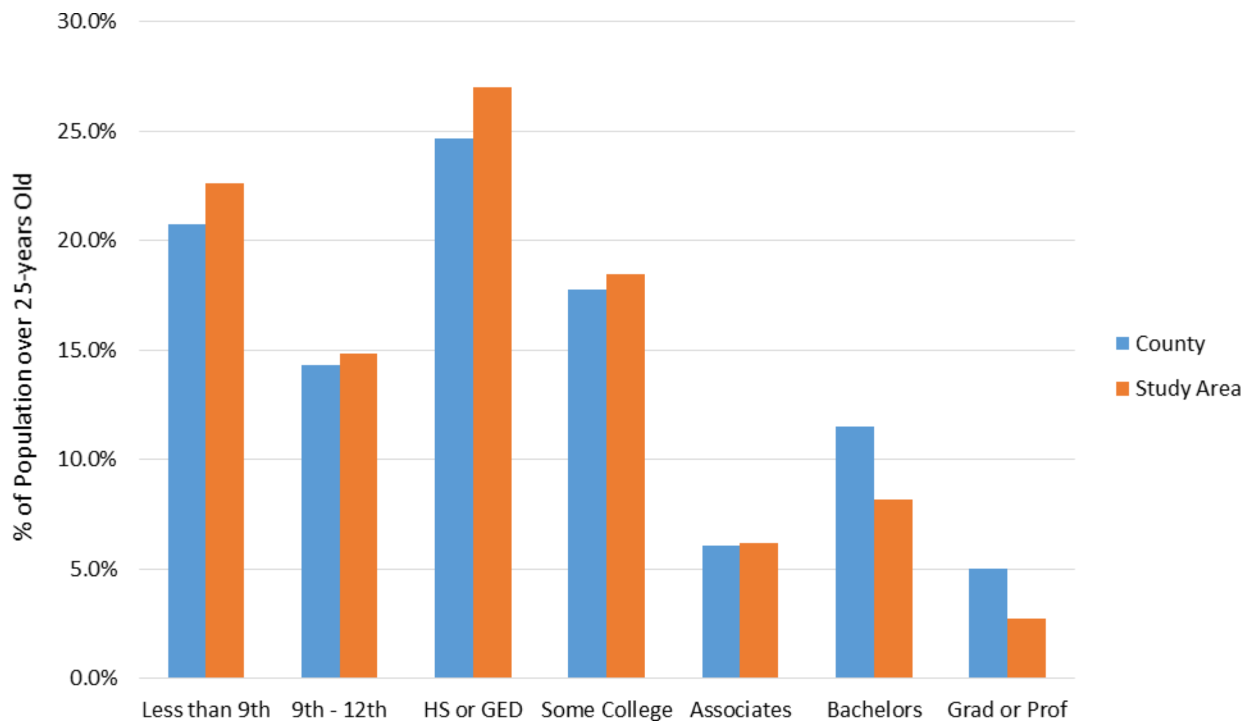


Figure A-3. Educational Attainment, Webb County and Study Area

Like the measures of income, the levels of educational attainment for the study area are very similar to those of Webb County. The study area has a slightly higher level of high school graduates than the County, but the study area shows slightly lower percentage of college degrees.

Employment

Table A-6 displays the unemployment rates for both Webb County and the study area for 2000.

Table A-6. County Unemployment Rates

Labor Force Characteristic	Webb County
Total Male	54,844
Employed	40,968
Unemployed	2,194
Unemployment Rate	4.0%
Total Female	43,407
Employed	24,134
Unemployed	1,649
Unemployment Rate	3.8%
Total Combined	98,251
Employed	65,103
Unemployed	3,843
Unemployment Rate	3.9%

Source: 2015 American Community Survey

The county showed a 3.9% percent unemployment rate for the year 2015. Based on the other socio-demographic data, it is likely that the study area would reflect relatively similar employment data. Based on the other data points, one could anticipate that the unemployment numbers are slightly higher for the study area, as holds with many of the other data discussed.

Housing

Table A-7 describes the average home values for owner occupied housing units, as well as the percentages of home ownership and rentals.

Table A-7. County and Study Area Housing Statistics

Housing Characteristic	Webb County	Study Area
Total Units	87,748	5,497
Occupied Units	80,282	5,132
Vacant Units	7,466	365
Owner Occupied	49,655	3,766
Renter Occupied	30,627	1,366
Owner Occupied (Percent of Total Occupied)	61.9%	73.4%
Renter Occupied (Percent of Total Occupied)	38.1%	26.6%
Vacancy Rate	8.5%	6.6%

Source: 2010 Census Data from HAZUS

This table depicts higher home ownership rates for the study area, 73 percent compared to a home ownership rate of 62 percent for Webb County. Subsequently, this translates into a higher rental rate for the County than the study area.

Population Projections

The following population projections for Webb County come from the Texas Demographic Center and reflect the projections based on its 2014 analysis. Based on these projections, the total population for Webb County is expected to grow by 97 percent between 2010 and 2050. Virtually all the growth in Webb County is in the Hispanic population, which is projected to grow by over 100 percent between 2010 and 2050. Alternately, the Black population is expected to grow just 49 percent for the same period, and the Anglo population is expected to decrease by just over 14 percent. Figures A-4 and A-5 reflect the population growth of Webb County itself and the growth rates of the State compared to Webb County. As the figure shows, Webb County is anticipated to grow at significantly higher rate than the overall state over the next 40 years.

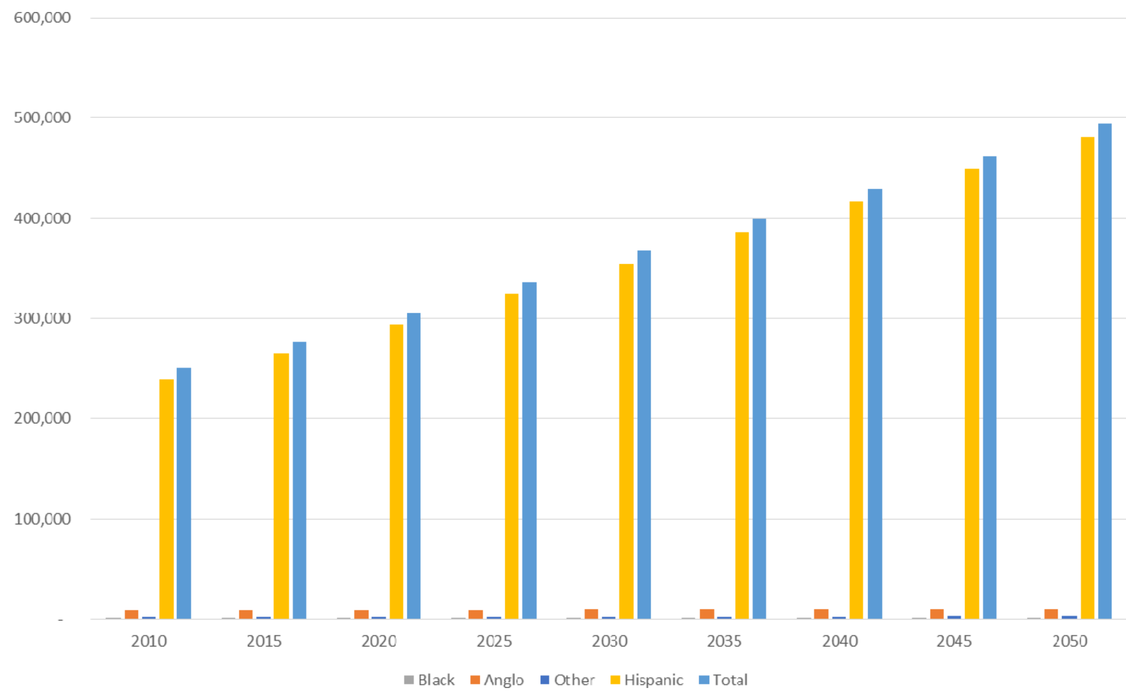


Figure A-4. Webb County Population Growth by Race

Source: Texas State Data Center

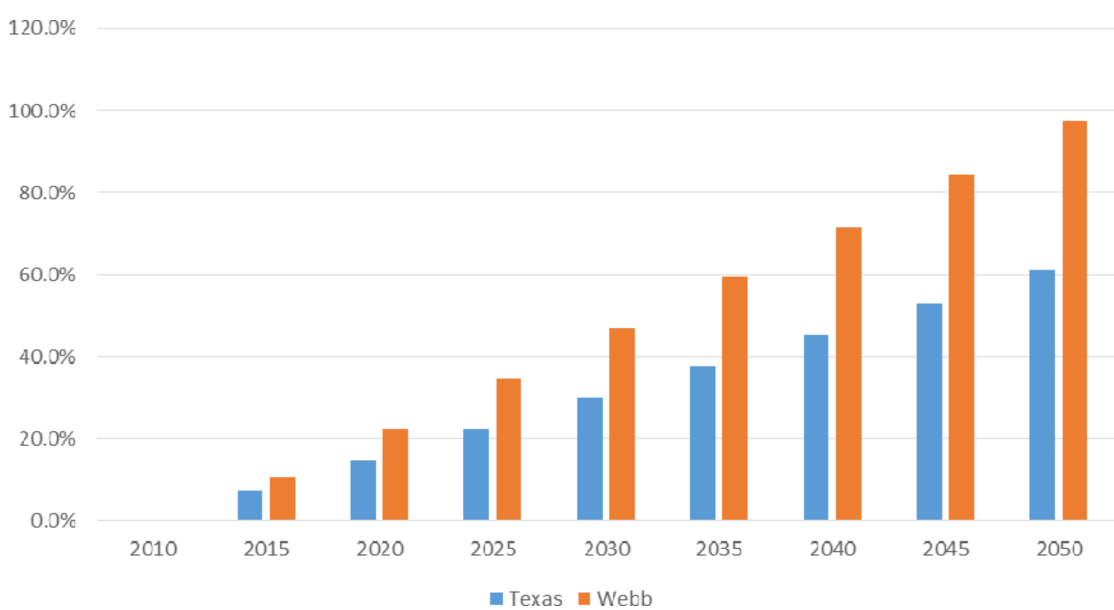


Figure A-5. Population Growth in Texas vs. Webb County

Source: Texas State Data Center

Affected Populations

In accordance with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," data was compiled to help assess the potential impacts to minority and low-income populations within the study area. The data indicate that all fifteen of the 2010 Census tracts that intersect the study area have minority populations well in excess of 50 percent. Most of the tracts have Hispanic populations ranging above 95 percent. Table A-8 shows the racial makeup percentages of each census block that intersects the study area.

Table A-8. Distribution of Population by Race/Ethnicity per Census Block

Census Tract	White	Hispanic	Black	American Indian	Asian	Hawaiian / Pacific Islander
48479000101	2.5%	96.9%	0.0%	0.3%	0.1%	0.1%
48479000105	2.1%	97.9%	0.0%	0.0%	0.0%	0.0%
48479000106	1.3%	98.6%	0.0%	0.1%	0.0%	0.1%
48479000107	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
48479000200	0.0%	99.0%	0.0%	0.0%	0.0%	1.0%
48479001001	2.2%	97.7%	0.0%	0.0%	0.0%	0.2%
48479001003	1.0%	98.8%	0.0%	0.1%	0.0%	0.0%
48479001004	1.2%	98.5%	0.0%	0.0%	0.0%	0.3%
48479001105	2.2%	97.5%	0.0%	0.0%	0.3%	0.0%
48479001714	3.1%	92.0%	1.4%	0.0%	0.4%	3.1%
48479001810	1.6%	97.2%	0.3%	0.0%	0.6%	0.2%
48479001811	3.3%	96.2%	0.0%	0.0%	0.1%	0.3%
48479001812	1.7%	97.4%	0.7%	0.1%	0.1%	0.0%
48479001814	1.6%	97.8%	0.1%	0.0%	0.4%	0.2%
48479001816	1.6%	97.7%	0.3%	0.1%	0.3%	0.0%

Source: U.S. Bureau of the Census, 2010

In assessing the existence of low-income populations for the study area, household incomes were examined for the study area census blocks. Based on a poverty threshold for a family size of four (considering that average number of persons per household for Webb County is 3.75), an income of $24,600 was used for this analysis (value from Federal poverty level 2017). Since Table A-9 presents income ranges and household counts, it is assumed that half the households in the $20k to 30k range fall below the $24,600 value. With this assumption, approximately 1,709 households in the study area are earning below the poverty threshold. This equates to approximately 36% of households in the study area.

Table A-9. Comparison of Median Household Income to Poverty Threshold

Household Income	No. of Households	Percent of Households
Less than $10k	495	10.5%
$10k - $20k	850	18.1%
$20k - $30k	729	15.5%
$30k - $40k	744	15.9%
$40k - $50k	392	8.4%
$50k - $60k	315	6.7%
$60k - $75k	608	13.0%
$75k - $100k	399	8.5%
Over $100k	161	3.4%

Source: 2010 Census Data from HAZUS

County Economic Profile

To compare economic sectors of the County with those of the study area, the data in Table A-10 was obtained from the 2015 County Business Patterns (US Census Bureau), which outlines the number of establishments for the major North American Industry Classification System (NAICS) classifications. The table gives the total number of establishments per NAICS category for Webb County and for the zip codes that intersect the study area.

Table A-10. 2015 County and Study Area Business Establishments by NAICS Sector

Sector	Webb County		Study Area	
	Number	Percent	Number	Percent
Total Establishments	5,245		3,189	
Accommodation and food services	404	7.7%	290	9.1%
Administrative and support and waste management and remediation services	188	3.6%	100	3.1%
Agriculture, forestry, fishing and hunting	4	0.1%	1	0.0%
Arts, entertainment, and recreation	53	1.0%	44	1.4%
Construction	229	4.4%	148	4.6%
Educational services	43	0.8%	33	1.0%
Finance and insurance	302	5.8%	225	7.1%
Health care and social assistance	531	10.1%	428	13.4%
Industries not classified	8	0.2%	5	0.2%
Information	60	1.1%	44	1.4%
Management of companies and enterprises	22	0.4%	15	0.5%
Manufacturing	60	1.1%	49	1.5%
Mining, quarrying, and oil and gas extraction	76	1.4%	40	1.3%
Other services (except public administration)	283	5.4%	193	6.1%
Professional, scientific, and technical services	364	6.9%	254	8.0%
Real estate and rental and leasing	215	4.1%	142	4.5%
Retail trade	788	15.0%	623	19.5%
Transportation and warehousing	1,218	23.2%	320	10.0%
Utilities	14	0.3%	6	0.2%
Wholesale trade	383	7.3%	229	7.2%

Source: County Business Patterns or U.S. Bureau of the Census, 2015

Table A-11 provides Bureau of Labor Statistics data depicting the number of employees for the occupancy group for the City of Laredo.

Table A-11. 2016 Webb County Employment by NAICS Sector

Sector	Webb County	
	Number	Percent
Total Employees	97,630	100.0
Management Occupations	2,990	3.06%
Business and Financial Operations Occupations	3,070	3.14%
Computer and Mathematical Occupations	700	0.72%
Architecture and Engineering Occupations	480	0.49%
Life, Physical, and Social Science Occupations	180	0.18%
Community and Social Service Occupations	970	0.99%
Legal Occupations	310	0.32%
Education, Training, and Library Occupations	7,750	7.94%
Arts, Design, Entertainment, Sports, and Media Occupations	740	0.76%
Healthcare Practitioners and Technical Occupations	3,310	3.39%
Healthcare Support Occupations	2,350	2.41%
Protective Service Occupations	4,570	4.68%
Food Preparation and Serving Related Occupations	10,070	10.31%
Building and Grounds Cleaning and Maintenance Occupations	2,370	2.43%
Personal Care and Service Occupations	7,590	7.77%
Sales and Related Occupations	10,710	10.97%
Office and Administrative Support Occupations	20,990	21.50%
Farming, Fishing, and Forestry Occupations	0	0.00%
Construction and Extraction Occupations	2,370	2.43%
Installation, Maintenance, and Repair Occupations	3,470	3.55%
Production Occupations	1,260	1.29%
Transportation and Material Moving Occupations	11,370	11.65%

Source: U.S. Bureau of Labor Statistics, 2016

In terms of the number of establishments, both Webb County and the study area have more establishments in the health care, retail trade and transportation categories. In terms of actual employment numbers, both the City has more employees working in office and administrative support occupations than any other business category.

WITHOUT-PROJECT FLOOD DAMAGES AND COSTS

2018 Updates

The alternatives evaluation for NED benefits was originally completed in 2010. The analysis from the 2010 work has not changed, but all dollar values have been escalated from February 2009 price levels to February 2018 prices.

Overview

Key to alternative formulation is an understanding of the monetary damages caused by flooding and the number and makeup of damaged structures. This section provides the analysis of the number of structures in the floodplain and presents damages to these structures by frequency event under existing conditions, expected annual damages by damage reach, and a preliminary comparison of with- and without-project equivalent annual damages for initial alternatives.

Methodology

The theoretical computation of flood damages is relatively simple. It is based on the depth of flooding for various flood events (exceedance probabilities) and a relationship between the depth of flooding and the estimated damages based on a percentage of the structure and contents value or value of privately owned vehicles (POV). The nomenclature used in this appendix to describe the relative risk reflects the actual probability, rather than the average recurrence interval, of flood events. For example, the commonly used term "100-year frequency flood," meaning that flood which stands a one-percent chance of being equaled or exceeded in any given one-year period, will hereafter be known as the "1-percent annual chance exceedance (1% ACE) flood."

Using a software model, the damages to the various structures, accumulated by frequency of events, produce a frequency-damage function. An integration process uses this frequency-damage data to calculate estimates of expected annual damages. This involves aggregating the multiplication of the mean damage between each pair of flood events by the difference in exceedance probabilities. This is then repeated for the range of flood events in each damage category.

Hydrologic Engineering Center - Flood Damage Assessment Program

The Hydrologic Engineering Center - Flood Damage Assessment (HEC-FDA) software program version 1.2.4 was used to compute flood damages under without- and with-project conditions. This version of the model is currently the certified corporate model for estimating flood damages and benefits. The program integrates hydrologic, hydraulic, and floodplain characteristics through application of a Monte Carlo simulation method, and computes single event damages and expected annual damages (EAD), while accounting for uncertainty in the values of structures and contents. To estimate flood damages, the program uses damage susceptibility factors that include the number and type of structures, structure and contents values, elevation where the structure begins to sustain measurable damages, and flood depth-to-percent damage relationship.

Inventory of Floodplain Structures

To determine the number and type of structures, values of structures and contents, and ground and finished floor elevations (elevation where water enters the structure), an inventory was conducted of properties that lie within the limits of the 0.2% ACE (500-year) floodplain. Structures were initially identified and digitized in GIS using digital orthoquads as base maps. A field survey was then conducted to determine condition and quality of the structures and to identify the first floor elevation. In addition, the survey identified the applicable relationship of flood depth to percent damage for each structure type. Last, the number of POVs susceptible to flood was estimated. The rest of this section describes each inventory item in detail.

- **Depreciated Structure Value/Replacement Cost**. Structure values were obtained from the Webb County Appraisal District and used as a base value. In compliance with ER-1105-2-101, to accurately reflect replacement cost less depreciation to the existing structures, values were calculated using Marshall and Swift Commercial and Residential Estimator based on information collected during a field survey, with the sample representing those structures in which all necessary data to obtain a value was obtainable. The sample for commercial structures consisted of nine buildings, which represented 11 percent of the commercial structures in the study area. This corresponds to a 95 percent confidence level with an approximate 11 percent margin of error.

  Residential structures including multi-family were also adjusted based on a sample of 47 one- and two-story structures, representing just over 10 percent of those structures and corresponding to a 95 percent confidence level and approximately 13 percent margin of error. Replacement cost is the cost of physically replacing (reconstructing) the structure. Depreciation accounts for deterioration that occurred prior to flooding and variations in remaining useful life of the structure. Structure values for single- and multi-family residential were adjusted upward by 33.5 percent; commercial properties were adjusted upward by 10.9 percent. This adjustment was also applied to mobile residences.

  Values for public structures were by square footage based on the applicable estimates produced by Marshall and Swift. Uncertainty distributions associated with estimating the depth-damage functions, structure values, content ratios, and first flood stage are used to develop the total aggregated stage-damage uncertainty function by damage categories for each damage reach. An uncertainty factor of 10 percent was used for all residential structures and 15 percent for commercial and public structures.

- **Content Value**. Contents values for residential structures were not specifically collected. Residential contents values are embedded in the depth to percent damage relationship (see “Depth to Percent Damage Relationships” to follow). The applicable appraisal district records provided contents value data on commercial structures. Contents value data for public structures was obtained from the entity involved.

- **Ground and First Floor Elevations**. Topographic maps compiled from aerial photography flown during 2002 served as base maps to identify flood prone properties and estimate ground elevations. First floor elevations were visually inspected for each structure. For each Monte Carlo simulation, the *first floor stage with uncertainty* is computed from the first floor flood stage, the uncertainty distribution, and uncertainty parameters. The uncertainty parameters use the same units as for the first floor stage. The uncertainty in the first floor stage is modeled using the normal distribution with a standard deviation of 0.5 foot.

- **Depth to Percent Damage Relationships**. Flood depth-to-percent damage relationships (represented by line curves) relate the depth of flooding relative to the structure first floor to the dollar amount of flood damages as a percent of the estimated structure value. For residential structure types, the relationship curves used were compiled by the USACE Institute of Water Resources (IWR), based on data collected from flooding events in various parts of the United States between 1996 and 2001. These curves assume that contents for all residential structures are equal to the value of the structure (although contents damages are maximized at 100% of their value).

  Damage curves for commercial and public structures also reflect the results of analyses of historical data collected from major flood events across the United States, and were supplemented based on the findings of subsequent economic field surveys of floodplain properties in the Fort Worth District, considering such factors as the design of the structure and nature of the structure contents. The uncertainty associated with residential structures and contents is modeled using a normal distribution with a standard deviation of 10 percent. Commercial and public structures are similarly modeled with a standard deviation of 15 percent.

- **Privately Owned Vehicles**. Damages for privately owned vehicles (POV) were estimated based on the average number of vehicles per residence characteristic of the study area and the probability of their being present at the time of a flood. An analysis was made of registered motor vehicles per occupied housing unit for counties within Metropolitan Statistical Areas (MSA) in Texas, using data from the U.S. Census and the Texas State Department of Highways and Public Transportation. The number of registered vehicles per occupied housing unit in the MSA clusters around a mean value of 2.48. Given that not all registered motor vehicles are associated with private residences and some housing units are unoccupied, an average of 2.0 vehicles per residence is assumed for this analysis. It is anticipated that 1.5 of these would be present during non-work hours (128 hours per week) and 0.5 present during work hours (40 hours per week). Therefore, the expected number of vehicles present at any given time that a flood might occur is derived as follows:

  $$((128/168) * 1.5) + ((40/168) * 0.5)$$

  or 1.26 vehicles per residence

  Values for vehicles associated with single-family homes as well as multi-family and mobile residences were based on the national average price of new and used vehicles as reported by the U.S. Bureau of Transportation Statistics (BTS). Prices for new vehicles are calculated by subtracting CNW Marketing Research vehicle leasing data from Bureau of Economic Analysis data, which combines sales and leases. Used car sales data is derived from sales from franchised dealers, independent dealers, and casual sales. The average new and used sales price also includes leased vehicles. The most recent price reported by BTS is $12,774. Under the assumption that a family's purchase of a vehicle is a function of income, this average price can be adjusted down to the Census block level based on Census Bureau data for median family income. From the 2000 U.S. Census, the median household income is $41,994 nationally. Median household income for the Census blocks that intersect the study area ranges from $17,566 to $57,392. This translates into individual values for vehicles within the study area of $5,343 to $17,458.

Hydrology and Hydraulic Characteristics

Flood Profiles and Probability of Flood Events

A range of without-project water surface profiles was developed. Profiles include the 50, 20, 10, 4, 2, 1, 0.4, and 0.2% ACE flood events (or the 2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year floods, respectively). The profiles were used to delineate the floodplain (and damage) limits and to determine the relationship of damageable properties to both elevation and frequency of flood occurrence. As mentioned earlier, the computation of flood damages is based on the depth of flooding for various flood events and a relationship between the depth of flooding and the estimated damages based on a percentage of the structure and contents value or vehicle value.

Flood Profile Stationing

This study adopts stations along the stream, denoted as feet above the mouth of the stream. Stationing is attached to structures by assigning the structure to the closest cross-section.

Damage Reaches

Damage reach definitions are summarized in Table A-12. Structures within the study area are assigned to one of four damage reaches—three on the main stem of Chacon and one consisting of structures along Trib 2.

Table A-12. Economic Damage Reaches

Reach	Upstream Limit	Downstream Limit
Chacon R1	State Highway 359	Mouth
Chacon R2	Texas Mexican Railway	State Highway 359
Chacon R3	Lake Casa Blanca Spillway	Texas Mexican Railway
Trib 2	Concord Hills	Confluence

Approximately 157 structures were initially assigned to Trib 3. However, the water surface profiles for Trib 3 were observed to be lower than those of the main stem of Chacon, making these structures more susceptible to flooding originating from Chacon than from Trib 3 itself. Consequently, these structures were assigned to Chacon Creek. Additionally, 18 mobile residences were initially assigned to

Tributary 1, but it was determined that the first-floor elevation of these structures was well above the water surface profiles of either Trib 1 or Chacon Creek. These structures were also assigned to the main stem of Chacon. On the next page, Figures A-6 and A-7 depict the first-floor elevations of the structures assigned to Chacon and Trib 2 relative to the stages of each of the eight modeled events.

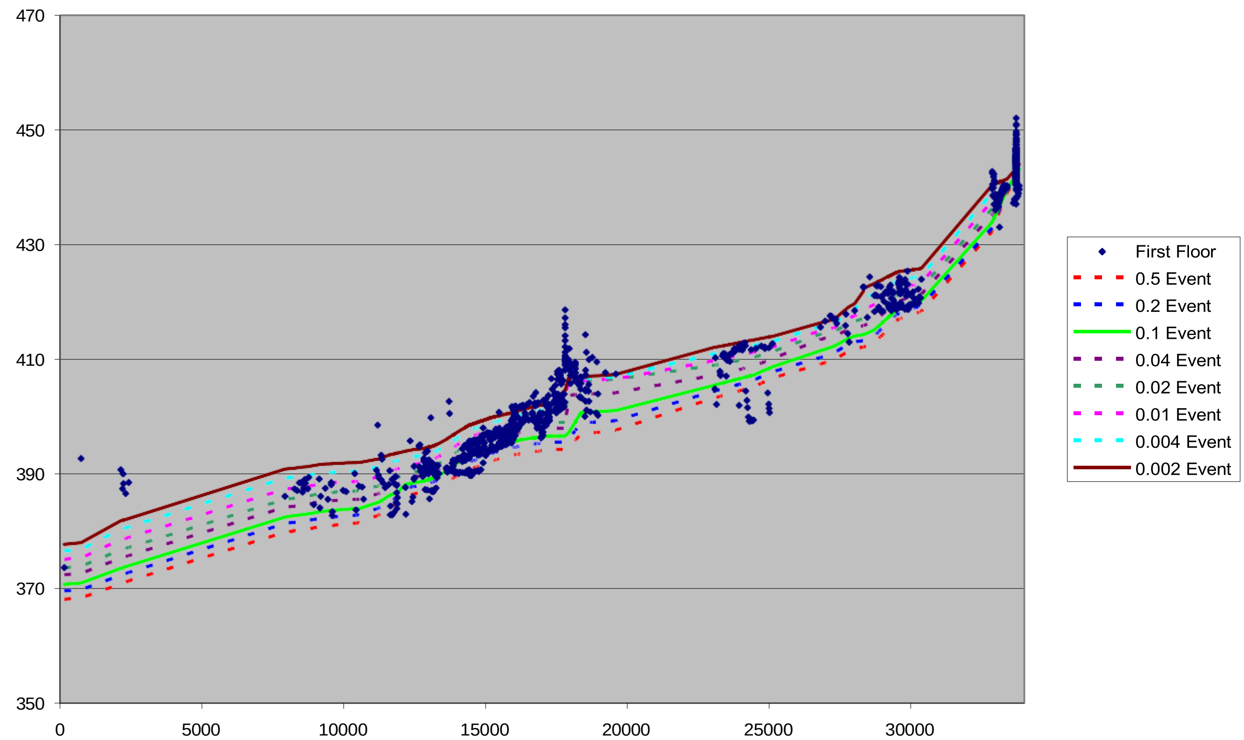


Figure A-6. Chacon Creek Stage vs. Structure Elevation

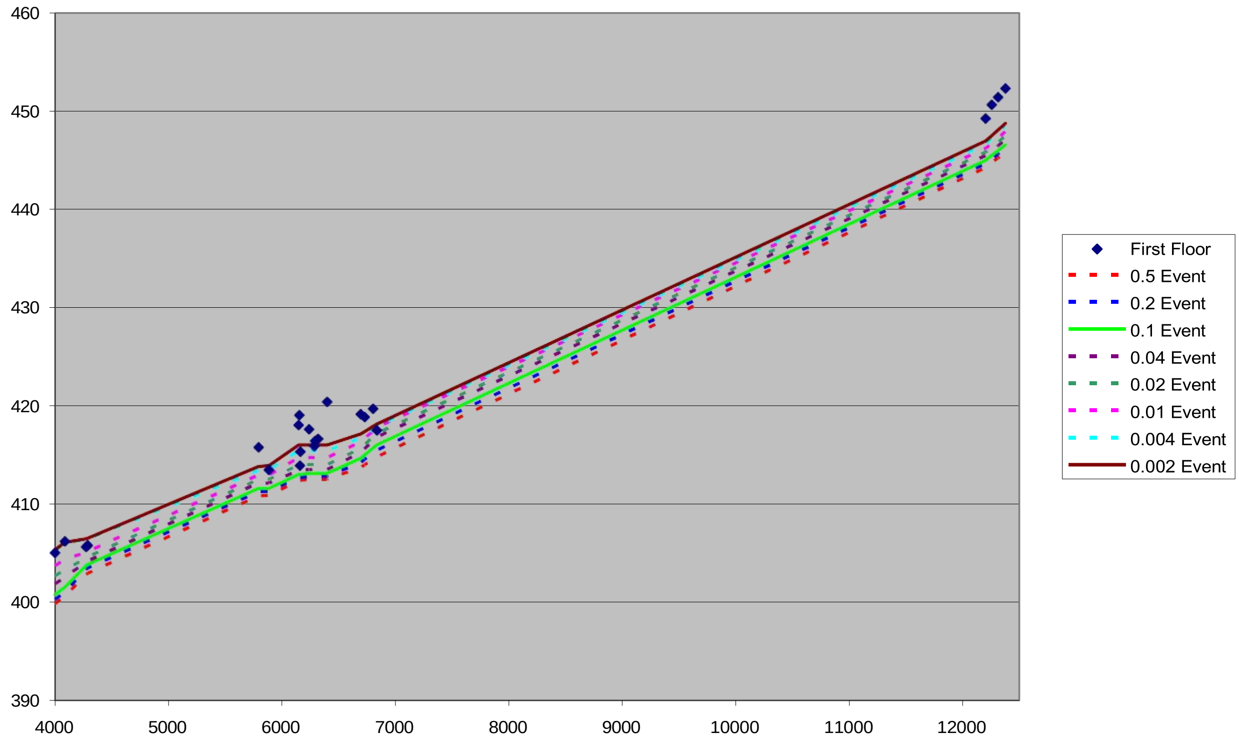


Figure A-7. Trib 2 Stage vs. Structure Elevation

Value of Floodplain Inventory

Within the study area, as estimated in 2010, 449 structures are in the 0.2% ACE with a combined escalated total value of $64,178,100 in 2018 prices. Structures are categorized as either residential (single- or multi-family), commercial (such as retail, industrial), or public (government, schools, hospitals, churches). Residential structures make up 83.1 percent of the structures and 83.8 percent of the structure and contents value. Foundations for the residential inventory are both slab and pier and beam but with no basements. Commercial structures make up 16 percent of the structures and 13.5 percent of the structure and contents value. Public structures make up less than one percent of the structures and 2.7 percent of the structure and contents value.

In Reach 1, between the confluence with the Rio Grande and State Highway 359, are 52 structures: 36 residential, 15 commercial, and one public. The total value of structures and contents within Reach 1 is approximately $6,269,500. In Reach 2, between State Highway 359 and the Texas Mexican Railway, there are 308 structures: 303 residential, four commercial, and one public. The total value included in the analysis of Reach 2 is approximately $45,603,500. Reach 3, between Texas Mexican Railway to Lake Casa Blanca, has 81 structures: 29 residential, 50 commercial, and two public. The total value of Reach 3 is estimated to be $10,413,800. In Tributary 2 there are eight structures: five residential and three commercial with a total value in the floodplain of $1,891,200.

- Reach 1 comprises 11.6 percent of the structures and 9.8 percent of the structure and contents value.

- Reach 2 comprises nearly 68.6 percent of the total structures in the study area and 71.1 percent of the value.
- Reach 3 comprises about 18 percent of the structures and 16.2 percent of the value.
- An estimated 400 POVs are in the study area with an estimated value of about $3.029 million, or about 5.2 percent of the total floodplain investment value.

Table A-13 is a summary of the number and value of structures and POVs by floodplain.

Single Event Damages

All three reaches along Chacon Creek experience damages at the 50% ACE, with the study area experiencing an estimated $14,837,370 in damages at the 0.2% ACE. Reach 1 of Chacon (Rio Grande confluence to State Highway 359) contributes 10.8 percent to the damages; Reach 2 of Chacon (State Highway 359 to Texas Mexican Railway) contributes 76.3 percent; Reach 3 of Chacon (Texas Mexican Railway to Lake Casa Blanca) contributes 12 percent; and the Tributary 2 reach accounts for 0.9 percent of the damages.

Table A-14 provides single event structure damages and single event damages to privately owned vehicles. After the table, Figure A-8 is a graph of damages by ACE.

Table A-13. Number and Value of Floodplain Properties and POVs (February 2018 Price Level)

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Rio Grande Confluence to State Highway 359 (Reach 1)																
Commercial	3	169.3	5	448.6	6	514.1	8	595.7	11	785.8	13	1,085.0	15	1,957.9	15	1,957.9
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	115.3	1	115.3	1	115.3
Single-Family	1	103.5	2	353.2	5	833.1	8	1,219.3	12	1,504.1	25	3,059.0	33	3,933.6	34	3,973.4
Mobile Home	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	133.7	2	222.9	2	222.9
Total	4	272.8	7	801.8	11	1,347.1	16	1,815.0	23	2,289.9	40	4,393.0	51	6,229.7	52	6,269.5
POV	1	6.39	2	19.77	5	47.04	8	69.85	13	100.29	27	201.30	36	264.27	37	267.62
State Highway 359 to Texas Mexican Railway (Reach 2)																
Commercial	0	0.0	0	0.0	0	0.0	1	225.6	2	332.8	3	732.7	3	732.7	4	983.4
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	97.3
Single-Family	15	2,133.3	24	3,682.4	34	5,228.7	102	16,045.1	150	24,182.2	222	34,969.1	256	39,191.6	266	40,615.2
Multi-Family	0	0.0	0	0.0	0	0.0	1	87.9	2	484.9	3	689.2	3	689.2	3	689.2
Mobile Home	4	353.8	5	459.7	6	569.8	7	683.2	11	1124.7	20	1976.6	27	2615.1	34	3218.4
Total	19	2,487.0	29	4,142.2	40	5,798.5	111	17,041.9	165	26,124.6	248	38,367.5	289	43,228.6	308	45,603.5
POV	20	166.28	30	266.99	40	355.36	120	1,061.11	174	1,590.20	258	2,298.22	305	2,636.81	327	2,804.14
Texas Mexican Railway to Lake Casa Blanca (Reach 3)																
Commercial	16	314.7	16	314.7	20	635.4	27	1,466.0	28	1,469.4	29	1,483.5	45	3,997.4	50	5,517.1
Public	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1,514.3	2	1,514.3
Single-Family	0	0.0	0	0.0	3	353.0	9	884.8	16	1,543.9	17	1,597.3	18	1,701.0	22	2,087.9
Multi-Family	0	0.0	0	0.0	2	538.5	3	1,004.2	3	1,004.2	3	1,004.2	3	1,004.2	3	1,004.2
Mobile Home	0	0.0	0	0.0	0	0.0	1	94.6	3	243.6	4	290.3	4	290.3	4	290.3
Total	16	314.7	16	314.7	25	1,526.9	40	3,449.6	50	4,261.1	53	4,375.4	72	8,507.3	81	10,413.8
POV	0	0.00	0	0.00	6	58.08	14	125.35	26	186.52	26	186.52	27	192.92	31	217.21

Reach / Property Type	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Chacon Creek Tributary 2																
Commercial	0	0	0	0	0	0	0	0	0	-	0	-	3	198.7	3	198.7
Single-Family	0	0	0	0	0	0	0	0	1	236.6	2	776.1	3	1,069.6	5	1,692.6
Total	0	0	0	0	0	0	0	0	1	236.6	2	776.1	6	1,268.3	8	1,891.2
POV	0	0	0	0	0	0	0	0	1	12.8	2	40.0	3	55.5	5	88.1
Total Watershed																
Structures	39	3,074.5	52	5,258.6	76	8,672.6	167	22,306.4	239	32,912.2	343	47,912.0	418	59,233.8	449	64,178.1
POV	21	172.7	32	286.8	51	460.5	142	1,256.3	214	1,889.8	313	2,726.0	371	3,149.5	400	3,377.1

Table A-14. Single Event Flood Damages, Structures and Privately Owned Vehicles (April 2009 Prices - $000)

Reach /	50% ACE		20% ACE		10% ACE		4% ACE		2% ACE		1% ACE		0.4% ACE		0.2% ACE	
Property Type	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Rio Grande Confluence to State Highway 359 (Reach 1)																
Commercial	3	14.0	5	33.0	6	54.1	8	84.3	11	117.7	13	186.3	15	333.1	15	523.1
Public	0	-	0	-	0	-	0	-	0	-	1	16.9	1	30.0	1	35.5
Single-Family	1	12.2	2	41.0	5	81.5	8	174.2	12	296.4	25	541.4	33	933.3	34	1,243.1
Mobile Home	0	-	0	-	0	-	0	-	0	-	1	17.2	2	40.4	2	67.7
Total	4	26.2	7	74.0	11	135.6	16	258.4	23	414.1	40	761.8	51	1,336.8	52	1,869.4
POV	1	3.9	2	11.5	5	25.4	8	48.6	13	78.0	27	137.5	36	222.3	37	258.8
State Highway 359 to Texas Mexican Railway (Reach 2)																
Commercial	0	-	0	-	0	-	1	5.8	2	25.3	3	132.9	3	234.1	4	308.0
Public	0	-	0	-	0	-	0	-	0	-	0	-	0	-	1	4.1
Single-Family	15	238.2	24	572.6	34	1,000.8	102	2,329.1	150	3,887.7	222	6,455.8	256	9,354.3	266	11,617.5
Multi-Family	0	-	0	-	0	-	1	40.2	2	66.5	3	115.2	3	153.6	3	205.9
Mobile Home	4	36.2	5	67.6	6	92.8	7	160.8	11	271.4	20	495.1	27	781.8	34	1,068.9
Total	19	274.4	29	640.2	40	1,093.6	111	2,535.9	165	4,250.9	248	7,199.0	289	10,523.7	308	13,204.4
POV	20	94.5	30	192.2	40	268.1	120	618.4	174	1,008.4	258	1,641.0	305	2,177.0	327	2,501.7
Texas Mexican Railway to Lake Casa Blanca (Reach 3)																
Commercial	16	72.6	16	92.9	20	120.3	27	193.3	28	274.2	29	330.5	45	621.9	50	1,116.0
Public	0	-	0	-	0	-	0	-	0	-	0	-	2	13.7	2	125.7
Single-Family	0	-	0	-	3	16.8	9	124.9	16	303.8	17	329.1	18	383.5	22	436.6
Multi-Family	0	-	0	-	2	50.3	3	169.0	3	263.1	3	267.6	3	281.7	3	293.3
Mobile Home	0	-	0	-	0	-	1	26.3	3	71.4	4	76.0	4	90.1	4	102.5
Total	16	72.6	16	92.9	25	187.4	40	513.5	50	912.5	53	1,003.1	72	1,390.9	81	2,074.2
POV	0	-	0	-	6	20.3	14	82.9	26	150.4	26	157.3	27	168.6	31	182.7
Chacon Creek Tributary 2																
Commercial	0	-	0	-	0	-	0	-	0	-	0	-	3	4.5	3	5.8
Single-Family	0	-	0	-	0	-	0	-	1	16.8	2	54.7	3	87.1	5	146.6
Total	0	-	0	-	0	-	0	-	1	16.8	2	54.7	6	91.6	8	152.3
POV	0	-	0	-	0	-	0	-	1	2.8	2	13.6	3	23.4	5	36.8
Total Watershed																
Structures	39	373.1	52	807.1	76	1,416.6	167	3,307.8	239	5,594.4	343	9,018.7	418	13,343.1	449	17,300.4
POV	21	98.4	32	203.7	51	313.8	142	749.9	214	1,239.5	313	1,949.5	371	2,591.4	400	2,980.0

Expected Annual Damages

Expected annual damages for the study area total $1,026,709. Reach 1 of Chacon contributes 8.3 percent; Reach 2 of Chacon contributes 77.7 percent; and Reach 3 of Chacon contributes 13.5 percent to the total expected annual damages. Tributary 2 contributes only 0.4 percent toward the EAD. Table A-15 summarizes the expected annual flood damages. Figure A-8 is a graph of EAD by reach.

Table A-15. Expected Annual Damages (April 2009 Prices - $000)

	Property Type				
Reach	**Residential**	**Commercial**	**Public**	**POV**	**Total**
Rio Grande Confluence to State Highway 359 (Reach 1)	$44,240	$29,700	$440	$11,790	$86,170
State Highway 359 to Texas Mexican Railway (Reach 2)	$634,060	$4,710	$30	$166,700	$805,500
Texas Mexican Railway to Lake Casa Blanca (Reach 3)	$40,480	$87,350	$980	$9,920	$138,730
Tributary 2	$3,800	$160	$0	$610	$4,570
Grand Total	$722,580	$121,920	$1,450	$189,020	$1,034,970

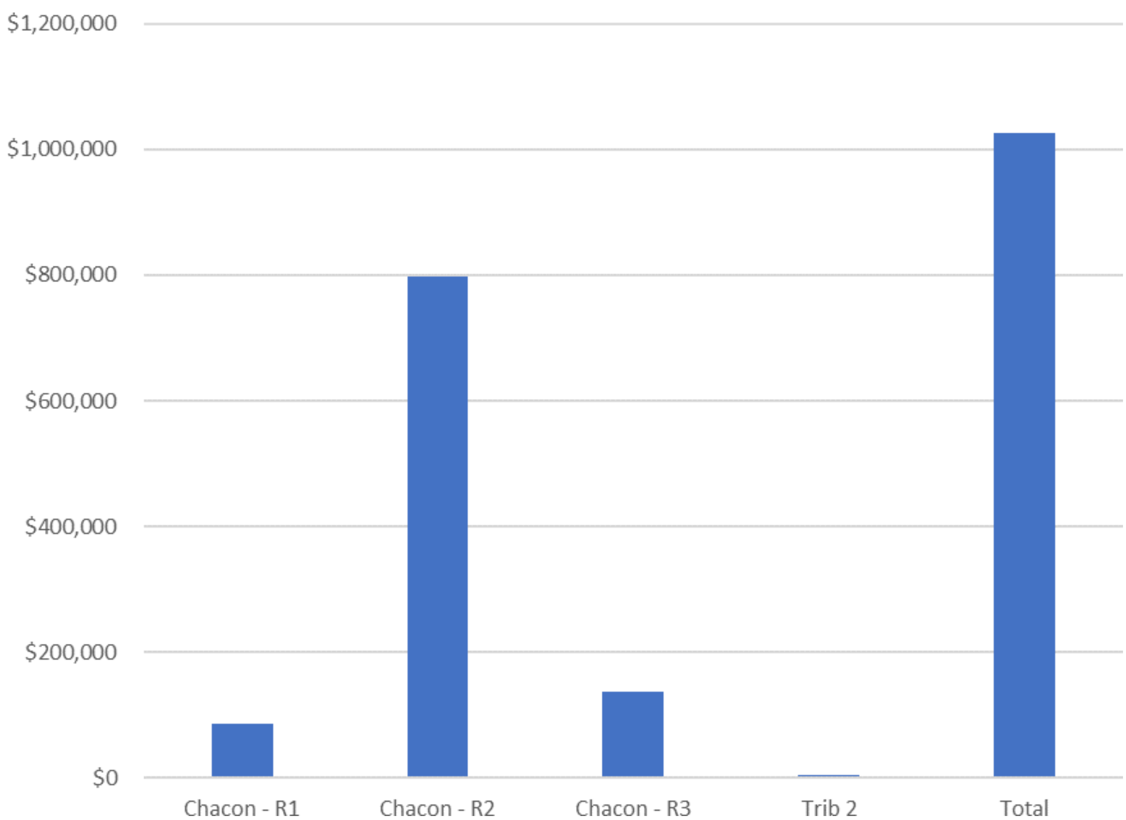


Figure A-8. Expected Annual Damages by Reach

FORMULATION OF ALTERNATIVES

This section describes the methods and procedures undertaken in the formulation of alternatives that seek to achieve the highest net benefits. Alternatives are analyzed and described in terms of their expected performance, not in terms of levels of protection.

- Structural alternatives can include dams with reservoirs, dry dams, channelization measures, levees, walls, diversion channels, pumps, ice-control structures, and bridge modifications and are designed to reduce the frequency of damaging levels of flood inundation.
- Non-structural alternatives reduce flood damages without significantly altering the nature or extent of flooding, which is accomplished by changing the use made of the floodplains or by accommodating existing uses to the flood hazard. These measures can include flood proofing, raising of structures, and permanent evacuation.

Revisions to Existing Conditions

During the beginning of the plan formulation process, existing conditions were reviewed by the Fort Worth District and the city of Laredo to determine if the existing conditions accurately reflected the city's history of flooding. The expected annual damages of Reach 3 of the main stem of Chacon Creek were too high due to the assignment of 157 structures along Tributary 3 to the main stem of Chacon. These structures were initially assigned to the main stem under the assumption that they were being flooded due to the backwater effect from the main stem. However, this assumption was not reflected in the area's flooding history. The structures were subsequently assigned to Tributary 3, which is out of the purview of the study area. Additionally, some structures were incorrectly categorized as residential structures when they were in fact commercial structures. This also contributed to higher expected annual damages because the depth-damage relationships for residential structures begin at –2 feet and zero feet for commercial. The associated POVs were also eliminated from these previously classified residential structures.

Following the Feasibility Scoping Meeting in September 2007, the city provided topography to the District with 1-foot resolution, compared to the 2-foot resolution used in the initial assessment of existing conditions. A small pocket of structures in Reach 2 of Chacon Creek in the Villa Del Sol neighborhood were evaluated to be in the 10% ACE (10-Year) surrounded by structures in the 4% ACE (25-Year). Closer examination using the 1-foot contours revealed that these structures were assigned to elevations that needed to be adjusted by roughly 1 to 1.5 feet.

Benefits Methodology for Plan Formulation

NED Plan

Principles and Guidelines state that the Federal objective of water and related land resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment, in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements. Benefits from reducing flood hazards accrue primarily through the reduction in actual or potential damages to affected land uses, but can also apply to the provision of recreational opportunities. Alternatives, both structural and non-structural, are analyzed and described in terms of their expected performance, not in specific terms of levels of protection. The selected plan, or NED plan, should seek to provide a maximum of net benefits. Net benefits are calculated by annualizing the project costs as well as project benefits and subtracting these annualized project costs from the annualized project benefits. The future without-project condition provides the basis from which to formulate alternative plans and assess impacts.

PRELIMINARY INVESTIGATION OF FLOOD RISK MANAGEMENT ALTERNATIVES

Flood risk management measures generally fall into two types, structural and non-structural. This section describes the investigation of preliminary alternatives for flood risk management with the intent to determine which alternatives warrant further analysis. Structural modifications are measures such as channel modifications, levees, and floodwalls. Non-structural measures consist of floodplain evacuation, flood proofing, and flood warning systems. These measures are described in detail in the following sections. Measures are generally formulated to solve the flooding in a particular reach for a particular frequency event. However, regional measures such as detention can be considered that apply benefits to the entire system. The following sections will discuss regional measures considered and reach-by-reach measures where applicable.

Structural Measures

Benefits attributed to a structural plan are expressed on an annualized basis and are calculated by taking the difference between the expected damages under with-project and without-project conditions. The computer program known as HEC-FDA (Flood Damage Assessment), developed by the Hydrologic Engineering Center, Davis, California, was used as the primary assessment tool. Inputs to the program include water surface profiles for the spectrum of frequency storms, ranging from the 50% to 0.2% ACE storm events, as well as a structure database that indicates the elevation, type, and value of each structure. Also, depth versus percent damage relationships are a required input for each type of structure listed in the database.

Channel Modifications

The potential flood risk benefit of channel modifications generally results in lowering the water surfaces and evacuating fewer structures other than those necessary to excavate the channel. Potential negatives include increased water velocities, which can lead to downstream higher inundation as well as modification of the creek, thereby requiring mitigation as specified under Section 404 of the Clean Water Act.

Detention

As noted in Section One of the main report, the city has already constructed three detention basins within the Chacon Creek watershed. Any additional detention would therefore be relegated to secondary sites that would not provide any adequate additional protection relative to their cost. Therefore, detention will not be analyzed as a viable alternative.

Levees/Floodwalls

Both levees and floodwalls were initially considered as potentially viable alternatives, but were quickly ruled out as infeasible due to the relatively low existing expected annual damages in two of the reaches, limited amount of space to accommodate the footprint of a levee, and anticipated expense of both a levee and a floodwall. Additionally, both could potentially conflict with design standards the city established by ordinance, to specify the dimensions for stream buffers along Chacon Creek. Levees and floodwalls can also require significant and periodic maintenance and do not eliminate the need to evacuate during flooding for events that are larger than the design event.

Non-Structural Measures

Section 219 (a) of WRDA 99 specifies that benefits for nonstructural flood damage reduction should use methods similar to those used in calculating the benefits for structural projects, including similar treatment in calculating the benefits from losses avoided. Previously, Planning Guidance directed that only the externalized portion of flood damages prevented be used in calculating benefits for evacuation projects by assuming that that the internalized portion of flood damages is reflected in reduced market value of the properties in the cost of the buyout of the property. This internalized potion includes uninsured losses, flood insurance premiums, any deductible and agent’s fees. Per Section 219 (a) of WRDA 99, flood damage reduction benefits for evacuation projects will be calculated as the total flood damages reduced. Generally for costs, the market value of a replacement, non-floodplain property will exceed the value of the displaced, floodplain property.

Identification of a feasible flood risk management buyout plan also depends on meeting several criteria. The buyout evaluation for this study only considered residential structures based on topographical location within each targeted exceedance zone, regardless of the finished first floor elevation. Ideally, the benefit-cost ratio (BCR) for the group of structures should exceed 1.0.

Floodplain Evacuation

One advantage of floodplain evacuations is that they generally provide high marginal benefits, because they target structures that are being damaged at the most frequent events. Floodplain evacuation can also expand open space and enhance natural and beneficial uses and facilitate the secondary use of newly vacated land. The disadvantages are that they often leave many structures flood-prone in less frequent events, which might not provide sufficient space for vacated lands to be used optimally. When evaluating alternatives for floodplain evacuation, to avoid double-counting of the internalized portion of the flood damages reduced, costs should use comparable flood-free land costs in the valuation of floodplain land, as specified in Section 219 of the Water Resources Development Act of 1999.

Flood-Proofing

Flood-proofing includes both wet and dry types. Wet flood-proofing consists of modifying uninhabited portions, such as a crawlspace or an unfinished basement, to allow floodwaters to enter and exit ensuring equal hydrostatic pressure on the interior and exterior of the structure and its supports. The equalized pressures reduce the likelihood of wall failures and structural damage. Wet flood-proofing however, is practical in only a limited number of situations.

Dry flood -roofing structures requires making structures watertight below the level that needs flood protection to prevent floodwaters from entering. Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete. This type of measure is normally applicable where structures are only inundated for a few feet. This measure does not minimize the potential damage from high-velocity flood flow and wave action and may not be used to bring a substantially damaged or substantially improved residential structure into compliance with the community’s floodplain management ordinance or law. Due to the relatively low structure value of the structures associated with Chacon Creek, these measures were not given further consideration.

Flood Warning Systems

While a flood warning system can be an effective measure to reduce the loss of life during a flood event, the effectiveness of such a system will vary with a range of factors, including the number and location of sirens, level of background noise, sound absorption by buildings, night or day, and weather conditions. As such, warnings are only part of a comprehensive flood risk management solution. Flood warning systems are also subject to maintenance problems, availability during power failures, and limited broadcast range.

Due to the “flashiness” of rain events along Chacon Creek and the fact that many of the structures are located in high frequency events, such as the 5- and 10-year events, flood warning systems would not provide adequate time to allow residents to evacuate and would not prevent damage to structures. As such, a flood warning system will not be analyzed as a standalone alternative, but will be considered as a measure to assist with reducing residual damages from the NED alternative.

Study Area Reaches

This section outlines the flood risk management measures considered for each of the study area reaches. On page A-38, Table A-16 provides the costs and net benefits for each of the alternatives investigated, by reach. All values in this section reflect escalated values to 2018 price levels.

Reach 1 - Rio Grande Confluence to State Highway 359

Reach 1 contains approximately 40 structures in the 1% ACE floodplain with only $86,170 in expected annual damages. In cases such as these, potential projects are usually not justified because there are not enough damages to support the cost of a project and result in a positive benefit/cost ratio.

Structural Measures

The only potential feasible structural measures considered in the Chacon Creek study area were channelization alternatives involving widening the channel to increase conveyance during a flood. For Reach 1 these alternatives were not pursued because there were only 40 structures through the 1% ACE (100-year event) with expected annual damages of $86,170 under existing conditions. This would only support roughly a $1,750,000 project if all of the structures were removed from the floodplain.

Non-structural Measures

The floodplain evacuation measures investigated for Reach 1 included buyouts of the 50%, 20%, 10%, and 4% ACE (2-, 5-, 10-, and 25-year events respectively). Each of these buyout scenarios are illustrated in Figure A-11 on the next page. To capture the accumulation of structures for each event, the structures from the previous event need to be included in the next event. Using Reach 1 as an example, the three buyout parcels from the 50% ACE (2-year event) need to be added to the three parcels in the 20% ACE (5-year event) to capture all parcels for that 5-year event.

Evacuation of Structures in 50% ACE

This alternative would consist of purchasing and removing four structures in Reach 1 that are within the 50% ACE (2-year frequency event) floodplain. Benefits based on the reduction of expected annual damages are estimated at $24,140. Costs associated with buying the structures and land, demolition, and real estate administration total $585,610, which annualizes to $29,030. This would produce -$4,890 in net benefits—meaning that annual costs would exceed the annual net benefits for the alternative, yielding a benefit/cost ratio of 0.83-to-1.00.

Evacuation of Structures in 20% ACE

This alternative would consist of purchasing and removing seven structures in Reach 1 within the 20% ACE (5-year frequency event) floodplain. Benefits based on the reduction of expected annual damages are estimated at $54,650. Costs associated with buying the structures and land, demolition, and real estate administration would total $1,024,820, annualize to $50,800, and produce $3,850 in net benefits with a benefit/cost ratio of 1.08-to-1.00.

Evacuation of Structures in 10% ACE

This alternative would consist of purchasing and removing 11 structures that are within the 10% ACE (10-year frequency event) in the reach. Benefits based on the reduction of expected annual damages are estimated at $67,500. Costs associated with buying the structures and land, demolition, and real estate administration would total $1,610,430, which annualizes to $79,840 and yields -$12,340 in net benefits with a benefit/cost ratio of 0.85-to-1.00.

Evacuation of Structures in 4% ACE

This alternative would consist of purchasing and removing 16 residential structures that are within the 4% ACE (25-year frequency event) in the reach. Benefits based on the reduction of expected annual damages are estimated at $72,410. Costs associated with buying the structures and land, demolition, and real estate administration would total $2,342,440, which would annualize to $116,130. This would produce -$43,720 in net benefits with a benefit/cost ratio of 0.62-to-1.00.

Reach 2 - State Highway 359 to Texas Mexican Railway

Reach 2 of the main stem of Chacon represents the one reach in which a substantial number of structures are in the floodplain for sufficient EAD to support a potential project. Approximately 248 structures are in the 1% ACE floodplain for almost $805,500 in EAD. For the reach, both structural measures in the form of channel modifications and (non-structural) floodplain evacuations were analyzed. The rest of this section outlines these measures and describes the results used to determine which measures would be given further consideration.

Structural Measures

Three channel modification alternatives were investigated using a 50-year period of analysis. To improve the physical aquatic habitat, each alternative includes habitat benches to help simulate a natural channel cross-section. This section presents a brief description of each structural measure considered.

Small Channel Alternative

For this alternative, the left bank and the bottom of the channel would remain untouched. This design would begin 2.0 feet above the existing bottom and would entail constructing a new 50-foot-wide channel cut to create valley storage and conveyance. A new side slope of 1-on-4 would be cut to an elevation 2.0 feet higher than the first bench. The second bench area would average 50 feet in width with the 1-on-4 side slope upward to existing ground.

This channel configuration would require purchasing and removing 25 residential structures to construct the modifications. Benefits based on the reduction of expected annual damages are estimated at $574,660. Costs associated with buying the structures and land, demolition, channel excavation and mitigation, and real estate administration total $4,884,290, which annualizes to $242,150, yielding $332,510 in net benefits and a 2.37-to-1.00 benefit/cost ratio. This alternative provides varying flood protection to the remaining structures in the range of the 25- to 50-year level. This channel alternative is depicted in Figure A-9.

US Army Corps of Engineers
Fort Worth District

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Project: Chacon Creek
Project Manager: Jodie Foster
Section: CESWF-PER-PT
Date: April 2, 2010
Author: Fawn Tran
Location: \\swf-fs1\bgis\projects\cwjobs\Chacon_Creek\Documents\2010_AFB_Maps

Figure A-12.

Reach 2
Small Channel

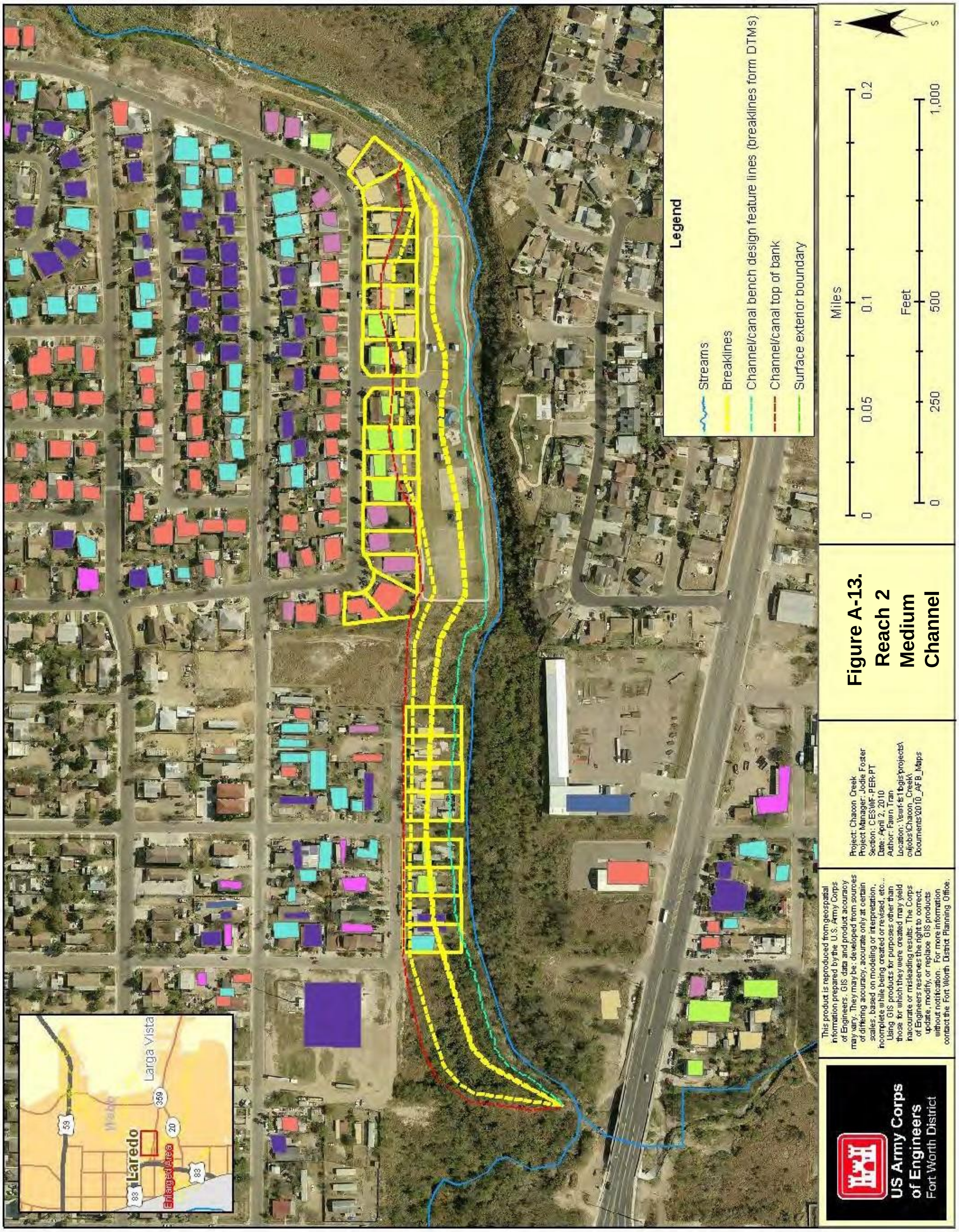

Image Source: USACE, 2010

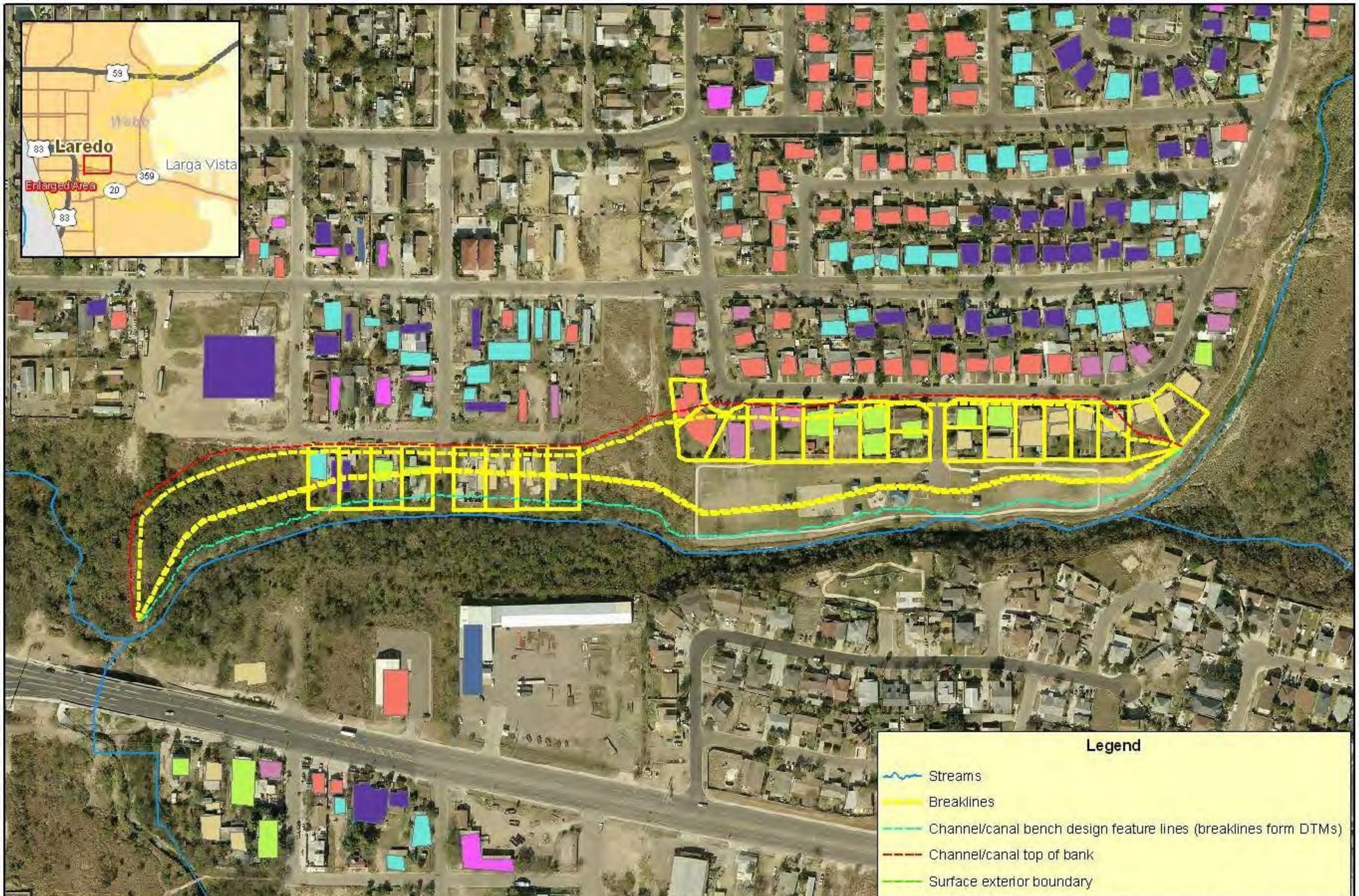

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Figure A-14.
Reach 2
Large Channel

Medium Channel Alternative

Depicted in Figure A-10, the medium channel configuration would be similar to the small channel alternative but would have an average channel width of 100 feet. This channel configuration would require the purchase and removal of 31 residential structures to allow for the construction of the channel modifications. Benefits based on the reduction of expected annual damages are estimated to be $642,230. Removal of the buyout structures, land costs, demolition, channel excavation and mitigation, and real estate administration would total $5,943,010, which would annualize to $294,630 and yield $347,600 in net benefits with a 2.18-to-1.00 benefit/cost ratio. This alternative provides varying flood protection to the remaining floodplain structures in the range of the 50- to 100-year level.

Large Channel Alternative

The large channel configuration would be similar to the other channel alternatives investigated but have an average channel width of 200 feet. This channel configuration would require the purchase and removal of 32 residential structures to allow for construction. Based on the reduction of expected annual damages, benefits are estimated at $657,570. Costs associated with buying the structures, lands, demolition, channel excavation and mitigation, and real estate administration would total $6,320,770, which would annualize to $313,370, yield $344,200 in net benefits, and produce a 2.10-to-1.00 benefit-to-cost ratio. This alternative provides varying flood protection to the remaining floodplain structures in the range of a 100- to 250-year level. This channel alternative is depicted in Figure A-11, page A-32.

Non-structural Measures

The following describes the floodplain evacuation measures investigated for Reach 2. These included buyouts of the 50%, 20%, 10%, and 4% ACE, which are the 2-, 5-, 10-, and 25-year events respectively. Each of these buyout scenarios are illustrated in Figure A-12 on page A-34.

Evacuation of Structures in 50% ACE

This alternative consists of the purchase and removal of 19 residential structures that are within the 50% ACE (2-year frequency event) in Reach 2. Benefits based on the reduction of expected annual damages are estimated at $350,970. Costs associated with buying the structures and land, demolition, and real estate administration would total $2,781,650, which would annualize to $137,910. This would produce $213,060 in net benefits with a 2.54-to-1.00 benefit/cost ratio.

Evacuation of Structures in 20% ACE

This alternative consists of the purchase and removal of 29 residential structures that are within the 20% ACE (5-year frequency event) in Reach 2. Benefits based on the reduction of expected annual damages are estimated at $476,640. Costs associated with buying the structures and land, demolition, and real estate administration would total $4,245,670, which would annualize to $210,490. This would produce $266,150 in net benefits with a 2.26-to-1.00 benefit/cost ratio.

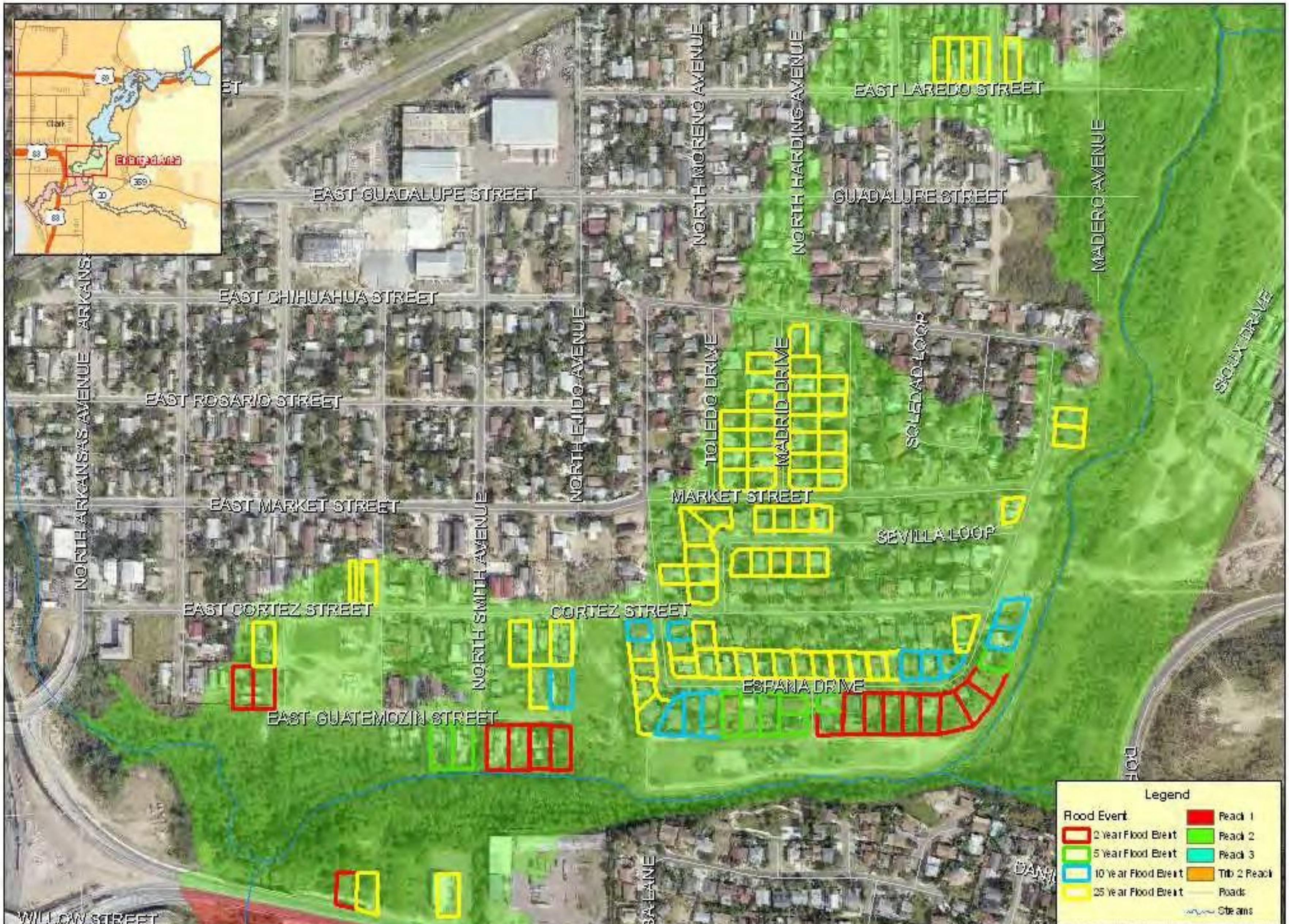


Figure A-15.
Reach 2
Permanent Evacuation

Evacuation of Structures in 10% ACE

This alternative consists of purchase and removal of 41 residential structures that are within the 10% ACE (10-year frequency event) in Reach 2 of the Chacon Creek main stem. Based on the reduction of expected annual damages, benefits are estimated at $545,040. Costs associated with buying the structures and land, demolition, and real estate administration would total $6,002,500, which annualizes to $297,590. This would produce $247,440 in net benefits with a 1.83-to-1.00 benefit/cost ratio.

Evacuation of Structures in 4% ACE

This alternative consists of the purchase and removal of 111 residential structures that are within the 4% ACE (25-year frequency event) in Reach 2. Based on the reduction of expected annual damages, benefits are estimated at $693,130. Costs associated with buying the structures and land, demolition, and real estate administration would total $16,250,660, which annualizes to $805,660. This would produce -$112,530 in net benefits with a 0.86-to-1.00 benefit/cost ratio.

Reach 3 - Texas Mexican Railway to Lake Casa Blanca

Similar to Reach 1, Reach 3 contains approximately 53 structures in the 1% ACE floodplain with only $138,730 in expected annual damages. As mentioned earlier, this normally results in potential projects not being justified because there are not enough damages to support the cost of a project and result in a positive benefit/cost ratio. This section discusses the alternatives analyzed for Reach 3 in the preliminary investigation of alternatives.

Structural Measures

For Reach 3, no structural alternatives were pursued because there were only 53 structures within the 1% ACE (100-year event) with expected annual damages of $138,730 under existing conditions. This would only support a roughly $2,800,000 project. Because Reach 3 is more than a mile long, any structural project would not be economically justified.

Non-structural Measures

The following describes the floodplain evacuation measures investigated for this reach. These included buyouts of the 50%, 10%, and 4% ACE, which are the 2-, 10-, and 25-year events respectively. Each of these buyout scenarios are illustrated in Figure A-13 on page A-36.

Evacuation of Structures in 50% ACE

This alternative consists of the purchase and removal of 16 commercial structures that are within the 50% ACE (2-year frequency event) in Reach 3. Benefits based on the reduction of expected annual damages are estimated at $72,540. Costs associated with buying the structures and land, demolition, and real estate administration would total $2,342,440, which annualizes to $116,130. This would produce –$43,590 in net benefits with a 0.62-to-1.00 benefit/cost ratio.

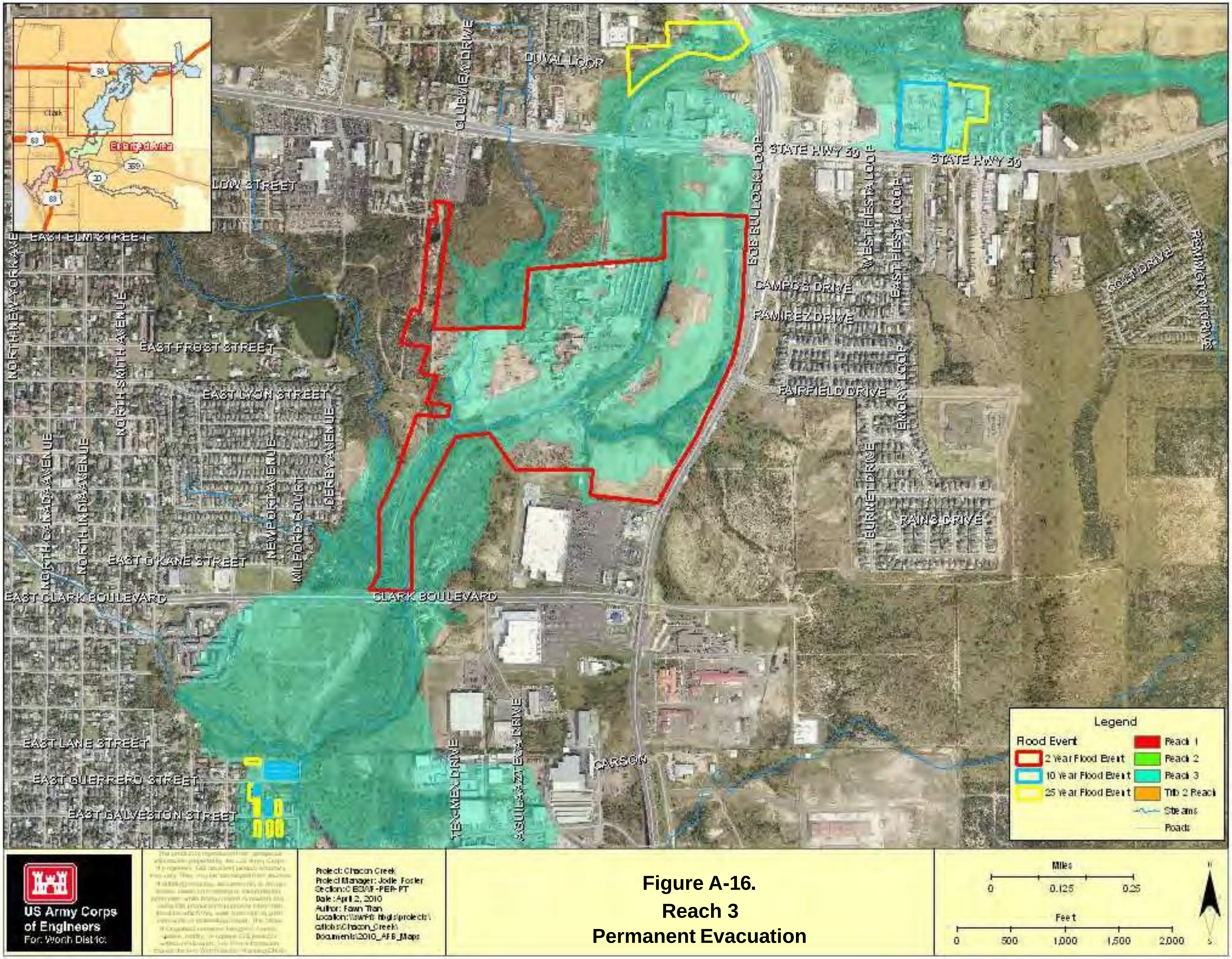


Figure A-16.
Reach 3
Permanent Evacuation

Evacuation of Structures in 10% ACE

This alternative consists of the purchase and removal of 25 structures, 20 commercial and five residential, within the 10% ACE (10-year frequency event) in Reach 3 of the main stem of Chacon Creek. The reduction of expected annual damages is estimated at $107,100. Costs associated with buying the structures and land, demolition, and real estate administration would total $3,660,060 annualizing to $181,460. This would produce -$74,360 in net benefits with a 0.59-to-1.00 benefit/cost ratio.

Evacuation of Structures in 4% ACE

This alternative consists of the purchase and removal of 40 structures, 27 commercial and 13 residential, within the 4% ACE (25-year frequency event) in Reach 2 of the Chacon Creek main stem. Based on the reduction of expected annual damages, benefits are estimated at $127,340. Costs associated with buying the structures and land, demolition, and real estate administration would total $5,856,090, which annualizes to $290,330. This would produce –$162,990 in net benefits with a 0.44-to-1.00 benefit/cost ratio.

Measures Considered for Study Area Tributary 2

No flood risk management measures were investigated because only eight structures existed through the 0.2% ACE (500-year event) and the expected annual damages under existing conditions were only $4,570, which would only support a $100,000 project.

SUMMARY PRELIMINARY SCREENING OF FLOOD RISK MANAGEMENT ALTERNATIVES

This section provides a brief narrative of the initial screening process used to determine which alternatives warrant further investigation for each reach. Not all the necessary costs to select a final, tentatively selected plan were included in this initial screening process, rather only those costs determined most germane to make a sound preliminary determination. It is fully expected that costs will rise as the result of additional studies and refinements that will occur during the detailed investigation of alternatives. On the next page, Table A-17 shows each of the preliminary measures analyzed for each of the three reaches along the main stem of Chacon Creek.

Section 219 of the Water Resources Development Act of 1999 directs the Corps to calculate benefits for non-structural projects the same as structural projects. The Principles and Guidelines, published in 1983 by the U.S. Water Resources Council, dictates that reduction of flood damages borne by floodplain activities should not be claimed as a benefit of evacuation and relocation because they are already accounted for in the fair market value of floodplain properties. As a result, estimated flood damages associated with a property must be based on a comparable property in a flood-free condition to avoid double counting. For this study area, there is no significant difference between costs of residential properties within the floodplain and residential structures outside the floodplain. Property values depicted in the Real Estate Plan (Appendix D) were based on a gross appraisal that considered both floodplain and non-floodplain comparable sales values in the estimate of real estate costs.

Table A-16. Preliminary Screening Summary (February 2018 Price Level)

Cost	Structural			Non-structural - Buyout			
	Small Channel	Medium Channel	Large Channel	2-year	5-year	10-year	25-year
Reach 1							
Number of Structures	-	-	-	4	7	11	16
Number of Parcels	-	-	-	3	6	9	13
Total Cost	-	-	-	$585.61	$1,024.82	$1,610.43	$2,342.44
Annual Cost	-	-	-	$29.03	$50.80	$79.84	$116.13
EAD Benefits	-	-	-	$24.14	$54.65	$67.50	$72.41
Net Benefit	-	-	-	($4.89)	$3.85	($12.34)	($43.72)
Benefit/Cost Ratio	-	-	-	0.83	1.08	0.85	0.62
Reach 2							
Number of Structures	25	31	32	19	29	41	111
Number of Parcels	20	26	27	16	25	36	109
Total Cost	$4,884.29	$5,943.01	$6,320.77	$2,781.65	$4,245.67	$6,002.50	$16,250.66
Annual Cost	$242.15	$294.63	$313.37	$137.91	$210.49	$297.59	$805.66
EAD Benefits	$574.66	$642.23	$657.57	$350.97	$476.64	$545.04	$693.13
Net Benefit	$332.51	$347.60	$344.20	$213.06	$266.15	$247.44	($112.53)
Benefit/Cost Ratio	2.37	2.18	2.10	2.54	2.26	1.83	0.86
Reach 3							
Number of Structures	-	-	-	16	-	25	40
Number of Parcels	-	-	-	1	-	10	19
Total Cost	-	-	-	$2,342.44	-	$3,660.06	$5,856.09
Annual Cost	-	-	-	$116.13	-	$181.46	$290.33
EAD Benefits	-	-	-	$72.54	-	$107.10	$127.34
Net Benefit	-	-	-	($43.59)	-	($74.36)	($162.99)
Benefit/Cost Ratio	-	-	-	0.62	-	0.59	0.44

Reach 1

For Reach 1, no structural measures were considered as viable options and none will be carried forward into the Detailed Investigations of Alternatives. Four non-structural alternatives were considered during the preliminary screening of alternatives for Reach 1. The net benefits for these scenarios ranged from –$43,720 for the 4% ACE (25-year) to $3,850 for the 20% ACE (5-year). Because secondary uses for evacuated land can be used to help justify a non-structural alternative, at least one of the non-structural alternatives will be analyzed by proposing recreational activities that have a strong, direct relationship to these non-structural measures.

Reach 2

Three structural measures were considered for Reach 2. The preliminary net benefits for each channel alternative for Reach 2 range from $332,510 for the small channel size to $347,600 for the medium channel size. Because the medium channel alternative produced the greatest net benefits, it is the only structural configuration that will be carried forward into the detailed investigations for comparison with other viable alternatives.

Four non-structural alternatives were considered during the preliminary screening of alternatives. The net benefits for these scenarios ranged from -$112,530 for the 4% ACE (25-year) to $266,150 for the 20% ACE (5-year).

The standalone non-structural alternatives will not be carried forward into the detailed investigations of alternatives as actual alternatives, but as the costs of these plans are refined, these alternatives will be included in the tables to make a true comparison between all plans. The 2- and 5-year floodplain evacuations do not include enough vacated land to have a viable secondary use to help justify a project. However, the 10- and 25-year floodplains in Reach 2 have structures that are mainly confined to a certain area known as Villa Del Sol. Because these structures are confined to this area and the parcels are mostly connected to each other, recreation can be considered a viable use of the vacated land to gain additional benefits to help justify a non-structural project. Therefore, non-structural plans analyzed during the detailed investigation of alternatives will include recreation as a secondary use of the land for the 10- and 25-year floodplain evacuations.

The plans carried further for detailed investigations for Reach 2 include the medium-width structural plan and the 10- and 25-year floodplain evacuations. In addition, combination plans of structural and non-structural plans might be considered.

Reach 3

For Reach 3, no structural measures were considered as viable options, and none will be carried forward into the Detailed Investigations of Alternatives. Three non-structural alternatives were considered during the preliminary screening of alternatives for Reach 3. No structures were located within the 5-year floodplain. The net benefits for these scenarios ranged from -$162,990 for the 4% ACE (25-year) to -$43,590 for the 50% ACE (2-year). Due to the fact that the parcels are spread over a large area, there is no secondary use of the land, such as recreation, that would be compatible with floodplain land and would produce enough benefits to justify the project. Therefore, no flood risk management alternatives for Reach 3will be carried into the detailed investigations of alternatives.

Tributary 2

Tributary 2 will not be considered further in this study.

DETAILED INVESTIGATION OF FLOOD RISK MANAGEMENT ALTERNATIVES

This section evaluates those flood risk management alternatives identified from the array of preliminary alternatives for further, more detailed consideration. In addition to the benefits derived from expected flood damage reduction, five of the alternatives carried forward also include benefits that could be generated by inclusion of recreational amenities on the vacated lands.

The non-structural alternatives are based on flooding events and, in one case, were expanded to include structures that are partially in the next less-frequent event. For screening purposes, costs for land and structures, demolition, and real estate administration were estimated based on information supplied by the Real Estate Services Branch, Cost Engineering, and Civil Design Section of the Fort Worth District. Preliminary costs and benefits were also obtained from the Fort Worth District Planning Branch and the City of Laredo.

As with the preliminary alternatives, there have been no changes to the final array alternatives. The costs and benefits in the final array reflect the 2010 structure inventory, with appropriate escalation to 2018 price levels.

Recreation Benefits Methodology

One of the primary reasons to formulate non-structural alternatives is to take advantage of new uses for vacated land, the most common uses being recreation and ecosystem restoration. Overall benefits therefore, can be derived from the reduction in flooding damages as well as benefits from recreational amenities on these lands. This section discusses the various acceptable methods for calculating recreational benefits, the methodology the City used to determine recreation demand, and how this methodology was used to aid in the development of compatible recreational amenities that might optimize flood risk management alternatives.

Recreation benefits can be calculated in a number of ways. The unit day value (UDV) method, travel cost method (TCM), and contingent valuation method (CVM) are all acceptable methods of calculating recreation benefits. In all cases, the number of visitors must be assumed or determined for each center of recreation such that it does not take benefits from another similar set of recreation opportunities. Double counting the same set of visitors would result in the over counting of demand and benefits.

Local Recreation Survey

The City of Laredo performed a local survey to determine the city’s future recreational demand. The analysis done by the City included interviews with key City of Laredo staff, organized recreation providers, and user groups, phone surveys for each of the eight Council Districts, four public meetings for the eight Council Districts, inventory/supply analysis, GIS analysis of land use, projected growth, the City's Thoroughfare Master Plan, consideration of natural land features such as slope and hydrography, and facility standards analysis of park service areas. The local survey was conducted in March 2007 by The Earl Survey Research Laboratory at Texas Tech University.

The survey yielded 535 completed surveys (of 3,408 calls made), with 60 percent English/40 percent Spanish speaking respondents, and a response rate of 15.3 percent. An overall cooperation rate of 71.7 was obtained for successful calls. This survey did not require the approval of the Office of Management and Budget, because it was done by the City for its own recreational planning and not in conjunction with any proposed activities under this study.

Priorities were established on a community planning district basis with needs categorized by a system of high, medium, and low priority rankings and corresponding time schedules. Latent demand identified by city staff, user groups, and survey respondents included features such as volleyball courts, playgrounds, picnic tables, pavilions, trails, and multipurpose fields. Table A-17 illustrates the latent demand estimated by the City after considering citizen, expert, and governmental input.

Table A-17. Latent Demand and Projected Recreation Deficiencies, Laredo, Texas

Amenity	Existing	Target Based on 2007 Population	Target Based on 2015 Population	2015 Surplus/ Deficiency
Competitive Soccer Field	12	44	60	(48)
Football Field	0	11	15	(15)
Competitive Baseball Field	22	44	60	(38)
Competitive Softball Field	7	44	60	(53)
Basketball Court	32.5	44	60	(28)
Tennis Court	17	55	75	(58)
Volleyball Court	3	11	15	(12)
Indoor Recreation Center	8	7	10	(2)
Swimming Pool	6	11	15	(9)
18-Hole Golf Course	2	4	6	(4)
Playground	46	221	302	(256)
Picnic Table	211	368	503	(292)
Large Pavilion	11	44	60	(49)
Multipurpose Court	0	9	12	(12)
Skating Facility (Hockey Rink)	2	2	3	(1)
Paved Trail (miles/system)	3.88	11.0	15.1	(11)
Skate Park	7	11	15	(8)
Multipurpose Field	16	11	15	1
Splash Park	5	11	15	(10)
Water Park	0	1	1	(1)

Source: City of Laredo, 2007

Because the results of the city's internal survey did not include development of estimates of value for the various proposed recreation types, the method of the study indicates that the UDV method be used to calculate benefits. Point assignments were based on compatible general recreation values established in Economics Guidance Memorandum 09-03, "Unit Day Values for Recreation, Fiscal Year 2018." The values for points to dollar value are listed in Table A-18, along with the criteria for assigning points for general recreation.

Table A-18. Conversion of Points to Dollars 2018

Point Value	General Recreation Value ($)
0	4.05
10	4.81
20	5.32
30	6.08
40	7.59
50	8.61
60	9.37
70	9.87
80	10.89
90	11.64
100	12.15
Criteria	
Recreation Experience	10
Availability of Opportunity	3
Carrying Capacity	7
Accessibility	14
Environmental	4
Total Points	**38**

For Recreation Experience, a value of 10 points was assessed because each of the recreational alternatives provided several general activities. Availability of Opportunity was assessed a value of three because several exist within a 30-minute drive of the location. A value of seven was assessed for Carrying Capacity because there will be adequate facilities so that no deterioration of the resource will occur. Accessibility was assessed a value of 14 because there will be good access for the facilities and to good roads. Environmental criteria was assessed a value of four conservatively, because the facilities are considered of average aesthetic quality.

Table A-19 summarizes all of the alternatives that were investigated in detail, along with the associated costs, net benefits, and benefit-to-cost ratios.

Table A-19. Detailed Investigation Summary (February 2018 Prices)

Cost Item	Reach 2 Structural (A2)	Reach 1 10-year w/ Recreation (A3)	Reach 2 10-year w/ Recreation (A4)	Reach 2 Partial 25-year w/Recreation (A5)	Reach 2 "VDS Plan" (A6)	Reach 2 25-Year w/ VDS Rec. (A7)	Reach 2 VDS Plan w/ Small Channel (A8)	Reach 1 10-year w/Rec. and "VDS Plan" (A10)
Structures	31	11	42	62	62	111	62	73
Parcels	26	9	37	57	57	109	57	66
Without EAD	$805.5	$86.2	$805.5	$805.5	$805.5	$805.5	$805.5	$891.7
Residual EAD	$163.2	$18.7	$288.7	$244.0	$244.0	$112.3	$120.0	$262.7
EAD Benefits	$642.3	$67.5	$516.8	$561.5	$561.5	$693.2	$685.5	$629.0
Recreation Benefits	$28.5	$157.6	$448.6	$628.8	$674.9	$674.9	$674.9	$911.3
Total Benefits	$670.8	$225.1	$965.4	$1,190.3	$1,236.4	$1,368.1	$1,360.4	$1,540.3
Structure and Land	$3,320.5	$1,757.0	$4,498.9	$6,641.2	$6,641.2	$11,889.8	$6,641.2	$8,398.2
Demolition, Cleanup	$669.8	$237.6	$907.4	$1,339.5	$1,339.5	$2,398.2	$1,339.5	$1,577.2
Real Estate Admin	$498.1	$263.5	$674.9	$996.2	$996.2	$1,783.5	$996.2	$1,259.7
Recreation Costs	$161.2	$1,228.1	$5,814.7	$7,780.0	$7,838.4	$7,838.4	$7,838.4	$9,066.5
Other Costs	$2,860.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2,591.4	$0.0
Total Costs	$7,509.8	$3,486.3	$11,895.8	$16,756.9	$16,815.4	$23,910.0	$19,406.8	$20,301.7
Investment								
Total First Cost	$7,509.8	$3,486.3	$11,895.8	$16,756.9	$16,815.4	$23,910.0	$19,406.8	$20,301.7
Interest During Const.	$333.4	$156.9	$537.6	$756.8	$759.5	$1,075.6	$873.6	$916.4
Total Investment Cost	$7,843.2	$3,643.2	$12,433.4	$17,513.7	$17,574.9	$24,985.6	$20,280.4	$21,218.2
Annual Charges								
Interest	$345.6	$162.7	$557.3	$784.4	$787.2	$1,114.9	$905.6	$949.9
Amortization	$46.0	$21.7	$74.3	$104.5	$104.8	$148.4	$120.6	$126.5
O&M	$59.0	$29.5	$82.5	$88.4	$88.4	$88.4	$117.9	$117.9
Total Annual Charges	$450.5	$213.9	$714.1	$977.3	$980.5	$1,351.7	$1,144.1	$1,194.3
Annual Benefits								
Inundation Reduction	$642.3	$67.5	$516.8	$561.5	$561.5	$693.2	$685.5	$629.0
Recreation	$28.5	$157.6	$448.6	$628.8	$674.9	$674.9	$674.9	$911.3
Total Annual Benefits	$670.8	$225.1	$965.4	$1,190.3	$1,236.4	$1,368.1	$1,360.4	$1,540.3
Net Annual Benefits	$220.3	$11.2	$251.3	$213.0	$255.9	$16.3	$216.3	$345.9
Benefit/Cost Ratio	1.49	1.05	1.35	1.22	1.26	1.01	1.19	1.29

Alternative 1 (A1): No-Action (Future Without-Project) Plan

The City of Laredo has existing zoning and building code regulations that govern various detention and drainage practices when undertaking actions within the floodplain. These regulations were adopted by the city to help prevent erosion caused by storm water. However, based on field observations, the existing regulations are not sufficient to prevent further erosion, and the wetland habitats would continue to suffer from the altered flows and low water quality.

The future without-project condition under the no-action alternative implies acceptance of the existing and future adverse impacts caused by increased erosion, persistence of invasive species, and continued flow of non-point source pollution that results in further environmental degradation. Thus, the no-action alternative fails to meet the planning objectives.

Structural Alternatives

The following discussion provides a more detailed description of the best-performing structural alternative for Reach 2 brought forward for further analysis and included in the final array of investigated alternatives. All costs and benefits have been escalated to 2018 dollars.

Alternative 2 (A2): Reach 2 Structural Plan

Because this alternative generated the greatest net benefits among the preliminary structural alternatives investigated, only the medium channel alternative was brought forward for more detailed analysis. This alternative was further refined to include recreational amenities on the upper bench that would be less susceptible to more frequent flooding events, annual operations and maintenance (O&M), and mitigation costs required to compensate for the anticipated ecosystem losses associated with the proposed channel improvements.

This alternative consisted of $3,320,500 in land and structures costs, $669,800 for demolition of the structures, $498,100 in real estate administration costs, $2,860,100 for channel excavation, and $161,200 for recreational amenities. Total cost for this alternative is $7,509,800 with total annual charges of $450,500. This alternative generates $220,300 in net benefits with a benefit/cost ratio of 1.49-to-1.00. Alternative 2 is shown in Figure A-9 and the generated recreation benefits are listed in Table A-20.

Table A-20. Recreation Benefits for A2: Reach 2 Structural

Activity	Visitor Days	Number	Unit	Annual Benefits
Frisbee Golf	4,167	9	Holes	$28,500
Total Benefits				$28,500

Non-Structural Alternatives

This section provides a description of the developed non-structural measures in the final array.

Alternative 3 (A3): Reach 1 10-Year Floodplain Evacuation with Recreation

This alternative was carried forward into detailed investigations because it had a positive benefit/cost ratio in the preliminary investigation of alternatives. This non-structural alternative would consist of purchasing and removing 11 structures in Reach 1 within the 10% ACE (10-year frequency event) floodplain. Benefits based on the reduction of expected annual damages are estimated at $67,500, and benefits from recreation are estimated at $157,600. Costs include $1,757,000 for the land and structures, $237,600 for the demolition of these structures, $263,500 for real estate administration, and $1,228,100 for recreation, for a total of $3,486,300. Total annual charges are $213,900 over 50 years with net benefits of $11,200 annually and a benefit/cost ratio of 1.05-to-1.00.

This alternative was compared to the 20% ACE (5-year frequency event) and the 10% ACE (10-year frequency event) *without* recreation to measure the performance of a more viable, developed, and comprehensive alternative. The 20% ACE had total costs of $1,024,800 which annualized to $50,800. Benefits from reduced were $54,700 producing net benefits of $3,900. The 10% ACE had total costs of $1,610,400 which annualized to $79,800. Benefits from reduction in expected annual damages were $67,500 producing net benefits of -$12,300.

The recreational component for this alternative consists of two areas. Area A (Figure A-14) is directly south of State Highway 359 and west of North India Avenue, located on parcels containing structures in the 2-, 5-, and 10-year flood frequencies. Because of this area's proximity to a major highway and the larger park, it was not desirable to attract much day use to the site, which is most appropriate as a trailhead. Therefore only parking, associated utilities, and four picnic tables are planned for Area A.

Area B (Figure A-15) is approximately four blocks downstream of Area A. Buyout and recreational amenities were planned along with additional ecosystem land acquisition to increase and ensure connectivity of the corridor. On the east side, Area B is adjacent to ecosystem property containing the planned wetland Site 3, which includes a boardwalk for interpretive use. West of Area B is residential property; therefore it was determined that this park could support more use than Area A and would include amenities to support the neighborhood and potential educational use of the wetland. Amenities included parking, playground, sidewalk/path, and connective links to the maintenance road/trail and the boardwalk. A restroom and eight picnic sites are planned for the area. Recreation benefits for this alternative are shown in Table A-21.

Table A-21. Recreation Benefits for A3: Reach 1 10-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	1,920	12	Tables	$157,600
Total Benefits				$157,600

Figure A-17.
(A3) Reach 1
Area A

Image Source: USACE, 2010

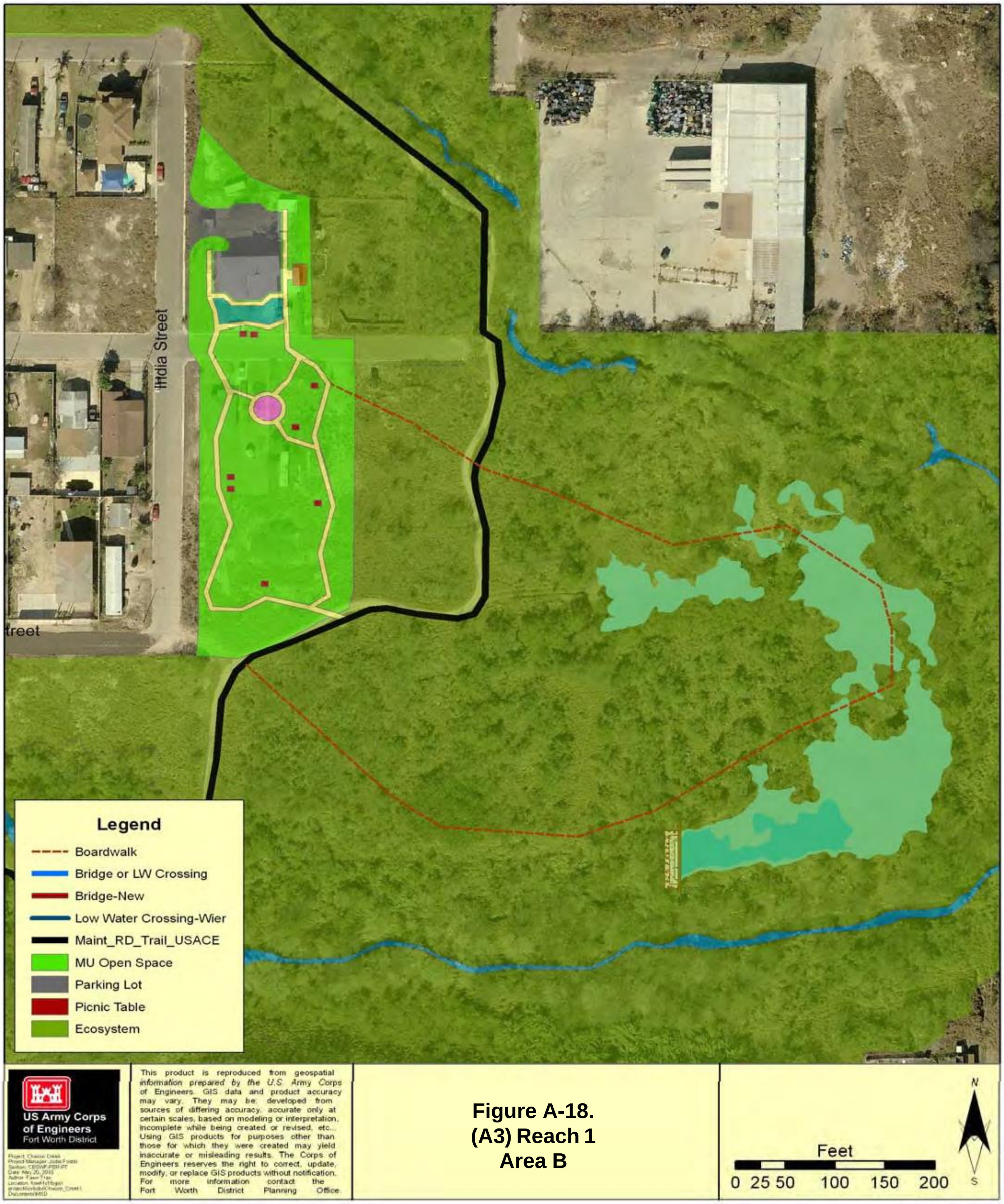


Figure A-18.
(A3) Reach 1
Area B

Image Source: USACE, 2010

Alternative 4 (A4): Reach 2 10-Year Floodplain Evacuation with Recreation

This non-structural alternative, shown in Figure A-16 on the next page, is carried forward because it evacuates virtually all of the structures in the more frequent events and provides a viable area for coherent secondary use in the form of recreation. This non-structural alternative would buy out the 42 residential structures located within the 10% ACE (10-year frequency). The alternative would generate $516,800 in EAD benefits and $448,600 in recreational benefits, for a total of $965,400. Costs include $4,498,900 for the land and structures, $907,400 for the demolition of these structures, $674,900 for real estate administration costs, and $5,814,700 in recreational costs, for a total of $11,895,800. Total annual charges are $714,100 over 50 years with net benefits of $251,300 annually and a benefit/cost ratio of 1.35-to-1.00.

The recreation plan associated with this alternative includes quality, basic amenities found in typical neighborhood parks, as well as several higher quality, but not exclusive amenities. These recreational amenities would cover approximately eight acres of the proposed parkland. Ready access to the park is available by both bus route and area roads, and ample parking is included in the plan. The points system used to calculate the recreation benefits yielded a value of $6.84 per visit for this level of parks is reasonable. Table A-22 lists the recreation benefits in this alternative.

The table also notes several recreation items with zero benefits, as these items have already been constructed at this location. Subsequent alternatives also reference these items which are not included as benefits for both without- and with-project conditions. This methodology provides continuity with the 2010 study.

Table A-22. Recreation Benefits for A4: Reach 2 10-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	6	Tables	-
Multiuse Open Space (unreserved)	26,075	3.2	Acres	$178,353
Multiuse Open Space (Reserved)	5,250	3.2	Acres	$35,910
Large Playground (1 large = 4 small)	20,998	4	Sites	$143,626
Medium Playground	10,499	2	Sites	$71,813
Amphitheatre	2,000	1	Site	$13,680
Multiuse Courts	765	1	Site	$5,233
Total Benefits				**$448,615**

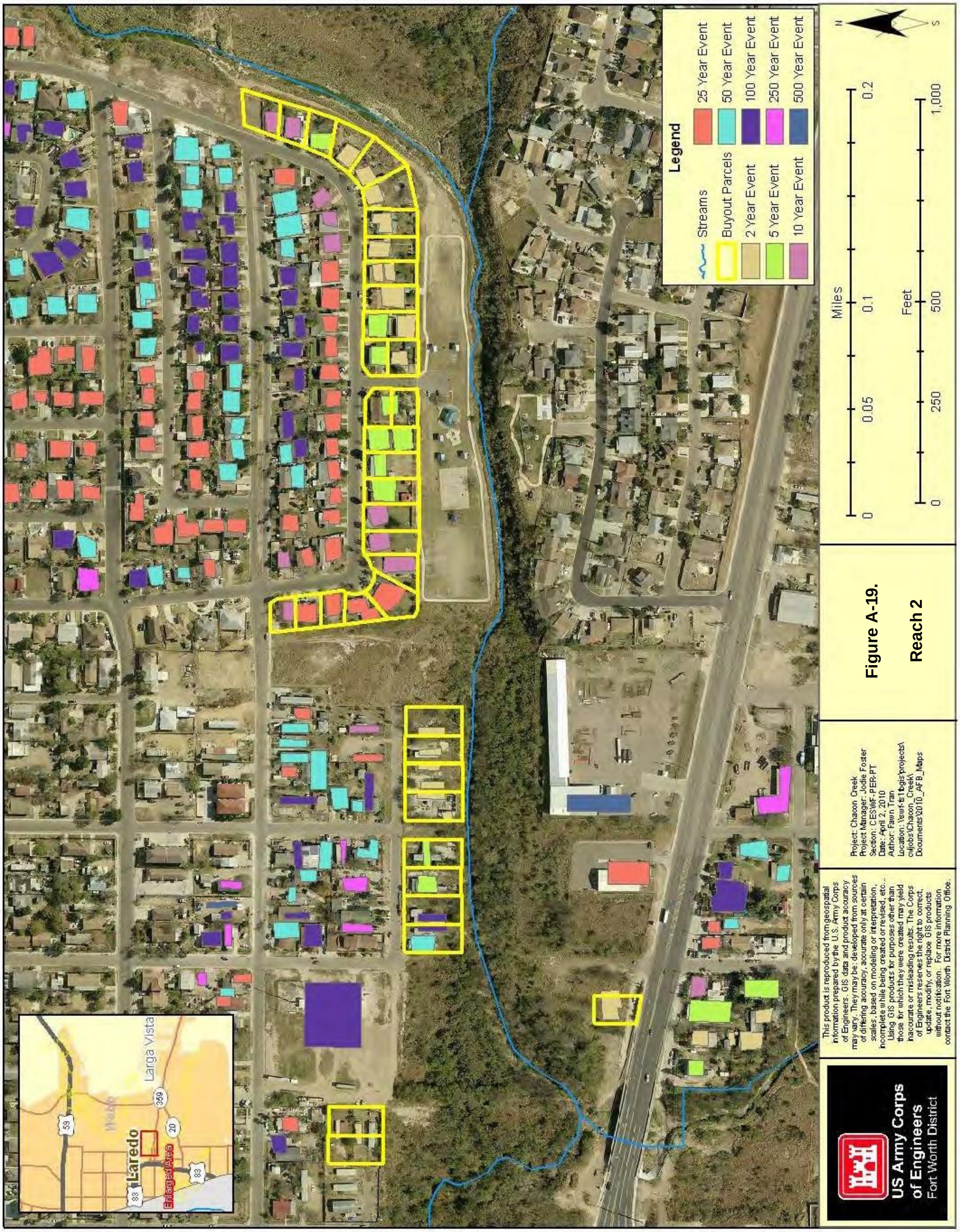


Image Source: USACE, 2010

Alternative 5 (A5): Reach 2 Partial 25-Year Floodplain Evacuation with Recreation

This non-structural alternative (Figure A-18) is carried forward because it evacuates virtually all of the structures in the more frequent events and provides a viable area for coherent secondary use in the form of recreation, just as in the previous alternative but to a greater degree. It would include the permanent evacuation of 41 residential structures within the 10% ACE (10-year frequency) and an additional 21 structures located on the south side of S. Espana Drive and the south side of Guatemozin Street, in the 4% ACE (25-year frequency).

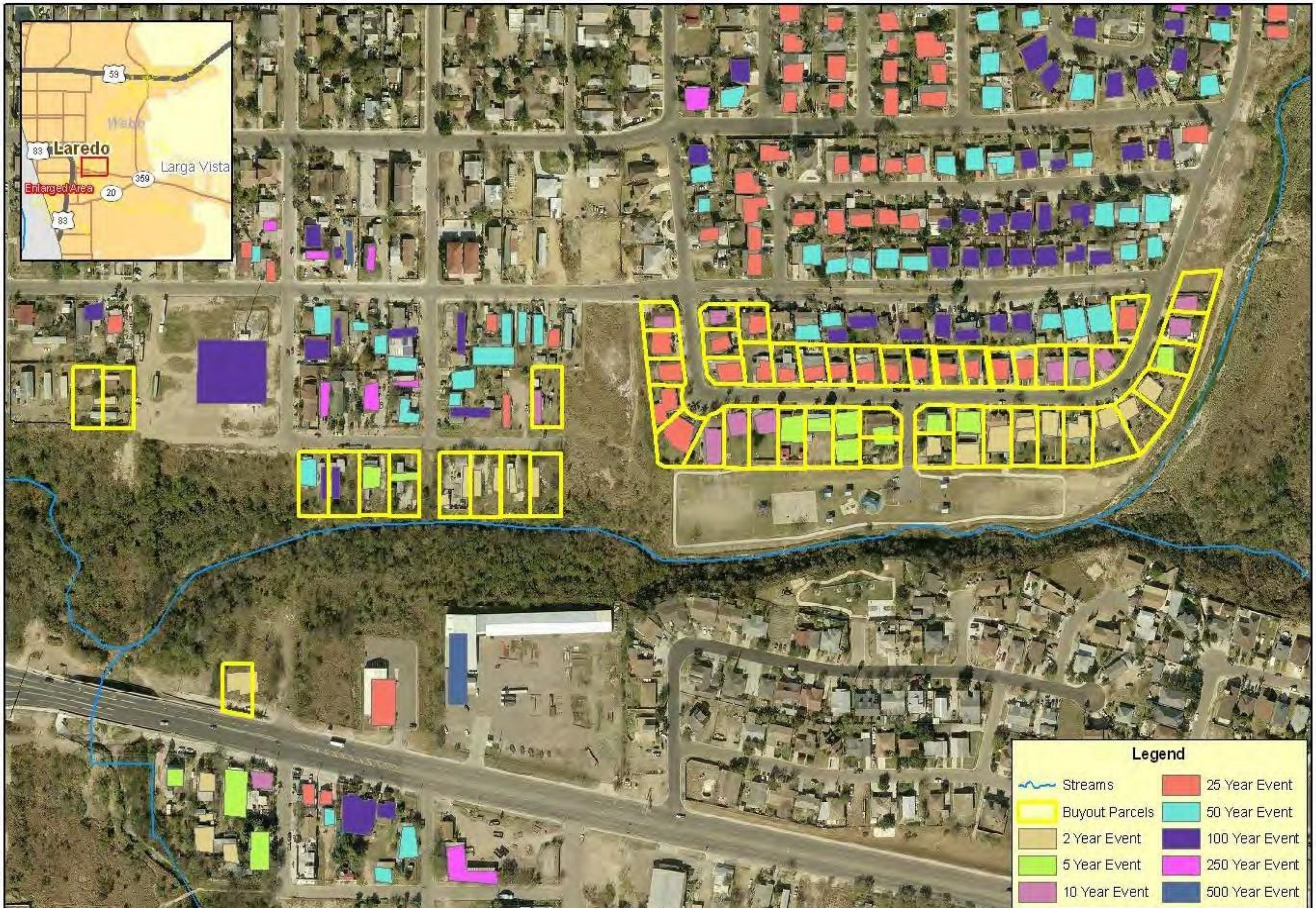
This alternative would generate $561,500 in EAD benefits and $628,800 in recreational benefits, for a total of $1,190,300. Costs include $6,641,200 for land and structures, $1,339,500 for demolition of these structures, $996,200 for real estate administration costs, and recreation costs of $7,780,000, for a total of $16,759,900 in first costs. Total annual charges are $977,300 over 50 years, with net benefits for this alternative at $213,000 annually and a benefit/cost ratio of 1.22-to-1.00.

This alternative evacuates all the structures in the 10% ACE (10-year event) and the most susceptible structures in the 4% ACE (25-year event). Other structures in the 4% ACE, extending into a residential area located north of Cortez Street and scattered among other residential structures, are not proposed to be evacuated. Although they receive damages by a 25-year event, they are located at the highest elevations and receive flooding only when a true 25-year event would occur. If these structures were purchased, there would be a high annual operations and maintenance requirements and the vacated lands would not generate benefits. These parcels would just be maintained (i.e., mowed) by the city in perpetuity.

Benefits from the recreation plan for this alternative are derived from increased open fields for general and reserved use, as well as from a large group shelter that can accommodate 200 visitors for reserved functions. The shelter's hard surface would also accommodate hard-court sports when there is no special activity planned. The points system used to calculate the recreation benefits indicates a value of $7.29 per visit for this level of amenities is reasonable. The value is higher than the smaller, 5-year buyout plan due to the addition of a large group shelter and an increase in the amount of open acres available for field activities. Table A-23 shows the recreation benefits for this alternative.

Table A-23. Recreation Benefits for A5: Partial 25-year Buyout with Recreation

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	4,167	0.5	Acre	-
Multiuse Open Space (Unreserved)	40,743	5	Acre	$297,016
Multiuse Open Space (Reserved)	8,250	5.5	Acres	$60,143
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$628,799**



US Army Corps of Engineers
Fort Worth District

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Project: Chacon Creek
Project Manager: Jodie Foster
Section: CESWF-PER-PT
Date: April 2, 2010
Author: Fawn Tran
Location: \\swf-fs1\bgis\projects\cwjobs\Chacon_Creek\Documents\2010_AFB_Maps

Figure A-17. Reach 2 Partial 25-year Flood Event with Recreation

Miles
0 0.05 0.1 0.2
Feet
0 250 500 1,000
N
S

Image Source: USACE, 2010

Alternative 6 (A6): Reach 2 "VDS Plan"

This plan is called the *VDS Plan* because it is generally located in the Villa Del Sol neighborhood. This non-structural alternative is virtually the same as the Partial 25-Year with Recreation Plan (A5) with slight differences in the number and location of recreational amenities. Recreational amenities in the previous plan were constrained to remain on project lands, while this alternative makes more efficient use of land not specifically included in a proposed project measure. It should be noted that these lands are all within the modeled floodplains but are located on parcels that do not need to be purchased. These lands are currently open space and recreation facilities owned by the City of Laredo and consist of Subarea 2 as described in Appendix F. The costs for Subarea 2 in this alternative are 100 percent non-Federal responsibility.

This plan would generate the same $561,500 in flood risk management EAD benefits and $674,900 in recreational benefits for a total of $1,236,400, which is an increase of $46,100 annually over the recreational benefits of A5. To achieve this increase in annual recreation outputs, recreational costs increase to $7,838,400 with total annual charges increased to $980,500. This plan, however, generates $255,900 in net benefits and a benefit/cost ratio of 1.26-to-1.00. Figure A-18 shows the recreation footprint for the VDS alternative.

The main difference in benefits for Alternative 6 involved relocating the Pit Sports feature outside of the multiuse open fields. This allows more space for both reserved and unreserved uses of the area. The increase in field space also allows for more intensive use of the area for tournament type events and organized team practice. The same value ($7.29) applied to Alternative 5 was used in Alternative 6. Alternatives 5 and 6 have a slightly higher point value and therefore a higher value recreation experience than Alternative 4. Table A-24 shows the recreation benefits for this alternative.

Table A-24. Recreation Benefits for A6: Reach 2 "VDS Plan"

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	-	6	Tables	-
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	44,817	5.5	Acres	$326,716
Multiuse Open Space (Reserved)	10,500	7	Acres	$76,545
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$674,901**

Image Source: USACE, 2010

Alternative 7 (A7): Reach 2 25-Year with VDS Recreation

This non-structural alternative would include the permanent evacuation of all 111 structures located in the 4% ACE (25-year frequency) and combine it with the same recreational amenities as the VDS Plan, along with its associated costs and benefits. This alternative would generate $693,200 in EAD benefits and the same $674,900 in recreational benefits for a total of $1,368,100 in benefits. This alternative assumes the same recreation costs of $7,838,400. Total investment costs are $24,985,600 with annual charges of $1,351,700, while generating $16,300 in annual benefits with a benefit/cost ratio of 1.01-to-1.00.

Just as in Reach 1, these non-structural, recreational alternatives (A4 through A7) were compared to the 50% ACE (2-year frequency event), 20% ACE (5-year frequency event), 10% ACE (10-year frequency event), and 4% ACE (25-year frequency event) *without* recreation, as a means of measuring the performance of more viable, developed, and comprehensive alternatives.

- The 50% ACE had total costs of $2,781,650, which annualized to $137,900. Benefits from reduction in expected annual damages were $351,000 producing net benefits of 213,100.
- The 20% ACE had total costs of $4,245,700 which annualized to $210,500. Benefits from reduction in expected annual damages were $476,600 producing net benefits of $266,100.
- The 10% ACE had total costs of $6,002,500 which annualized to $297,600. Benefits from reduction in expected annual damages were $545,000 producing net benefits of $247,400.
- The 4% ACE had total costs of $16,250,700 which annualized to $805,700. Benefits from reduction in expected annual damages were $693,100 producing net benefits of -$86,000.

Combination Plans

While analyzing the other alternatives, it seemed appropriate to analyze at least one non-structural/structural combination to ensure that the plan with the most net benefits can be identified.

Alternative 8 (A8): Reach 2 VDS Plan with Small Channel

The proposed combination plan used the VDS Plan as the starting point, because it had the highest net benefits out of the non-structural alternatives, and combined it with the small channel alternative as discussed in the preliminary investigations of alternatives. Figure A-19 on the next page shows this combination alternative (A8). The small channel configuration was evaluated because it would minimize any design adjustments necessary to retain the recreation features and benefits of the VDS Plan. Just as in the small channel design discussed for Reach 2, this structural component would entail a 50-foot-wide channel cut for creating valley storage and conveyance, with a second bench averaging a width of 50 feet and 1-on-4 side slopes. Total investment costs for this alternative are $20,280,400 with total annual charges of $1,144,100. Net annual benefits are $216,300 with a benefit/cost ratio of 1.19-to-1.00.

Image Source: USACE, 2010

This alternative represents what is considered to be the optimally performing combination plan, because it would alleviate much of the flooding originating from Chacon Creek. However, there would still be flooding from the south and north ends of the reach, which floods residences along Cortez and Market Streets just north of the proposed buyout area. Therefore, as part of this plan, a levee feature that would address the easterly flows was considered. This would consist of a levee along the channel beginning north of Market Street and continuing down roughly through the Villa Del Sol Park. The levee would prevent out of bank flows from the creek that currently impact structures north of Cortez Street. However, this feature was deemed to be too expensive relative to the additional benefits it might generate.

As a standalone or combination plan, the construction costs would be significantly higher than that of channel excavation, and because most of the flood risk management benefits would be obtained with the channel feature itself, it would be too expensive to be economically justified. In addition to direct construction costs, a levee feature would raise upstream and downstream water surface profiles and would require hydraulic mitigation, which would further increase costs. Finally, levees require interior drainage features so that they do not create additional flooding. Levees serve as a dam and back up water on the interior side of the levee, and without interior drainage structures, they can actually inundate structures they were designed to protect. This would again result in additional costs. Taking all of these factors into consideration, a levee alternative was not considered to be practicable as part of the combination alternative.

Alternative 10 (A10): Reach 1 10-year with Recreation and “VDS Plan”

The final non-structural alternative combines Alternative 6, the Reach 2 VDS Plan, with Alternative 3, 10-Year Floodplain Evacuation with Recreation. This alternative would consist of purchasing and removing 11 structures in Reach 1 within the 10% ACE (10-year frequency event) floodplain and 41 residential structures within the 10% ACE (10-year frequency) and an additional 21 structures located on the south side of S. Espana Drive and the south side of Guatemozin Street, in the 4% ACE (25-year frequency) in Reach 2. This plan would generate $629,000 in flood risk management EAD benefits and $911,300 in recreational benefits for a total of $1,540,300. Costs include $8,398,200 for land and structures, $1,577,200 for demolition, $1,259,700 for real estate administration, and $9,066,500 in recreation costs for a total of $20,301,700. Total annual charges are $1,194,300 over 50 years with net benefits of $345,900 annually and a benefit/cost ratio of 1.29-to-1.00.

Benefits from recreation for the combined alternatives are listed in Table A-25 Benefits for the recreation component associated with Reach 1 are calculated at $6.84 per visitor day and those recreational amenities associated with Reach 2 are calculated at $7.29 per visitor day.

Table A-25. Recreation Benefits for A10: Reach 1 10-year with Recreation and "VDS Plan"

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	1,920	18	Tables	$236,390
Small Group Shelter	-	8	Tables	-
Multiuse Open Space (Unreserved)	44,817	5.5	Acres	$326,716
Multiuse Open Space (Reserved)	10,500	7	Acres	$76,545
Large Playground (1 large = 4 small)	20,998	4	Sites	$153,075
Medium Playground	10,499	2	Sites	$76,538
Large Group Shelter	2,000	1	Site	$14,580
Amphitheatre	3,000	1	Site	$21,870
Multiuse Courts	765	1	Site	$5,577
Total Benefits				**$911,291**

Risk Analysis of Flood Risk Management Alternatives

As required by ER 1105-2-100 and Engineering Circular 1165-2-209, this section discusses the risk associated with each alternative considered to reduce the risk of flooding. Each alternative will be compared to other alternatives.

Alternative 1, the No-Action Plan, would result in the most risk of flooding remaining in the study area. Approximately $887,600 in EAD would remain in the study area and approximately 449 structures would remain within the 500-year floodplain. The highest risk would continue for the structures in the high frequency events such as the 2-, 5-, and 10-year events.

Alternative 2, the Reach 2 Structural Plan, targets Reach 2 where there is currently $805,500 in existing EAD. This alternative would result in the reduction of $642,300 in expected annual damages, but would leave $163,200 in residual damages. To implement this plan, 31 structures would have to be permanently evacuated from the floodplain. The risk of failure from non-performance on these structures would be nonexistent. However, the main intent of this alternative would be to lower water surface profiles by constructing a bench. This would provide some level of protection to the 277 structures that would remain in the 500-year floodplain in Reach 2. The risk of non-performance of this structural component would be that some level of protection would not be provided to these structures depending on the extent of non-performance. For instance, if the bench was not properly maintained and some conveyance was lost, the project would not perform to the design standards, but it would still provide flood protection above what currently exists today. Because this alternative only targets Reach 2, there would be an overall residual EAD of $392,700 remaining in the entire study area.

If structures are removed from the floodplain, they cannot receive future damages. Floodplain evacuations are the least susceptible to risk of any flood risk management alternative. Alternative 3, Reach 1 10-year Floodplain Evacuation with Recreation, targets Reach 1 where there is currently $86,200 in EAD. This alternative is justifiable and could be built as part of a Federal project. This plan would permanently evacuate 11 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 1, there would be an overall residual EAD of $967,500 and 438 structures remaining in the 500-year floodplain in the study area.

Alternative 4, the Reach 2 10-year Floodplain Evacuation with Recreation Plan, would result in the reduction of $516,800 in EAD, but would have a residual EAD of $288,700. This plan would permanently evacuate 42 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 2, there would be an overall residual EAD of $518,200 and 407 structures remaining in the 500-year floodplain in the study area.

Alternative 5, Reach 2 Partial 25-year Floodplain Evacuation with Recreation Plan, would result in the reduction of $561,500 in EAD, but would have a residual EAD of $244,000. This plan would permanently evacuate 62 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. Because this alternative only targets Reach 2, there would be an overall residual EAD of $473,500 and 387 structures remaining in the 500-year floodplain in the study area.

Alternative 6, or the Reach 2 VDS Plan, would result in the reduction of $561,500 in EAD, but would have a residual EAD of $244,000. From a flood risk management perspective, this plan has the same flood benefits, footprint, and risks as Alternative 5.

Alternative 7, or the Reach 2 25-year Floodplain Evacuation with the VDS Recreation Plan, would result in the reduction of $693,200 in EAD, but would have a residual EAD of $112,300. As compared to the other justified alternatives, this plan provided the least amount of residual risk, but also the lowest net benefits due to the cost. This plan would permanently evacuate 111 structures from the floodplain, so the risk of failure of this alternative would be nonexistent. This plan would be more effective than Alternatives 4, 5, or 6 because it would remove all structures within the 25-year floodplain. The only structures that would be left to receive damages from flood inundation in Reach 2 would be located above the 25-year flood frequency. Because this alternative only targets Reach 2, it has an overall residual EAD of $341,800 and 338 structures would remain in the 500-year floodplain in the study area.

Alternative 8, or the Reach 2 Combination VDS with Small Channel Plan, would result in the reduction of $685,500 in EAD, but would have a residual EAD of $120,000. This plan would permanently evacuate 62 structures from the floodplain. The risk of failure from non-performance on these structures would be nonexistent. However, as part of the total benefits, this plan would also provide in reduction of EAD by implementing a small bench in addition to the floodplain evacuation to further reduce some of the damages that remain by implementing Alternatives 5 and 6. This would provide some level of protection to the 197 structures that would remain in the 500-year floodplain in Reach 2. The risk of non-performance of this structural component would be similar to that of Alternative 2, but to a lesser extent. Because this alternative only targets Reach 2, an overall residual EAD of $349,500 would remain in the 500-year floodplain in the study area.

NED Plan

Because it has the highest net benefits, the VDS Plan (Alternative 6) coupled with the Reach 1 10-year buyout with Recreation was selected as the NED plan. As discussed previously, this non-structural alternative would buy out 73 structures located on the south side of S. Espana Drive and the south side of Guatemozin Street in Reach 2 along the main stem of Chacon Creek. This alternative includes 51 structures in the 10% ACE (10-year), 19 structures in the 4% ACE (25-year), one in the 2% ACE (50-year), and two in the 1% ACE (100-year). Additionally, this alternative would buy out 11 structures in the 10% ACE (10-year). This alternative generates $629,000 in EAD benefits, $911,300 in recreational benefits for a total of $1,259,700.

Costs include $8,398,200 for the land and structures, $1,577,200 for demolition of these structures, $1,259,700 for real estate administration, and recreation costs of $9,066,500, for a total of $20,301,700. These costs annualize to $1,076,400 over 50 years. O&M costs are estimated at $117,900, for total annual costs of $1,194,300 including interest during construction. Net benefits for this alternative are $345,900 annually with a benefit/cost ratio of 1.29-to-1.00. The structures in Reach 2 to be bought out are the same structures as in the Partial 25-Year Buyout with Recreation. Recreational amenities for this plan are depicted in Figure A-14 and Figure A-15, for the Reach 1 component, along with Figure A-18.

Figure A-20 charts a comparison of the annual net benefits of each alternative investigated.

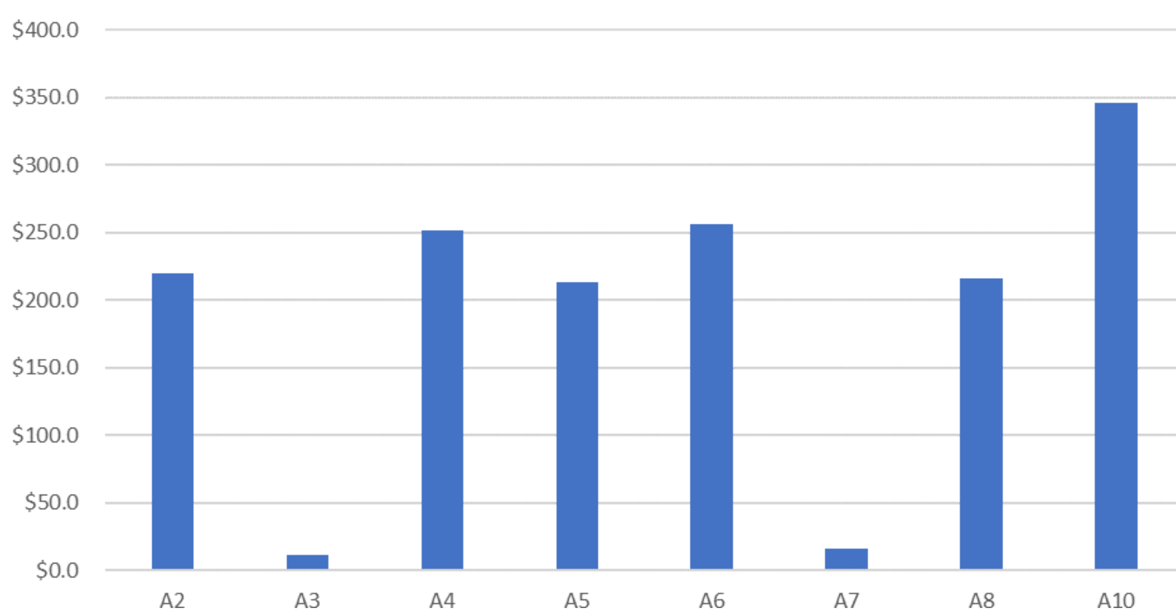

Figure A-20. Net Benefits for All Investigated Alternatives (2010 Dollars)

IMPACT ASSESSMENT OF TENTATIVELY SELECTED PLAN

This section describes the impacts to socioeconomics and environmental justice for the recommended alternative.

Socioeconomics

Overall, there would be positive and negative effects to socioeconomics as a result of implementation of the Tentatively Selected Plan. The long-term annual savings from the reduction of $629,000 in expected annual damages in the area would have positive impact. Short-term employment effects associated with project construction would stimulate increased demand for construction materials and services. These expenditures would be expected to have a positive multiplier effect on the local community and would last for the period of construction, which is estimated at 24 months. The reduction in the number of properties located in the study area would result in a decrease in the local tax base by taking property off of the tax rolls. This loss could be offset by higher valued properties being built elsewhere in the study area, partially due to the increased environmental and recreational amenities offered by the project.

Environmental Justice

The permanent evacuations in the tentatively selected plan do not disproportionately target or impact minority populations within the project area. Because median income is likely at or near the poverty level for the census block where the permanent evacuation would occur, there could be implications to low income populations. Comparable housing availability should not be an issue, because the city has experienced considerable growth since the advent of North American Free Trade Agreement (NAFTA). Housing of last resort—which may involve the use of replacement housing payments that exceed Uniform Act amounts or other methods of providing comparable decent, safe, and sanitary housing within a person's financial means—might be necessary however, to provide adequate replacements for those being permanently evacuated.

Human Health and Safety

The removal of 73 structures under the tentatively selected plan would alleviate much of the risk of flooding and would reduce the overall risk to public health and safety in the Villa Del Sol area. Because this alternative would only directly impact buyouts, the risk to the remaining structures would continue, but because the structures being bought out are at the highest risk of flooding, the overall risk is substantially reduced. Some of the 73 structures are removed to prevent individual structures or clusters of structures being isolated and thereby maintain a degree safety. Additionally, houses that potentially contain lead-based paint and asbestos will be removed from the city's housing stock. Improvements and alterations made to utility and transportation infrastructure to accommodate the evacuation of residential structures and the implementation of recreational features in their place will also improve the health and safety of the residents remaining in the area.

TENTATIVELY SELECTED PLAN (NED)

2018 Updates

The tentatively selected plan has been re-analyzed to update costs and benefits to 2018 dollars, and current discount rates. The tentatively selected plan from 2010 has been assumed to be the same, and therefore the updates have been applied to the VDS Plan (Alternative 6) coupled with the Reach 1 10-year buyouts, which is reflected in Alternative 10 in the above analysis. In order to update the analysis, several modifications to the existing data were completed. These changes to the analysis are discussed in the following sections.

FDA Model Updates

Several changes have been made to the existing FDA model to generate the estimated benefits for the tentatively selected plan. Table A-26 reflects the EAD results from the new FDA analysis.

1. Structure value costs were escalated based on Marshal & Swift escalation factors. These escalation factors are separated by the “structure class” which is the primary building materials for the structure. Since a majority of the structures are likely to have structure class C (concrete) or D (wood), the two escalation factors for these classes were used. Class C structures were estimated to have an escalation factor from Marshal & Swift of 1.183, and class D structures have an estimated escalation factor of 1.204. All structures were modified based on these two rates.

2. To verify whether any further depreciation has occurred over the study area, a re-sampling of 20 random structures was completed. Marshal & Swift valuations were re-calculated, and then compared to the 2010 study values for the same structure. The results of this comparison showed that on the whole, there has not been significant depreciation of all structures.

3. No new hydraulic information was developed for these updates. The hydrology identified during the plan formulation phase of the 2010 study still represents current conditions. Therefore, the same hydraulic inputs were used in the FDA analysis. The same depth-damage functions were used as well. Additionally, no new structures have been added to the study, as very few new structures have been built in the area. The few that have been constructed since 2010 are well out of the floodplain based on field visits.

4. Based on discussions with the City of Laredo, as well as a field visit and recent aerial imagery, there have already been eleven (11) structure evacuations, and/or structures have been removed for other reasons. Since these structures are no longer there, they have been removed from the structure inventory, and are not included in the updated

benefits calculations. Figure A-21 shows the location of the structures that have been removed from the analysis.

Table A-26. 2018 FDA EAD Results by Plan and Structure Type ($1,000s)

Plan	C	MFR	MR	P	POV	R	Total
Without Proj.	$1.3	$6.1	$13.5	$0.02	$126.7	$566.9	$714.5
With Project	$1.3	$6.1	$9.8	$0.02	$56.8	$238.4	$312.5
						Net EAD Benefits:	$402.0

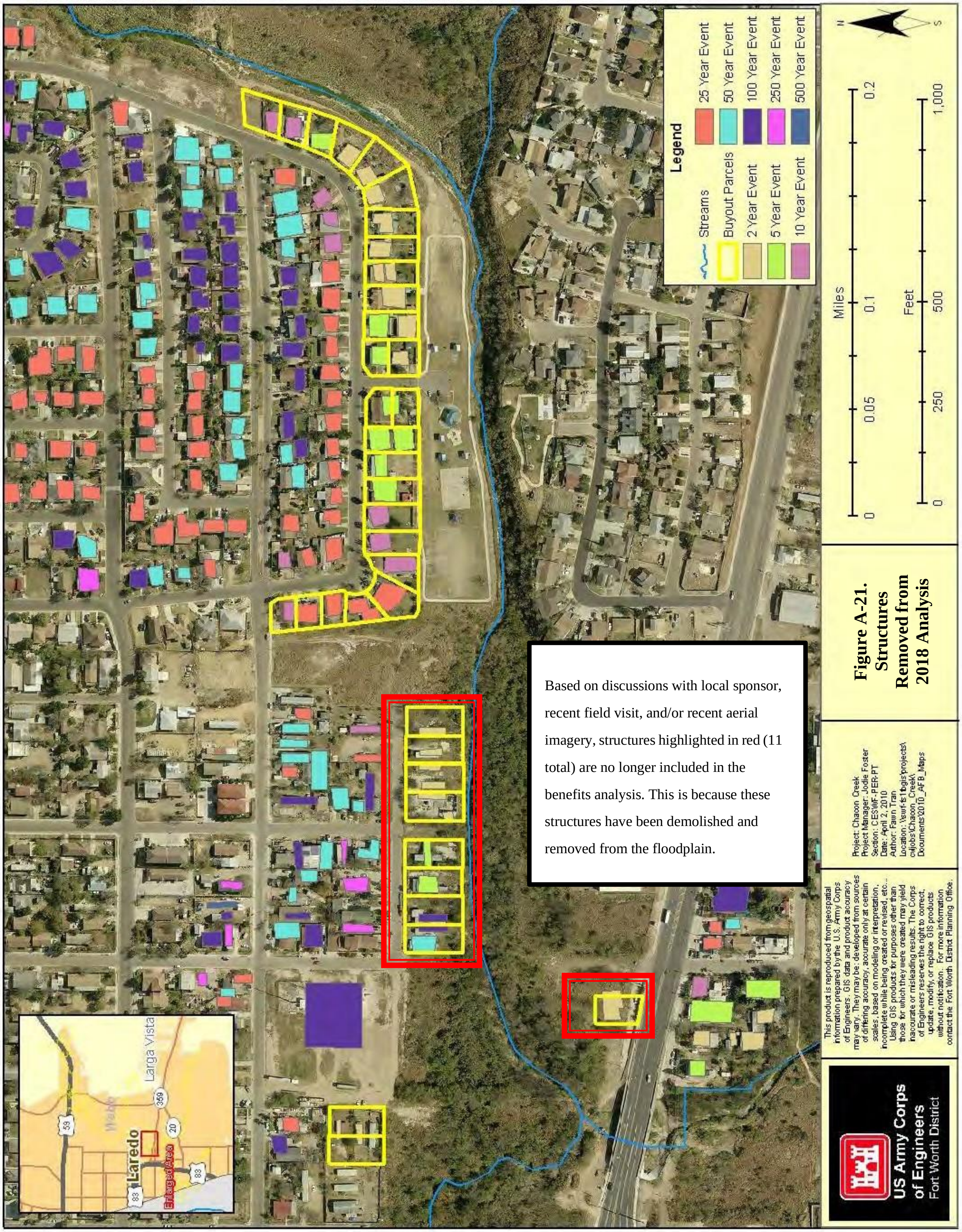

Figure A-21. Structures Removed from 2018 Analysis

Image Source: USACE, 2010

Recreation Updates

The same recreation plan for the VDS alternative is included in the current updates. However, the number of visitor days and unit day values have been updated. In terms of the visitor days, it has been assumed an increase of 2 percent of visitors to the average annual visitation numbers for each recreation opportunity proposed. Based on the demographic data, Webb County has seen an increase in population of approximately 36 percent since 2000. With this large population increase, and continued expected increase over the next 40 years, an assumed 2 percent increase to the average annual residents using the newly proposed recreation facilities appears reasonable.

The unit day values (UDV) have been updated as well based on the latest Economics Guidance Memorandum 18-03, Unit Day Values for Recreation for Fiscal Year 2018. The 2018 points to dollars conversion is provided in Table A-27.

Table A-27. Conversion of Points to 2018 Dollars

Point Value	General Recreation Value ($)
0	4.05
10	4.81
20	5.32
30	6.08
40	7.59
50	8.61
60	9.37
70	9.87
80	10.89
90	11.64
100	12.15

The assessed point value from the original alternatives analysis is assumed to still be accurate. The point value is equal to 38 which equates to $7.29. Table A-28 provides the updated benefits calculation with the changes in visitation and updated points to value results.

Table A-28. Updated Recreation Benefits for TSP (2018 Dollars)

Activity	Visitor Days	Number	Unit	Annual Benefits
Picnic Site	1,958	12	Tables	$171,286
Multiuse Open Space (Unreserved)	45,713	5.5	Acres	$333,248
Multiuse Open Space (Reserved)	10,710	7	Acres	$78,076
Large Playground (1 large = 4 small)	21,418	4	Sites	$156,137
Medium Playground	10,709	2	Sites	$78,069
Large Group Shelter	2,040	1	Site	$14,872
Amphitheatre	3,060	1	Site	$22,307
Multiuse Courts	780	1	Site	$5,686
Total Benefits				**$859,681**

Real Estate Updates

The detailed costs in the Real Estate Appendix have been used in this analysis. Each of the costs has been escalated based on real estate index values calculated for the City of Laredo by the Federal Reserve Bank of St. Louis. See Appendix D for more detailed Real Estate cost information.

Figure A-22. Laredo Real Estate Price Index from Federal Reserve Bank of St. Louis

Tentatively Selected Plan Results

Table A-29 presents the economic summary for the flood risk management and recreation components of the Recommended NED Plan. In accordance with current regulations, costs for real estate relocation assistance are not considered economic costs in the determination of economic feasibility, but are appropriately shown as financial costs of the project. It is also assumed that all real estate costs were developed in accordance with non-structural evacuation procedures. Lands and damages costs are based on the real estate plan for Chacon Creek and construction costs are based on the escalated costs to 2018 dollars from the original MCACES estimate produced by Cost Engineering.

The Tentatively selected plan would have annual costs allocated to flood risk management and recreation of $1,075,100; total annual economic benefits of $1,453,900; annual net benefits of $378,800; and a BCR of 1.35-to-1.00.

Table A-29. Economic Summary for Tentatively Selected Plan (Feb. 2018 Prices; 2.75%)

Project Cost Items	Values
Flood-Risk Management	
Lands and Damages	$6,983,800
Relocation Assistance	$2,368,000
Construction	$2,110,000
Engineering and Design	$189,855
Construction Management	$189,855
Real Estate Contingency	$1,784,100
Total Flood-Risk Management	$13,726,310
Interest During Construction	$382,700
Total Investment Cost	$14,109,010
Annual Investment Cost	$522,600
Flood Risk Benefits	$594,200
Benefit-to-Cost Ratio (Flood Risk Management	1.14
Recreation	
Construction	$9,615,000
Engineering and Design	$865,145
Construction Management	$865,145
Total Recreation Cost	$11,345,290
Interest During Construction	$316,300
Total Investment Cost	$11,661,590
Annual Investment Cost	$432,000
OMRR&R**	$120,500
Total Annual Cost	$552,500
Recreation Benefits	$859,681
Benefit-to-Cost Ratio	1.56
Total TSP (Flood Risk Management and Recreation	
Total First Costs	$25,770,600
Interest During Construction	$699,000
Total Investment Cost	$26,469,000
Annual Investment Cost	$954,600
OMRR&R**	$120,500
Total Annual Costs	$1,075,100
Total Annual Benefits	$1,453,881
Net Annual Benefits	$378,781
Benefit-to-Cost Ratio	1.35

Sensitivity Analysis and Risk & Uncertainty

There is inherent uncertainty regarding the recreational benefits developed in this study. The uncertainty primarily relates to the estimation of the annual visitation for the various recreation activities that are planned. To account for this uncertainty, several approaches have been taken to analyze the impact that changes to the estimated visitation numbers would have on the total benefits calculation.

Sensitivity Analysis

The recommended NED plan has an estimated annual recreation benefits of $859,700. This value is based on estimated annual visitation estimates for the proposed recreation activities that would be built post-structure buyout and demolition. Visitation estimates are typically a source of uncertainty in recreation analyses, and they are instrumental in the benefits calculation procedure.

The sensitivity analysis completed here within has been calculated to estimate at what level of reduction in annual visitation would result in a benefit-to-cost ratio that falls below the 1.0 rate for the NED recommended alternative. In order for this to be accomplished, annual visitor rates would need to fall approximately 31 percent, from the visitation values shown in Table A-28. The comparison of several iterations of reductions to visitation is provided in Table A-30.

Table A-30. NED Recreation Plan Sensitivity Analysis Results

Item Description	Current Visitation	Visitation Reduced 50%	Visitation Reduced 25%	Visitation Reduced 31%
Flood Benefits	$594	$594	$594	$594
Recreation Benefits	$860	$430	$645	$653
Total Benefits	$1,262	$832	$1,047	$1,055
Total Annual Costs	$1,075	$1,075	$1,075	$1,075
BC Ratio	1.20	0.79	0.99	1.00

Risk & Uncertainty Distributions

A second methodology for analyzing the inherent risk in the visitation rates, is to use simulation software that is able to analyze distributions for the data, and output a resulting visitation number for the recreation activities based on the distribution parameters. For this study, Oracle's Crystal Ball software has been used, and each of the recreation activities has been assigned a low and high value, with the current value set as the mean. These values are then assigned as a triangular distribution for which the program simulates 10,000 events and generates total visitation rates for designated confidence intervals.

Assuming a standard confidence interval value of 80 percent, and assuming triangular distributions with a 33 percent decrease in visitation on the low end, and 10 percent increase in visitation on the high end, the simulations estimate that the annual net benefits would equal $827,800. The total net benefits is slightly lower calculating it with risk and uncertainty. However, this would still result in a final benefit-to-cost ratio of 1.32, which is marginally lower than what was calculated in Table A-29.

APPENDIX B

ECOSYSTEM RESTORATION (ENVIRONMENTAL)

Ecosystem Restoration (Environmental) Appendix

Chacon Creek, Laredo, Texas

August 2018

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Table of Contents

List of Figures

List of Tables

Addenda

Addendum A 2017 HEP Report

Addendum B Plant List

Addendum C IBI Report

Acronyms and Abbreviations

BA	Biological Assessment
BMPs	Best Management Practices
cm	centimeters
DS	Defensible Space
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
HFR	Hazardous Fuels Reduction
HMGP	Hazard Mitigation Grant Program
NMED	New Mexico Environment Department
PCE	Primary Constituent Element
MBTA	Migratory Bird Treaty Act of 1918
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service

Introduction

This Biological Assessment (BA) was produced by Tetra Tech to evaluate proposed Ecosystem Restoration (ER) measures presented in the Chacon Creek, Laredo, Texas Feasibility Report and Environmental Assessment (City of Laredo, 2018). Aspects of this BA originated in the initial 2007 Existing Conditions Report (ECR)/Feasibility Study titled, "Chacon Creek, Laredo, Texas, Draft Feasibility Report and Environmental Assessment" which was produced to assess challenges related to the flood threat, aquatic and riparian ecosystem restoration, and recreation opportunities in the corridor. Although the 2007 effort and analysis is referenced in this report, this BA constitutes a complete reanalysis of potential impacts to special status species.

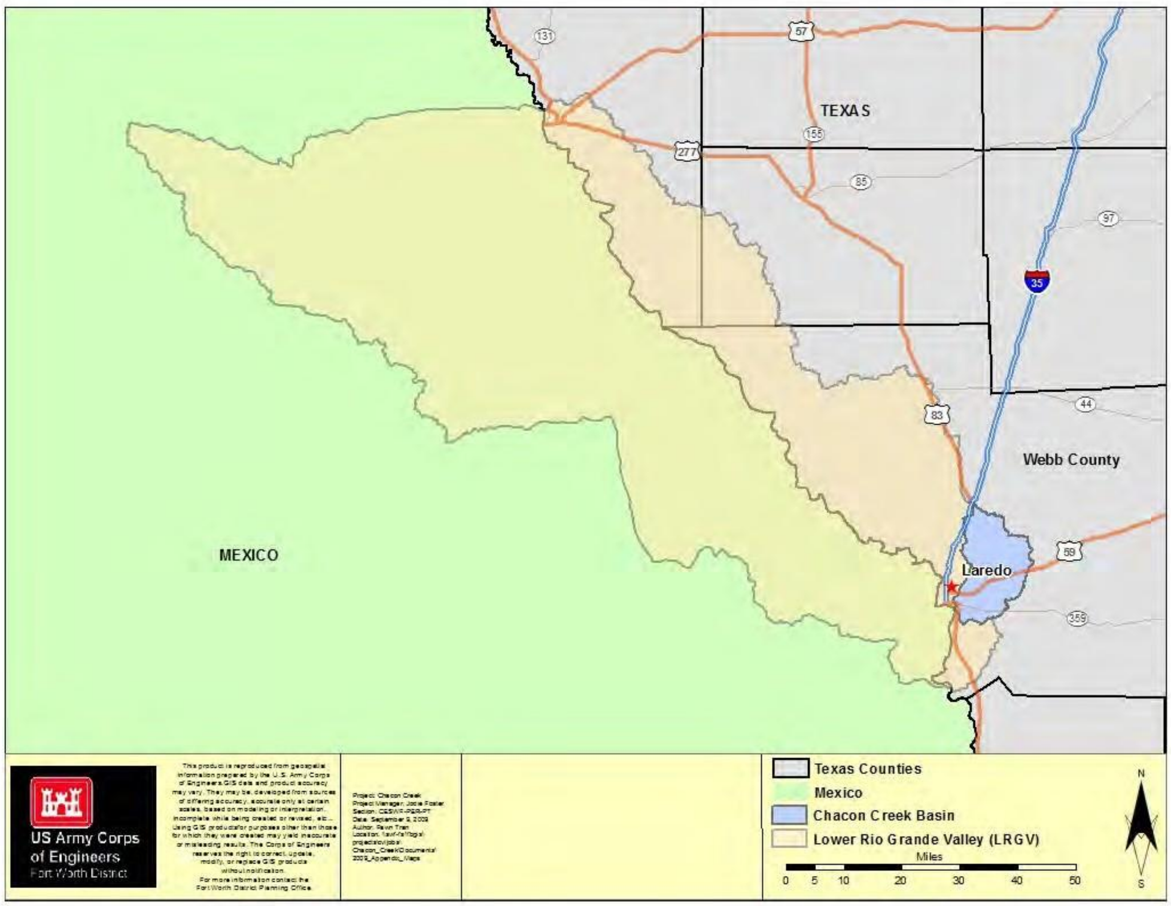
The removal of vegetation, rapid urban development, alteration of flows, and invasion of exotic species have affected both terrestrial and aquatic habitats in the lower Chacon Creek watershed. This appendix provides background information on the biological resources of the lower Chacon Creek watershed and the results of a baseline assessment of the availability of habitats for common wildlife for the Chacon Creek Feasibility Study, which identifies potential measures that could be implemented to reduce the risk of flooding and restore degraded aquatic ecosystems. Specifically, this ECR updates information from the 2007 Feasibility Study report and provides a current analysis of soils, current and historical vegetation communities and wildlife populations, threatened and endangered species, and other pertinent natural resources information applicable to restoration measures and potential flood reduction measures.

The 2007 ECR provided an assessment of the suitability of habitats for wildlife species following Habitat Evaluation Procedures (HEP). Five Habitat Suitability Index (HSI) models were selected for the 2007 assessment and approved by the United States Fish and Wildlife Service (USFWS) following a site visit and meeting. In 2017 a HEP analysis was performed to update conditions described in 2007 and provide current information regarding the quality and quantity of available habitat for target wildlife species. The analysis performed in 2017 using the same five species selected in 2007 to evaluate existing habitat conditions in each of five cover types in the study area. Three species models were used to develop models in two cover types. These data were used to determine the suitability of existing habitats based on one or more of the seven HSI models. The availability of habitat is provided as a function of area and suitability. The complete HEP report and associated species tables is presented in Addendum A and a detailed explanation of HEP methodology is described in the following sections below.

1.1 Study Area

The study area is located in the City of Laredo, Texas in the Lower Chacon Creek corridor, which is situated in the larger San Ambrosia-Santa Isabel watershed (8-digit Hydrologic Unit Code (HUC) 13080002) within the Lower Rio Grande Valley (LRGV) (Figure 1). The lower Chacon Watershed is approximately 37.8 square miles and is defined as the sub-basin downstream from Casa Blanca Lake. The Laredo International Airport is located immediately west of Casa Blanca Lake and is in the northern part of the Lower Chacon Creek watershed. Average elevation is approximately 430 feet (ft) above mean sea level. The entire Chacon Creek watershed is approximately 155.2 square miles. Tributaries to Chacon Creek below

Casa Blanca Lake include Tinaja and TexMex creeks. The proposed environmental components detailed in the study are approximately 550 acres in size. The City of Laredo is just north of the Rio Grande in Webb County, approximately 120 miles south of San Antonio, Texas and is a major trucking route for international trade between the United States and Mexico. The City of Laredo and Webb County are currently experiencing rapid growth causing increased development in the Chacon Creek watershed.



(Image source: USACE, 2010)

Figure 1. Lower Rio Grande Valley

Suitability for common wildlife was assessed for all habitats within the study area, which includes undeveloped lands and city-owned property within the Chacon Creek floodway south of the spillway at Casa Blanca Lake. Casa Blanca Lake and Chacon Creek are located along the eastern and southern edge of development associated with the City of Laredo. A majority of the study area is bordered by residential and commercial development. Although much of the watershed west of Chacon Creek and a substantial portion of lands adjacent to the study area are within the 100-year floodplain and have been developed, a large portion of the watershed east of the creek and north of Casa Blanca Lake remains relatively undeveloped.

Lower Chacon Creek is situated in the within the Texas-Tamaulipan thornscrub within the southern Texas plains ecoregion (Griffith et al. 2004) and experiences a hot semi-arid climate (Kottek et al. 2006). Average annual precipitation is 19.6 inches (PRISM, 2004). The area is characterized by drought-tolerant, small-leaved, and often thorny small trees and shrubs. Native vegetation in the study area includes upland plant communities consisting of disturbed honey mesquite (*Prosopis glandulosa*) and prickly pear (*Opuntia* spp.) savannas with low vegetation diversity and little structural diversity. Common understory shrubs include Brazilian bluewood (*Condalia hookeri*), lime pricklyash (*Zanthoxylum fagara*), Texas persimmon (*Diospyros texana*), lotebush (*Ziziphus obtusifolia*), spiny hackberry (*Celtis ehrenbergiana*), kidneywood (*Eysenhardtia texana*), coyotillo (*Karwinskia humboldtiana*), Texas paloverde (*Parkinsonia texana*), anssacahuita (*Cordia boissieri*). Typical upland xerophytic species located on hillsides and gravelly ridges include blackbrush (*Vachellia rididula*), guajillo (*Senegalia berlandieri*), and Texas barometer bush (*Leucophyllum frutescens*). Riparian vegetation communities in the study area vary in structure and species composition. Riparian species consist of an herbaceous layer containing an assemblage of native and non-native species, however the area is dominated by invasive grasses and most sites lack herbaceous species diversity. Common riparian plant species consist of sugarberry (*Celtis laevigata*), cedar elm (*Ulmus crassifolia*), and Mexican ash (*Fraxinus berlandieriana*), and codominant stands of salt cedar (*Tamarisk* spp.), Mexican sabal palm (*Sabal mexicana*), and Mexican ash (*Fraxinus berlandieriana*). Hydric habitats support black willow (*Salix nigra*), black mimosa (*Mimosa pigra*), common reed (*Phragmites australis*), giant reed (*Arundo donax*), and hydrophytes such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and sedges (*Carex* spp.).

A list of plant species recorded during 2017 field surveys is provided in Addendum B.

1.1.1 Resource Significance

The focus of the U.S. Army Corps of Engineers (USACE) ecosystem program is aquatic ecosystem restoration. As stated in ER 1105-2-100, “those restoration opportunities that are associated with wetlands, riparian and other floodplain and aquatic systems are most appropriate for Corps involvement” (USACE 2000). The Policy Guidance on Authorization and Budget Evaluation Criteria for Aquatic Ecosystem Restoration Projects summarizes budgetary significance criteria to include scarcity, connectivity, special status species, plan recognition, and self-sustainability. These criteria are further discussed in EC 11-2-187, which defines the specific requirements for rating the criteria.

1.1.2 Scarcity

Scarcity refers to the scarcity of the habitat to be restored and is based on trend information and relative abundance of the habitat. According to estimates, Texas has lost approximately 52 percent of its wetlands (Teal and Johnston, 2004). Wetlands are known to provide important ecological functions including flood control, water quality improvements, and increases in biodiversity, and to provide valuable tourism and educational opportunities as well. Wetlands provide habitat for birds and are well known for being good bird watching areas and for providing important nursery habitat for a variety of aquatic species (Teal and Johnston, 2004). Additionally, the study area is within the Tamaulipan brushland ecosystem, which is limited to portions of south Texas and northeastern Mexico. The extent of riparian areas in the in the Tamaulipan brushland ecosystem of southern Texas plains has been severely diminished by various land use activities. Most native Tamaulipan brushland has been cleared and converted to agricultural land uses and only 1 percent of riparian areas in this ecosystem are intact (Jahrsdoerfer and Leslie 1988). Only about two percent of this ecoregion remains as intact habitat, and most of the remaining area has been heavily altered by human activity. This ecoregion contains no habitat blocks larger than 96 square miles and lacks protected areas. Only small patches of the original landscape remain. These remnants are largely isolated and provide little opportunity for species dispersal (World Wildlife Organization, 2009).

The 2007 ECR surveyed and evaluated habitat within the study area and presented baseline environmental conditions, in which degraded wetland, aquatic, riverine, and riparian shrubland habitats were identified within the study area. The 2007 ECR used the Index of Biological Integrity (IBI) to evaluate aquatic habitat for wildlife, which included a baseline fisheries survey using data collected in 2006. Migratory birds known to use remnant wetlands near Laredo include white-collared seedeater (*Sporophila torqueola*), red-billed pigeon (*Patagioenas flavirostris*), gray-crowned yellowthroat (*Geothlypis poliocephala*), Muscovy duck (*Cairina moschata*), and the masked duck (*Nomonyx dominicus*). A breeding bird species and migrant species was conducted in 2001 at several sites in the Laredo area. A total of 150 species of birds were detected in the Laredo area, including rare tropical species (white-collared seedeater, clay-colored robin (*Turdis* grayi), and the red-billed pigeon) and several western species at the eastern extent of their range (Woodin et al. 2001). More recently, Skorrupa and others documented nocturanal avian species along the Rio Grande in south Texas, noting high density of nightjars such as the common poorwill (*Phalaenoptilus nuttallii*), lesser nighthawk (*Chordeiles acutipennis*), and pauraque (*Nyctidromus albicollis*) (2009).

The 2007 ECR also identified two areas, approximately 3.5 acres, within the study area as Palustrine Wetland, which appeared to be permanently flooded with at least some herbaceous emergent vegetation along the channel edges and some persistent stems of inundated wood in areas of open water. Several factors influence the quality of these identified wetland habitats. High rainfall events and storm water runoff during urban construction have caused soil erosion and increased sedimentation of these wetland habitats, which threatens their sustainability. The presence and operation of an existing concentrated animal feeding operation (CAFO) adjacent to the stream introduces nutrient-laden livestock waste runoff to the system, which increases eutrophication of these wetlands. Further, low to stagnant water flows during much of the year limits the stream’s ability to flush excessive nutrients and sediment from these wetlands to maintain the quality and suitability of wetland habitat. These conditions provide an opportunity to restore identified habitats because much of the present watershed has been fully built-out and soil erosion from land development is a negligible factor. In stream restoration opportunities include consideration of the removal of the CAFO, increasing the depth and spatial extent of these wetlands, increasing water supply and quality, and adding in-stream structures to increase oxygenation. Restoration activities outside of the Chacon Creek channel include removal of invasive woody and grass species, and selective planting of native species, including some maintenance measures.

Several introduced, invasive plants are presently well established in the riparian shrubland habitat and throughout the project area. The most significant are buffelgrass (*Pennesetum ciliare*), Kleberg bluestem (*Dichanthium annulatum*), salt cedar, guineagrass (*Urochloa maxima*), giant reed (*Arundo donax*), castorbean (*Ricinus communis*), and Russian thistle (*Salsola* spp.). Invasive white leadtrees (*Leucaena leucocephala*) are present at low abundance. Invasive species, such as those listed above, disrupt ecosystem function, alter habitat conditions, and represent a threat to native vegetation and associated ecosystems (Marshall and Ostendorf 2011). Riparian restoration should include consideration of measures for removal and control of invasive-introduced species, followed by planting native riparian vegetation which would provide high quality habitat and forage. The introduction and spread of buffelgrass presents a threat to biodiversity in the study area (Marshall et al. 2012).

A baseline fisheries survey conducted in 2006 characterized the fish assemblages inhabiting Chacon Creek as "limited to intermediate." The survey concluded that the limited to intermediate characterization of the fish community could possibly be attributed to nominal stream habitat, marginal water quality, and/or limited in-stream flow. The survey recommends consideration of measures to enhance in-stream structure and water flow to provide suitable conditions for the improvement of fish habitat. Although no water quality testing was conducted, it was apparent that the presence and operation of the CAFO facility adds nutrient inputs to the system. It is expected that removal of the CAFO, as well as increasing water supply, flow, and oxygenation would improve water quality and provide positive opportunities for improved aquatic stream habitat in the area.

1.1.3 Connectivity

Connectivity addresses the extent to which a project facilitates the movement of native species by contributing to the connection of other important habitat pockets within the ecosystem, region, watershed, or migration corridor. The ecosystem restoration proposed along Chacon Creek would create an approximately five-mile-long continuous corridor between Casa Blanca Lake and the Rio Grande. The restoration plan would connect remnant habitats along Chacon Creek with the Rio Grande riparian corridor, which contains important habitat for federally listed species and is a critically important ecosystem for native southern Texas plains flora and fauna.

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Special Status Species

Two agencies are responsible for the protection of animal and plant species in Texas: The USFSW under authority from the Endangered Species Act (ESA) of 1973 (16 USC, Section 1531 et seq.) as amended, lists federal threatened and endangered species, and the Texas Parks and Wildlife Department (TPWD) provides a listing of threatened and endangered species within the borders Texas on a county-by-county basis. A list of threatened, endangered, and candidate species was acquired from the USFWS Information, Planning and Conservation System (IPaC) system to analyze potential effects under actions proposed in this report. A state list for Webb County, Texas was generated for further review pertaining to state listed species. Species listed under USFWS IPaC and TPWD are presented in Table 1. The list of threatened and endangered species is subject to change and information in the table should be confirmed if proposed actions are implemented.

Table 1. Threatened, Endangered, and Candidate Species in the Project Area

Taxon	Common Name	Scientific Name	Status		Habitat Type
			USFWS	TPWD	
Birds	Wood Stork	*Mycteria americana*		T	Marsh
Birds	Common Black-Hawk	*Buteogallus anthracinus*		T	Forested/Open
Birds	Peregrine Falcon	*Falco peregrinus*	DL	T	Open/Coastline/ Riparian
Birds	American Peregrine Falcon	*Falco peregrinus anatum*	DL	T	Open/Coastline/ Riparian
Birds	Interior Least Tern	*Sterna antillarum athalassos*	E	E	Riparian/Coastline
Fishes	Rio Grande silvery minnow	*Hybognathus amarus*	E	E	Aquatic
Fishes	Blue sucker	*Cycleptus elongatus*		T	Aquatic
Fishes	Rio Grande darter	*Etheostoma grahami*		T	Aquatic
Mammals	Gray wolf	*Canis lupus*	E	E	Grassland/Forest/ Desert
Mammals	Black bear	*Ursus amesssricanus*		T	Chaparral
Mammals	White-nosed coati	*Nasua narica*		T	Forested
Mammals	Ocelot	*Leopardus pardalis*	E	E	Forested/Riparian
Mammals	Jaguarundi	*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*	E	E	Desert Scrub/Forest
Reptiles	Texas tortoise	*Gopherus berlandieri*		T	Desert Scrub/ Grasslands
Reptiles	Reticulate collared lizard	*Crotaphytus reticulatus*		T	Desert Scrub/Rock Outcrops
Reptiles	Texas horned lizard	*Phrynosoma cornutum*		T	Open
Reptiles	Texas indigo snake	*Drymarchon melanurus erebennus*		T	Riparian
Mollusks	Texas hornshell	*Popenaias popeii*	E	T	Aquatic
Mollusks	Mexican fawnsfoot mussel	*Truncilla cognata*		T	Aquatic
Mollusks	Salina mucket	*Potamilus metnecktayi*		T	Aquatic
Plants	Ashy dogweed	*Thymophylla tephroleuca*	E	E	Grasslands

DL Delisted due to recovery

T Threatened

E Endangered

There are several federal and state listed threatened and endangered species in Webb County. Some species listed as threatened or endangered use habitats similar to those found in the study corridor. However, none of these species are known to still occur in the study area. The two listed cats, the ocelot (*Leopardus pardalis*) and the Gulf Coast jaguarondi (*Herpailurus yagouaroundi cacomitli*), could exist in riparian areas of the Rio Grande corridor and may potentially use the Chacon Creek corridor. The Texas hornshell (*Popenaias popeii*) is a federally endangered species and could occupy aquatic habitats in the project area.

Listed in 1972, historical records indicate that the ocelot once occurred throughout south Texas, the southern Edwards Plateau, and along the Coastal Plain. Today, its range is the south Texas brush country and lower Rio Grande valley, although unconfirmed sightings have been reported west of Chacon Creek in Maverick County, Texas. Ocelots are endangered because their habitat (including riparian shrubland) has been cleared for farming and growth of cities. Only about 30 to 35 ocelots live in the shrublands remaining at or near the Laguna Atascosa National Wildlife Refuge near Brownsville, Texas. In 1995, it was estimated that 80 to 120 individuals lived in Texas (TPWD 2018a).

Listed in 1976, the jaguarundi is so elusive that researchers have been unable to estimate how many are left in the wild. Like the ocelot, the jaguarundi is found in dense, thorny shrublands. Jaguarundi are endangered because the dense brush that provides habitat has been cleared for farming or for the growth of cities. Jaguarundi still exist in Mexico, but they are now very rare in Texas. They are found in the south Texas brush country and lower Rio Grande valley, although unconfirmed sightings have been reported west of Chacon Creek in Maverick County, Texas (TPWD 2018b).

The Texas hornshell was listed as a federally endangered species on March 12, 2018 (USFWS 2018a). The species was previously under a candidate review for listing since November 15, 1994. (USFWS 2016). The Texas hornshell is a native freshwater mussel found in undercut banks, under large boulders, and among travertine shelves in medium to large rivers (USFWS 2016). Texas hornshell is known to occur in Texas waters and has been documented in the Rio Grande near Laredo. No recovery plan has been issued for the Texas hornshell, nor has any critical habitat been designated for the species.

The 2007 ECR identified the study area as low quality habitat for the ocelot and jaguarundi, but also stated the potential of these cats to migrate through the study area near the Rio Grande. In a 2008 site visit report, the USFWS referred to the project area as potential migratory habitat for the federally listed ocelot and jaguarundi. Habitat suitability for the ocelot and jaguarundi could be improved with the restoration of riparian shrubland and by reconnecting the riparian corridor of the Chacon Creek watershed with the Rio Grande.

1.2 Plan Recognition

Plan recognition recognizes Corps ecosystem restoration projects that contribute to watershed or basin plans as emphasized in the “Civil Works Strategic Plan.” There are several planning initiatives within the Rio Grande Basin and many active basin studies, restoration projects, and research groups.

- *Section 206 Aquatic Ecosystem Restoration Project, USACE*. USACE, with the City of Laredo as the non-Federal sponsor, conducted a feasibility study on a proposed 130-acre aquatic ecosystem restoration area adjacent to the Rio Grande, along a 90-degree bend in the southwest portion of the city. This study was initiated about the same time as the Chacon Creek Feasibility Study; however, it was studied under Section 206 (Aquatic Ecosystem Restoration) of the USACE Continuing Authorities Program. The study was completed in 2013, the design was completed in 2015, and construction began in 2016 (USACE 2013).
- *Lower Rio Grande Ecosystem Initiative, Columbia Environmental Research Center, USGS*. The Lower Rio Grande Ecosystem Initiative was established by the National Biological Service (now the Biological Resources Division of the U.S. Geological Survey) to address research and information needs along the Lower Rio Grande from Elephant Butte Reservoir to the Gulf of Mexico (USGS 1999).
- *Rio Grande Basin Initiative, Texas Water Resources Institute, Texas A&M.* Congress initially appropriated funds in 2001 for the Efficient Irrigation for Water Conservation in the Rio Grande Basin project, also known as the Rio Grande Basin Initiative (RGBI). Through Extension and research efforts, Texas A&M AgriLife and the New Mexico State University College of Agriculture and Home Economics are implementing strategies for meeting present and future water demand in the Rio Grande Basin. These strategies expand the efficient use of available water and create new water supplies. (Texas A&M University 2018).
- *Middle Rio Grande Endangered Species Collaborative Program, USBR.* This program is organized to prevent the extinction and improve habitat for listed species in the Middle Rio Grande (MRG) (USBR 2018).
- *Regional Ecological Resource Assessment of the Rio Grande Riparian Corridor: A Multidisciplinary Approach to Understanding Anthropogenic Effects on Riparian Communities in Semi-arid Environments.* This study used remote sensing and field surveys to determine the extent of vegetation losses experienced in the LRGV (EPA 2000).
- *Lower Rio Grande Valley National Wildlife Refuge, USFWS.* The refuge connects natural existing tracts of brush lands left along the last stretch of the Rio Grande, and complements existing wildlife corridor, lands managed for the benefit of wildlife by the Texas Parks and Wildlife Department, National Audubon Society, The Nature Conservancy, private landowners, and the Santa Ana and Laguna Atascosa NWRs (USFWS 2018b).
- *Rio Grande International Study Center (RGISC)*, non-profit organization, partners with local and state organizations including Laredo Community College, with the mission to protect water

quality and to preserve water quantity in the Rio Grande watershed through research, education, and bi-national cooperation (RGISC 2018).

- *Mechanical Control of Carrizo Cane in the Rio Grande Basin in Texas, Department of Homeland Security, U.S. Customs and Border Protection (CBP), U.S. Border Patrol*. Dense cane stands along the Rio Grande obscures views of the riparian corridor and poses problems for USBP in accomplishing its goal of effective control of the border. A draft Environmental Assessment (EA) has been prepared to analyze and document potential environmental consequences associated with the proposed eradication project. The international border in the Laredo area and Chacon Creek are both within the cane control area (CBP 2016).

1.3 Self-sustaining

While the data used as a proxy for describing a plan's ability to be self-sustaining is only required during the pre-construction engineering and design (PED) and Construction phases, the concept should be considered during plan formulation. The ideal goal of most restoration is a self-sustaining ecosystem consisting of self-sustaining natural processes. The proposed plan for the study consists of initial construction along with some operation and maintenance requirements. As defined by EC 11-2-187, an average annual O&M cost per acre of $15.00 or less would be considered relatively low; an average annual O&M cost per acre greater than $15.00 but less than $100.00 would be considered medium; and an average annual O&M cost per acre that equals or exceeds $100.00 would be considered high. The average annual operation and maintenance cost per acre for this project is $11.61 (FY18 price level) and would be considered low as defined by EC 11-2-187 (see Table 2).

Table 2. NER Plan Costs

Project Cost Items	Scale A2	Scale B3	Scale C3	Scale G3	Total
First Cost	$284,282	$483,327	$143,107	$25,071,241	$25,981,957
Project Life (years)	50	50	50	50	50
Construction Period (months)	12	12	12	12	12
Interest During Construction	$3,611	$6,139	$1,818	$318,428	$329,996
Investment Cost	$287,893	$489,466	$144,924	$25,389,669	$26,311,952
Annualized Investment Cost	$10,664	$18,130	$5,368	$940,457	$974,619
Annual O&M Replacements	$837	$1,080	$536	$2,399	$4,852
Total Annual Charges	$11,500	$19,210	$5,904	$942,855	$979,469
With-Project Acres	5.99	8.69	2.07	401.12	417.870
With-Project AAHU	4.623	6.687	1.489	332.931	345.73
No-Action AAHU	0.229	0.268	0.01	181.307	181.814
Plan AAHU Gain	4.394	6.419	1.479	151.624	163.916
Annual Cost per AAHU Gain	$2,617.21	$2,992.68	$3,991.89	$6,218.38	$5,975.43
Annual Cost per Acre	$1,919.87	$2,210.59	$2,852.17	$2,350.56	$2,343.96
First Cost per Acre	$47,459.43	$55,618.76	$69,133.82	$62,503.09	$62,177.13
Average Annual O&M per Acre	$139.73	$124.28	$258.94	$5.98	$11.61

Evaluation of Habitats

For terrestrial habitats, Habitat Evaluation Procedures (HEP) were used to evaluate the suitability of riparian and wetland habitat for wildlife in the study area. A fisheries survey and an Index of Biotic Integrity (IBI) was used to assess the aquatic habitat in the study area.

1.4 Habitat Evaluation Procedures

A HEP (USFWS, 1980, 1981) study was used to evaluate the suitability of existing riparian and wetland habitats for wildlife in the study area, and to quantify the amount of habitat in 2007 and in 2017 (see Addendum A). HEP is a system that uses a habitat sampling approach to assess existing and future habitat suitability, compare study alternatives, and analyze mitigation measures to offset study impacts.

In a typical HEP study, several evaluation species are chosen for each cover type in the study area. Species are chosen because of their ecological, recreational, or economic value, or because they represent groups of species (guilds) that have similar habitat needs. The suitability of habitats is then quantified through the measurement of conditions described by a HSI model for each evaluation species. Habitat conditions for each HSI model are measured from maps, aerial photographs, or by onsite sampling and used to calculate an HSI value as described by the HSI models. The resulting HSI value represents the suitability of habitats on a scale from 0.0 (unsuitable) to 1.0 (suitable). The availability of habitats in the study area is quantified as Habitats Units (HU). HUs are derived for evaluation species and cover type by multiplying the HSI value (suitability) of a given habitat or cover type by the number of acres (area) in the study area.

1.4.1 Selection of Evaluation Species

The species selected for this evaluation are representative of common wildlife likely to utilize habitats found in small drainage corridors of the southern Texas plains ecoregion. The list of published HSI models was searched for species whose range is contiguous with the study area and that utilize habitats existing in the study area or habitats which could be restored or created within the study area as a result of restoration efforts.

In 2007, a total of eight HSI models were initially selected as applicable for evaluation of the existing and potential habitats within the Chacon Creek floodway:

- American Coot (*Fulica americana*) (USFWS, 1985a),
- Beaver (*Castor canadensis*) (USFWS, 1982a),
- Belted kingfisher (*Ceryle alcylon*) (USFWS, 1985b),
- Eastern cottontail (USFWS, 1984a),
- Field sparrow (*Spizella pusilla*) (USFWS, 1983),

- Great egret (*Casmerodius albus*) (USFWS, 1984b),
- Red-winged blackbird (*Agelaius phoeniceus*) (USFWS, 1985c),
- Yellow warbler (*Dendroica petechia*) (USFWS, 1982b) models.

Due to the limited suitability of existing and potential habitats for the beaver and yellow warbler, these two models were determined to be non-effective and were subsequently eliminated from further consideration. Following a USFWS (2006b) evaluation of aquatic habitat suitability, the bluegill (*Lepomis macrochirus*) (USFWS, 1982c) was considered for inclusion in the habitat assessment. However, the bluegill model requires the evaluation of several variables for which no data exist and these data would be exceedingly difficult to measure, and impossible to measure within the time constraints of the study. Therefore, the slider turtle (*Pseudemys scripta*) (USFWS, 1986) was alternatively selected for the assessment of aquatic habitats.

The list of selected models approved by the USFWS and the USACE Ecosystem Restoration Planning Center of Expertise (ECO-PCX) for 2007 habitat assessment included the following:

- American Coot
- Belted Kingfisher
- Eastern Cottontail
- Red-wing Blackbird
- Slider Turtle

Of the five approved HSI models listed above, the eastern cottontail HSI model was modified to accommodate the specific ecosystem settings found in south Texas to adequately quantify current and future habitat changes resulting from proposed ecosystem management actions described in this report. An explanation regarding the use of a modified eastern cottontail HSI model is provided in the Ecosystem Restoration documented under the subheading “Habitat Evaluation Methodology” within the “Ecosystem Restoration Plan Formulation Process” section. The southwestern extent of the eastern cottontail range is in the Laredo area and contains distinct vegetation associations. The use of a modified HSI model was suggested by the model’s author, based on the specific species requirements within the geographic location of south Texas. Consequently, the modified HSI formula relied on assigning a higher model weight to herbaceous cover than shrub cover, and a higher weight to shrub cover as compared to tree cover. This modification suggests the importance of each vegetation strata in providing winter forage and reflects habitat requirements for this species within Chacon Creek area.

In 2017 habitat assessments were conducted for the same species listed above, because they are representative of wildlife species likely to utilize habitats found in small drainages in the south Texas plains ecoregion. The resulting data was used to evaluate the suitability of habitats for wildlife species that are likely to occur in the area.

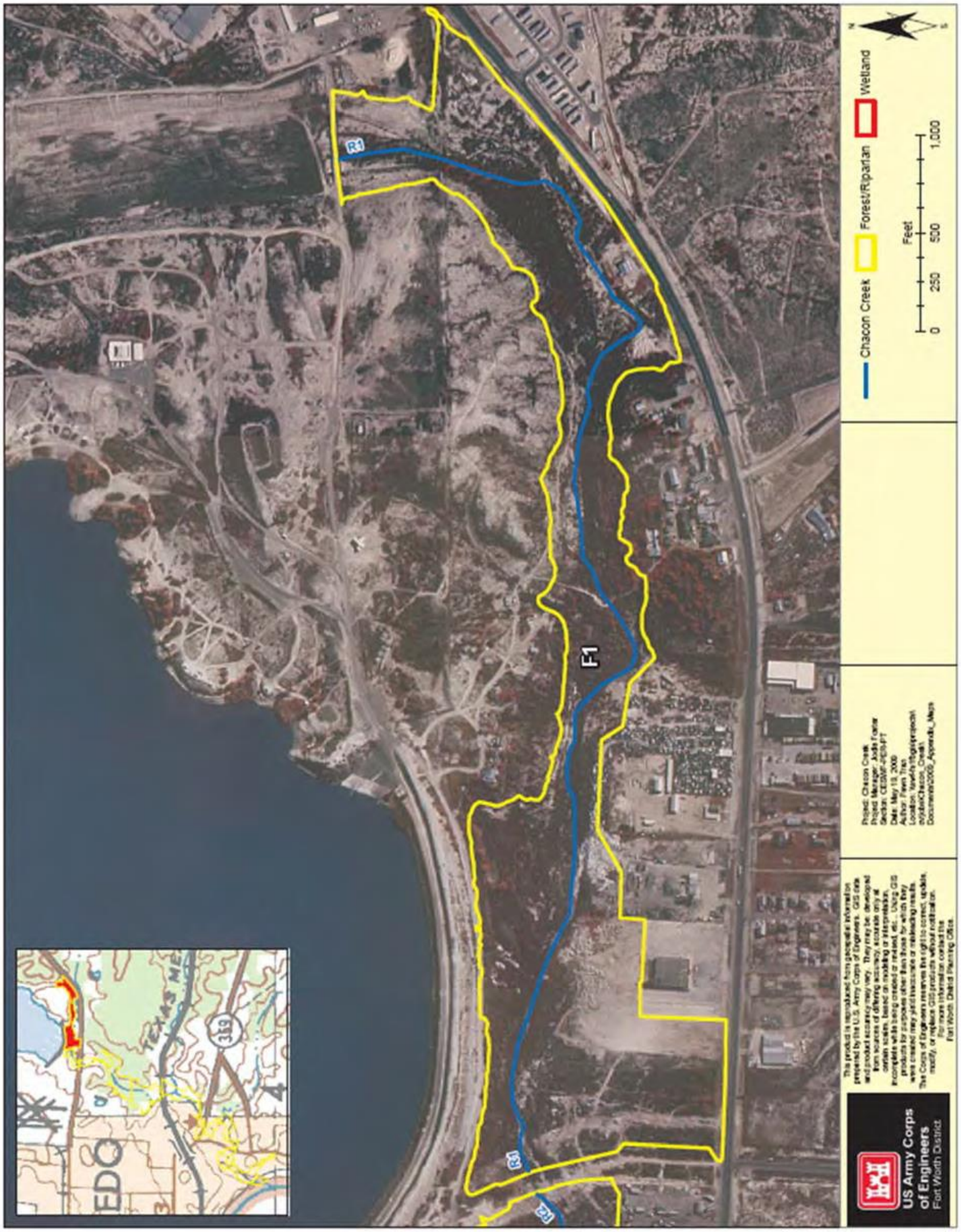
1.5 Delineation of Cover Types

The 2007 USACE ECR divided Chacon Creek into seven stream reaches, which were further subdivided by specific vegetation cover types within each reach (Figures 2-8). The delineation of cover types was conducted using previous investigations, interpretation of aerial photography, and field observations. In 2007 a total of three cover types were delineated in the study area including: Riparian/Tamaulipan thornshrub forest (Riparian), Wetland, and Riverine/aquatic (Riverine) (USFWS, 1981). In 2017, the same project boundaries, river reaches, and cover type stands created in the USACE ECR were used.

In 2017 vegetation was divided into five cover types:

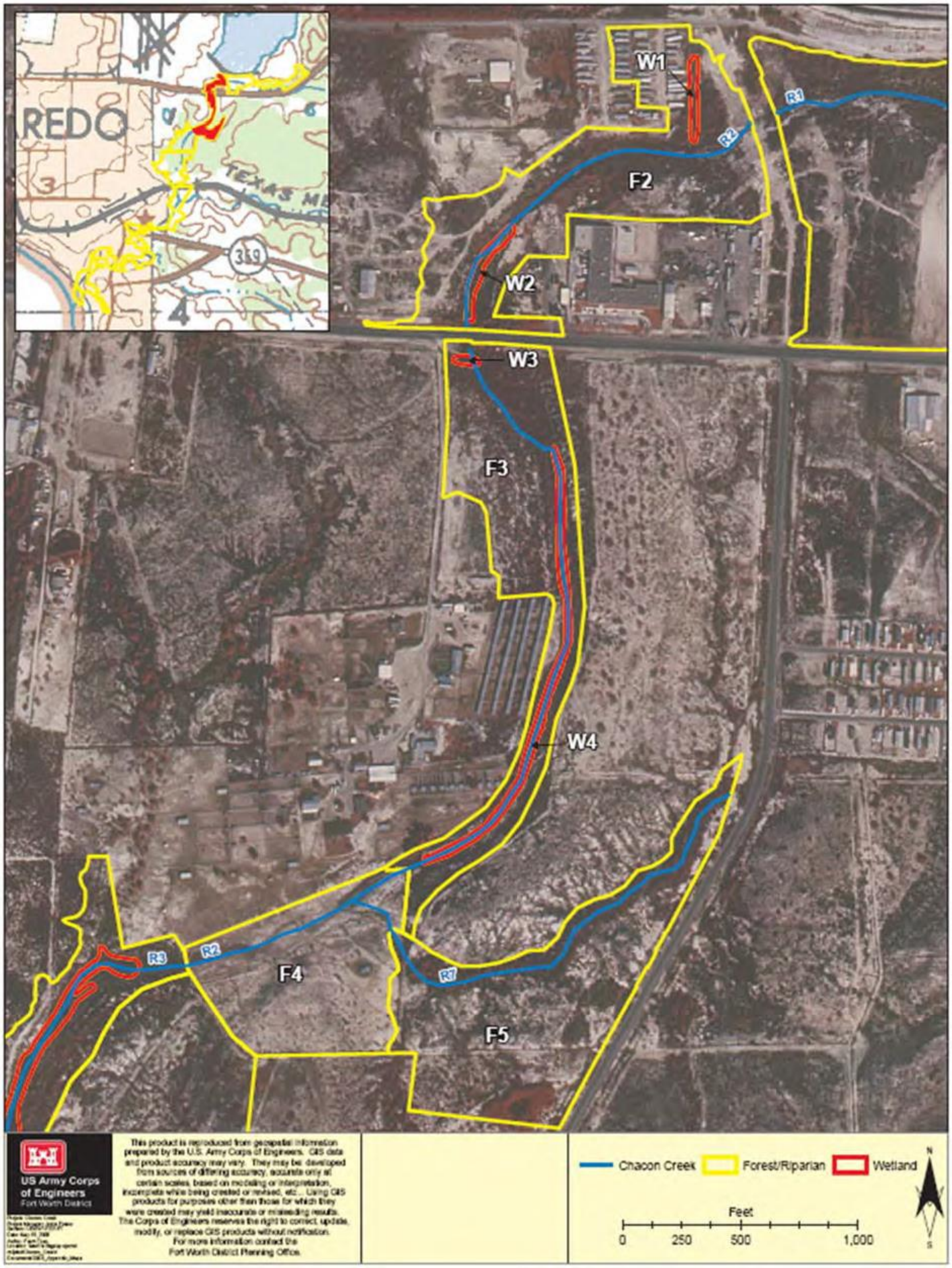
- Riverine (R)
- Palustrine wetland (PW)
- Herbaceous wetland (HW)
- Deciduous shrubland (DS)
- Deciduous forest (DF)

Riverine cover types were used to evaluate the aquatic system. The palustrine and herbaceous wetland cover types were used to assess the wetlands systems present in the study area. No palustrine wetlands were identified in the study area; therefore, no points were palustrine wetland points were evaluated. DS and DF cover type were used to evaluate mesic riparian settings and upland areas away from the channel corridor.



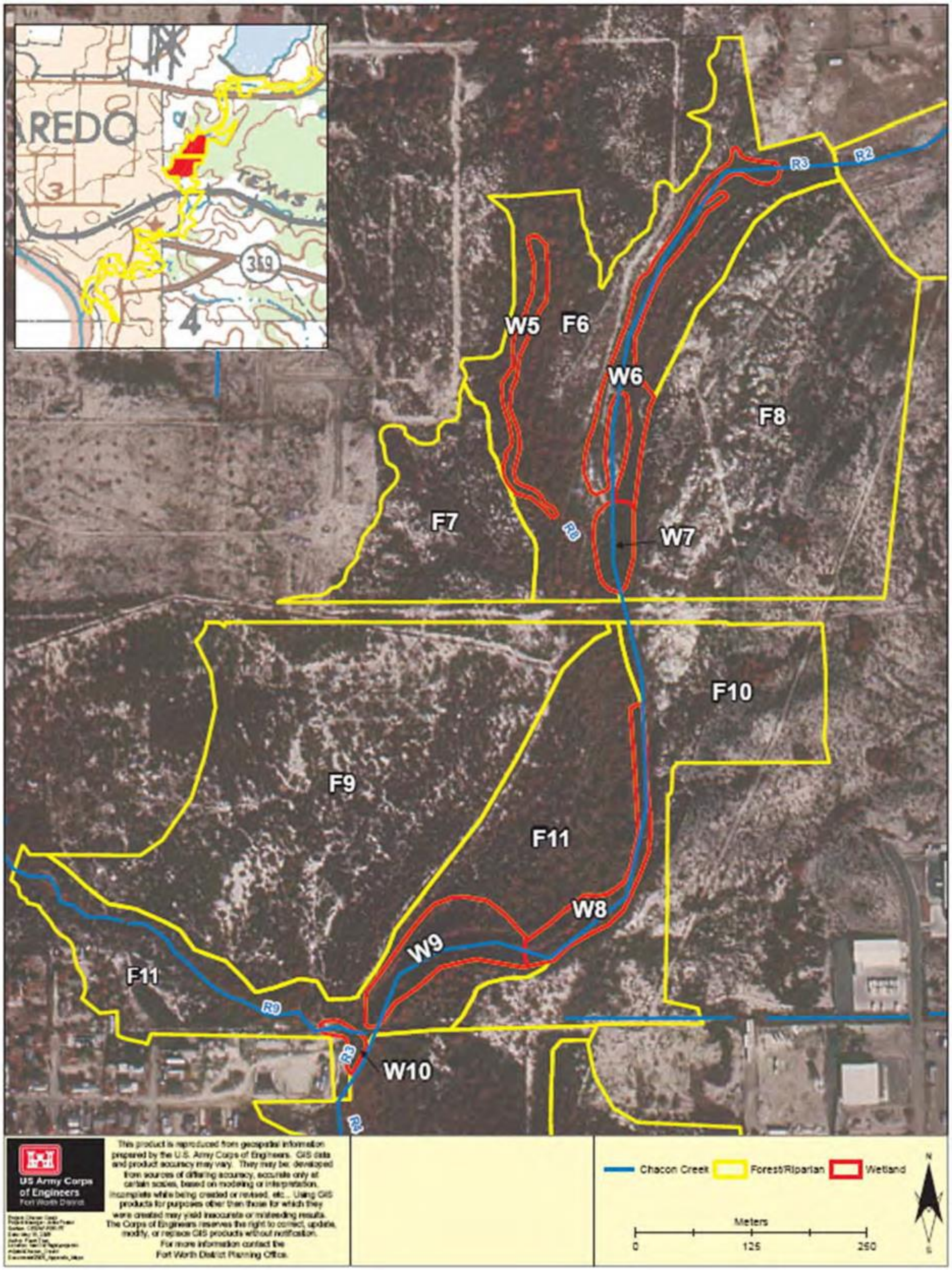
(Image source: USACE, 2010)

Figure 2. Study Area Cover Types



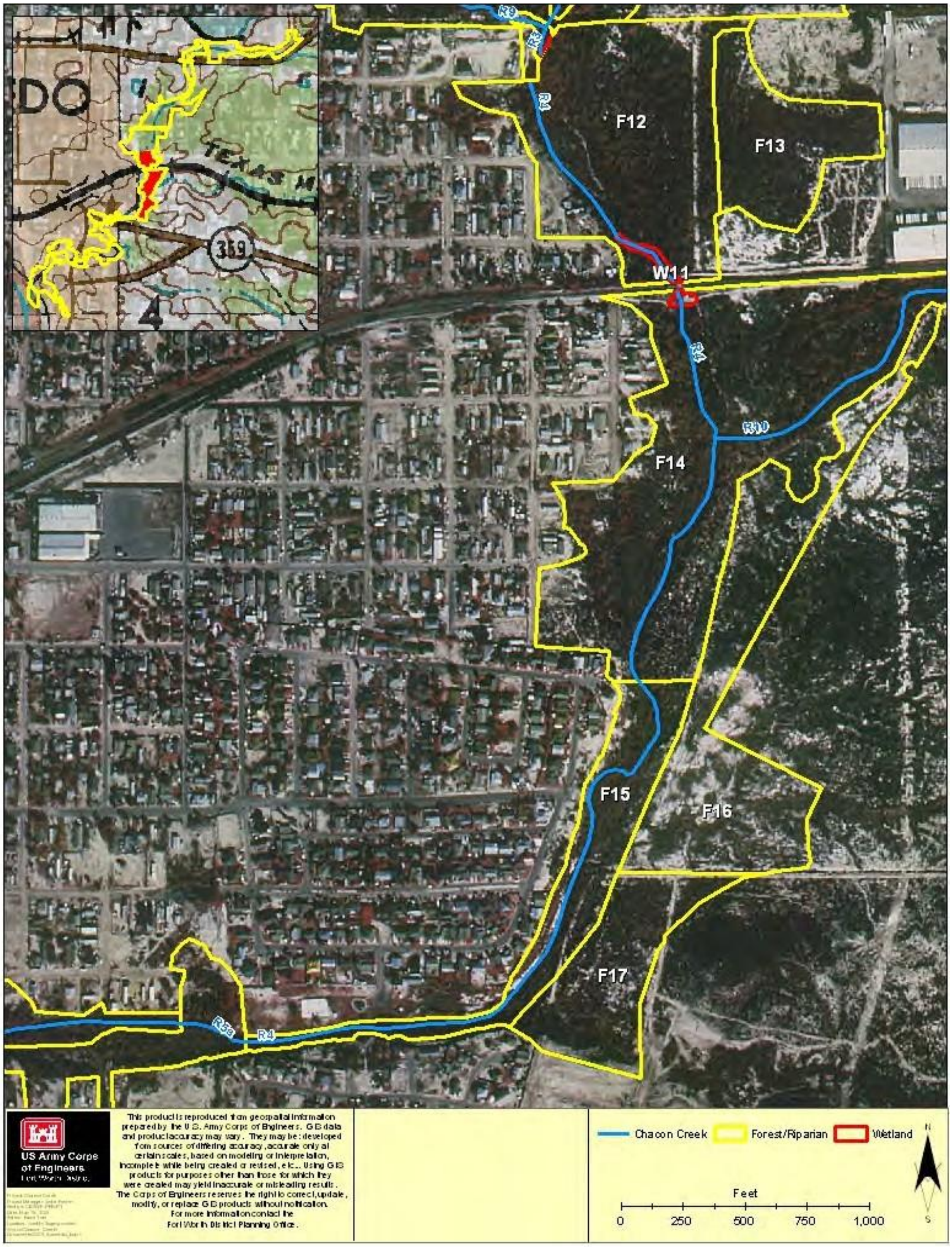
(Image source: USACE, 2010)

Figure 3. Study Area Cover Types



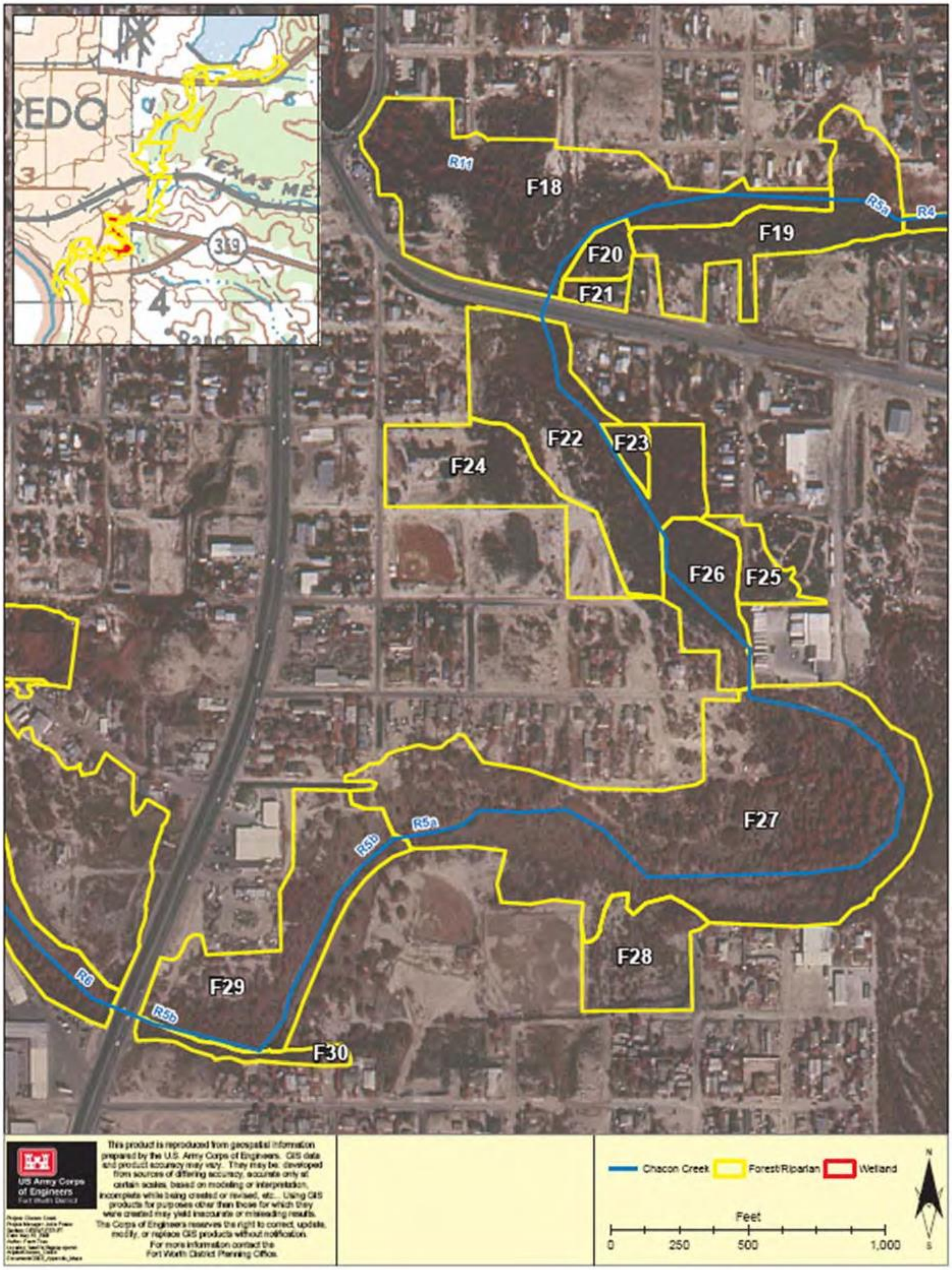
(Image source: USACE, 2010)

Figure 4. Study Area Cover Types



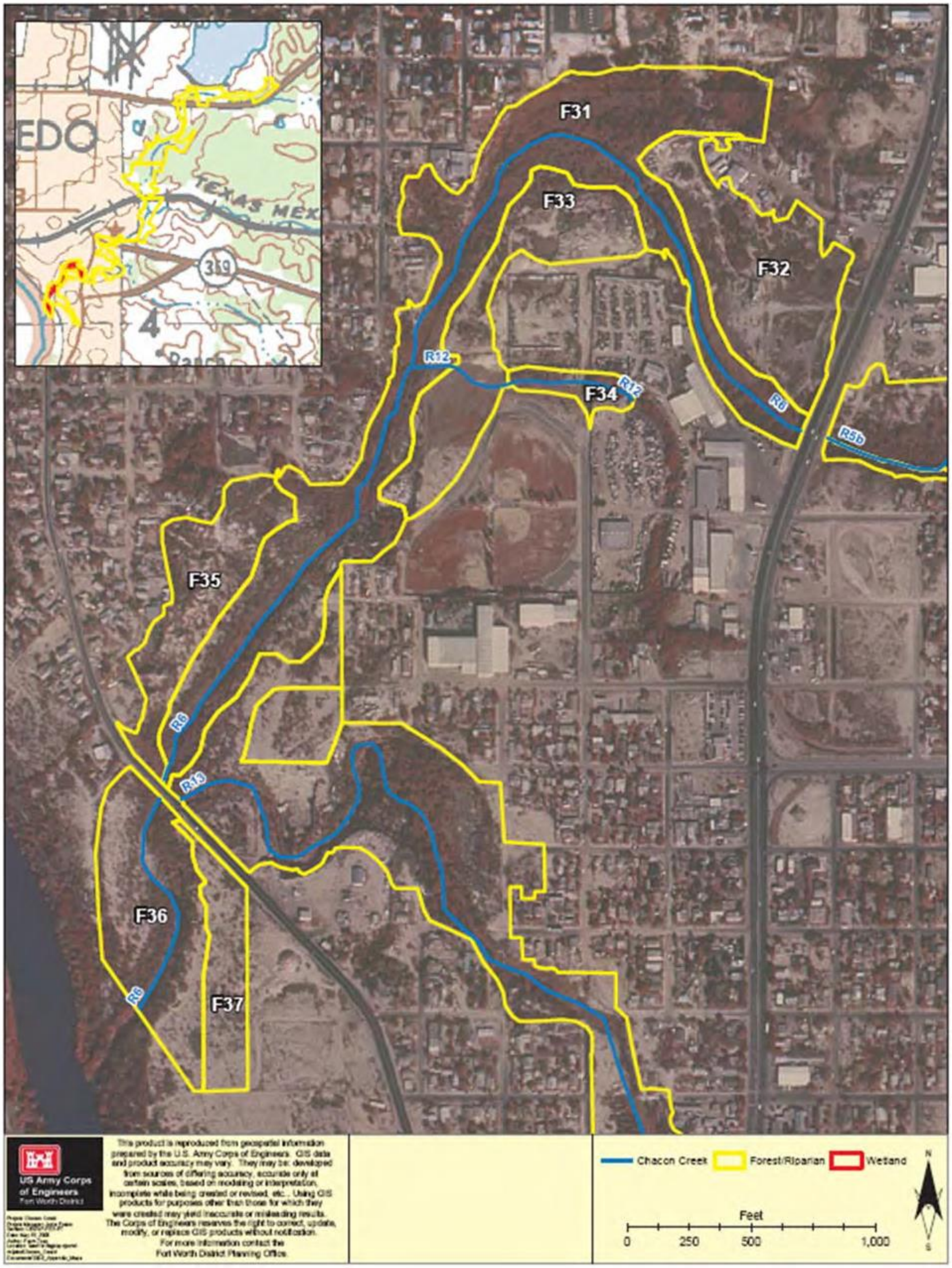
(Image source: USACE, 2010)

Figure 5. Study Area Cover Types



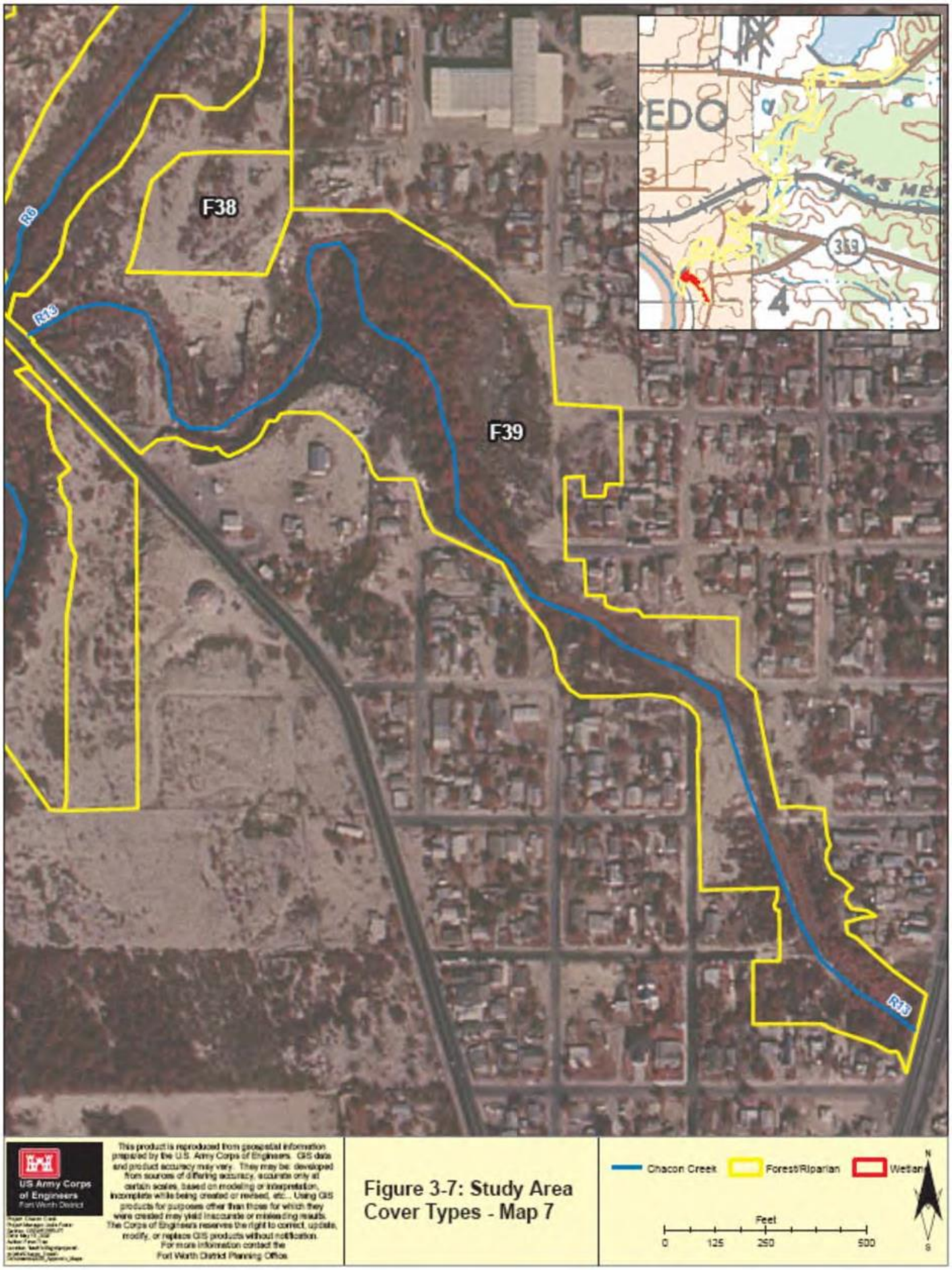
(Image source: USACE, 2010)

Figure 6. Study Area Cover Types



(Image source: USACE, 2010)

Figure 7. Study Area Cover Types



(Image source: USACE, 2010)

Figure 8. Study Area Cover Types

1.5.1 Selection of Sample Points

In 2007, sample points were randomly generated with a Geographic Information System (GIS) and data were collected within each reach of the vegetation cover types. Sampling efforts in 2017 used the same points identified in 2007 when feasible. A total of 76 points were sampled in 2017. As ground conditions, access, and development within the study area have changed since 2007, some points were relocated to accommodate new conditions. Where right-of-entry was available, and where the stands were accessible, additional sampling points were selected as representative of the stand.

1.5.2 Data Collection

Each point was located by using a global positioning system (GPS) receiver. At each point, a 0.25-acre plot was created. If the vegetation surrounding the point was relatively homogenous, a circular 0.25-acre plot with a radius of 59 feet was established. In locations with linear vegetation variations, such as the vegetation gradients near streams, a 0.25-acre rectangular plot measuring 65 feet by 164 feet was created. A rectangular plot was also used for wetland areas that were found along the linear channelized portions of the creek. The riverine plots were assessed by surveying a 164 feet length within and along the creek. The width of the plot corresponded with the width of the creek along that length.

Within each plot, the dominant vegetation in each stratum was noted by species. The overstory stratum included all trees greater than 16 feet, the understory stratum included all woody species from 1 to 16 feet tall, and the herbaceous stratum included all non-woody species. The herbaceous stratum includes tall species such as giant reed. In addition to the dominant species, the absolute cover of each species and of each stratum was recorded. The cover classes for each species were divided into 5 classes as follows:

1. 1 to 10% cover,
2. 11 – 25 % cover,
3. 26 – 50% cover,
4. 51 – 75% cover, and
5. 76 – 100% cover.

Species that occurred in the plots at low frequency were noted as <1%, but were not included in the estimates of absolute cover of each stratum.

The riverine reaches were surveyed both on the ground and from aerial photographs. For each reach, the average width of the channel, from bank to bank, was estimated from aerial photographs.

1.6 Index of Biotic Integrity

An IBI provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these metrics to define species richness, trophic composition, and abundance. Each one of these metrics is scored with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric score for a total score. Accounting for the high variability in fish assemblages in aquatic systems between various ecological regions (ecoregions) in Texas, Linam et al. (2002) developed regionalized IBIs. Chacon Creek is located in the region designated by Linam et al. (2002) as the southern Texas plains ecoregion (Ecoregion 31). The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages. The IBI report is presented in Addendum C.

A fisheries survey was conducted on Chacon Creek in Laredo, Webb County, Texas, on October 18, 2006, by U.S. Fish and Wildlife Service and City of Laredo Environmental Services Department personnel. The purpose of this survey was to determine baseline fish-community structure within the area of Chacon Creek that could be impacted by stream modifications, development, and/or construction activities associated with possible future flood control projects and restoration opportunities. No IBA update was conducted in 2017.

1.6.1 Methods and Materials

Three sites were selected on Chacon Creek to sample fish (Addendum C, IBI: Table 3). These three sites were all downstream of Casa Blanca Reservoir and were chosen based on in-stream habitat characteristics. Site 1 was considered riffle habitat. Site 2 was characterized as stream run habitat, while Site 3 was designated as pool habitat. The drainage basin for these sites encompasses approximately 155 square miles.

Fish were collected from all three sites using a fine mesh seine. In addition, fine mesh dip nets were used at Site 1, as a supplement to the seine, to collect fish from areas where the substrate was dominated by large cobble. A total of seven seine-hauls were performed at each site. After collection, fish were identified to species, counted, and any observed anomalies were recorded. All fish were then released back into the creek, with the exception of those fish preserved for voucher specimens. The data resulting from this sampling were used to calculate aquatic life use values for each site and the overall area sampled employing a regional index of biotic integrity.

Habitat Assessment Results

Data collected in the field were used to determine the average conditions found in each area or stand. These average conditions for the Riparian and Wetland cover types were then used to evaluate habitat suitability using the HSIs and formulas provided by the models. The eastern cottontail model was developed for northeastern regions of the U.S. and was modified, as suggested by the model author, to place a greater emphasis on herbaceous cover, which is present throughout most of the year in south Texas. The riverine cover types were assessed using IBI, which was then converted to a habitat index. Each section below describes the conditions limiting habit suitability in the study area and provides a summary of the HSIs provided by each area or stand.

1.7 Riverine

The habitat suitability of the riverine segments of the project area were evaluated with three models: the American coot, the belted kingfisher, and the slider turtle. Each of these species was dependent on the presence of flowing or standing water during most of the year. Several reaches of the Chacon Creek did not have water during the survey, or did not have water present most of the year, and these areas were not evaluated.

American coot habitat requirements include a stable source of surface water and emergent vegetation to provide suitable reproductive habitat. The highest nest success rates have been reported for permanently flooded to intermittently exposed wetlands (USFWS 1985a). Most of the riverine areas were of relatively low quality for the American coot, with HSI values less than 0.5 in most reaches, primarily limited by the lack of emergent vegetation interspersed with open water. There are 58 HUs for American Coots in the riverine segments of Chacon Creek.

Belted kingfishers are generally found along stream courses and lake and pond edges where the waters are clear and not overgrown with thick vegetation. Nests of the belted kingfisher are excavated in burrows on high vertical cutbanks of relatively friable soil. The belted kingfisher had limited suitable habitat within the riverine sections of Chacon Creek. Further, most of the water was overgrown by herbaceous and woody vegetation, with few perch sites. For kingfishers in riverine sections of the study area there were 26 HUs. It is not expected that belted kingfishers would occur within the areas of Chacon Creek surveyed during this investigation.

Slider turtles are predominantly aquatic turtles that inhabit virtually all water types; including rivers, ditches, lakes and ponds; but prefer waters that are between 3 and 10 feet deep, with a soft bottom, abundant vegetation, and suitable basking sites (USFWS 1986). Slider turtles are most commonly found in areas with aquatic vegetation such as algae and floating aquatic plants (e.g., milfoil and lily pads). The riverine sections of Chacon Creek have relatively low habitat quality for slider turtles, with HSI values consistently less than 0.3. The portions of Chacon Creek evaluated as riverine were relatively shallow, generally less than 2 feet deep, and did not contain floating aquatic vegetation. There were 19 HUs for slider turtles in riverine sections of the study area.

To summarize the combined suitable habitat for all riverine species evaluated, the average HSI values were summed and multiplied by the total number of acres to obtain a combined HU value for each stand, and the HUs were summed overall to obtain the total number of HUs for the riverine habitat. There was a total area of approximately 128 acres of riverine habitat, which provided 111 HUs. The creek was shallow, narrow, and during the surveys of this investigation, the waters were clear to only about 12 inches.

1.8 Herbaceous Wetland

Herbaceous wetlands were assessed using three species: the American coot, the slider turtle, and the red-winged blackbird. These species require permanent to semi-permanent water and emergent vegetation.

The American coot requires a stable source of water, as noted above. The HSI values for American coots throughout the project area were higher than for riverine systems, based on the presence of emergent vegetation. American coots in herbaceous wetlands had 42 HUs available.

The slider turtle is an aquatic turtle that requires permanent water sources, as noted above. The habitat suitability for slider turtles in wetlands associated with Chacon Creek were relatively low. There were 15 HUs available for slider turtles in herbaceous wetlands.

The red-winged blackbird nests most commonly in fresh and brackish wetlands, or in upland bushes and small trees adjacent to water courses. The herbaceous vegetation in the area was generally restricted to a narrow band along the both sides of the creek, without interspersion of vegetation and open water, and insect larvae were not found in most reaches of the creek, indicating limited food supply for the blackbirds. There was a total of 65 HUs available for red-winged blackbirds in the herbaceous wetlands of Chacon Creek.

To summarize the combined suitable habitat for all herbaceous wetland species evaluated, the average HSI values were summed and multiplied by the total number of acres to obtain a combined HU value for each stand, and the HUs were summed overall to obtain the total number of HUs for the herbaceous wetland habitat. The herbaceous wetlands adjacent to Chacon Creek provide suitable habitat for the wetland species evaluated in limited areas, but not throughout the length of the creek. The most suitable habitat for the species evaluated was in the area of the Clark Road wetland restoration. In general, wetland habitats were most suitable for American coots, slider turtles had some habitat areas available, and red-winged blackbirds had very little suitable foraging habitat available. For herbaceous wetlands, there were approximately 67 acres available, with a total of 59 HUs.

1.9 Deciduous Shrubland

The DS areas were evaluated with the eastern cottontail HSI model. The eastern cottontail requires a variety of habitats, including herbaceous feeding cover, and dense shrub cover for resting and escape cover (USFWS 1984a). Stands that provide a high cover of herbaceous vegetation, and some shrub vegetation were evaluated as the most suitable habitat for eastern cottontail. The abundance of shrubs and trees is assumed in the model to indicate suitable winter habitat. Although eastern cottontail rabbits in the southern part of the range may not rely on woody vegetation for winter forage as much as rabbits in the northern part of their range, the model was used as presented (USFWS 1984a). A total of 28 DS stands were evaluated, and an additional 8 DS stands were identified, but not evaluated due to lack of access. A total of 901 acres was identified as DS, which provide 345 HUs for the eastern cottontail.

1.10 Deciduous Forest

The eastern cottontail models were also used to evaluate DF settings. In general, forested areas have less persistent herbaceous vegetation, and are less suitable habitat for the eastern cottontail. In this evaluation two deciduous forest stands were identified, totaling 1.4 acres. Two stands in the previous evaluation were identified as deciduous forest, but inspection of the areas indicated that these stands were no longer forested, and they were recategorized to DS.

1.11 Aquatic

A total of 422 fish, comprising 10 species from seven families, were collected from Chacon Creek (see Addendum C: IBI Report, Table 3). From Site 1, 199 individual fish were collected (Addendum C, Table 4), while 71 fish were taken from Site 2 (Addendum C, Table 5), and 152 fish were collected at Site 3 (Addendum C, Table 6). Ten different species were collected at Site 1, five species were collected from Site 2, and six separate species were collected at Site 3. Five species (inland silverside, Mexican tetra, gizzard shad, western mosquitofish, and sailfin molly) were collected at all three sites. Cyprinids (blacktail and sand shiners), centrarchids (bluegill sunfish), and one cichlid species (Rio Grande cichlid) were collected from only one site (Site 1). Only one of the 422 fish collected exhibited lesions, a sailfin molly from Site 1.

Overall, inland silverside represented 27 percent of the total number of fish collected, followed by western mosquitofish (24%), blacktail shiner (16%), sailfin molly (15%), gizzard shad (8%), Mexican tetra (5%), bluegill sunfish (2%), and blue tilapia (2%). The number of Rio Grande cichlids and sand shiners collected represented less than 1% of the total number of fish collected.

Designated tolerance levels and associated trophic guilds for the fish species collected from all three sites were obtained from Linam el al. (2002) and are presented in Addendum C, Table 7. All three sites were dominated by insectivorous fish species. No piscivorous fish were collected at any of the sites. Blue tilapia was the only non-native species collected. No species considered intolerant to limited water conditions (poor water quality, fluctuating water levels, reduced flow) were collected at any of the sites.

Results of the IBIs for the three sites and the overall area sampled are included in Addendum C, Tables 8A through 8D. The results demonstrated intermediate aquatic life use values for Sites 1 and 3 (scores of 25 and 27, respectively), and a limited aquatic life use value for Site 2 (score of 21). The fish community within the overall study area was classified as intermediate with a score of 27.

1.11.1 IBI Conclusions and Recommendations

The maximum IBI score for these 11 metrics is 55. An index value can be arrived at by divide the IBI score by the maximum possible, and then used as an HSI (Table 3).

Table 3. Chacon Creek IBI Conversion to HSI

Collection Site	IBI Score	HSI
1	25	0.45
2	21	0.38
3	27	0.49
Total	**27**	**0.49**

Results of the baseline fisheries survey conducted on October 18, 2006, using the IBI developed by Linam et al. (2002), characterized the fish assemblages inhabiting Chacon Creek as limited to intermediate. Over 50% of the total number of fish collected were considered tolerant to limited in-stream water conditions. Twenty-five percent of the total number of fish collected were omnivorous however, fish communities at all three sites were dominated by insectivorous fish. No piscivorous fish species were collected from any of the sites during this survey. Anomalies such as lesions or tumors were observed on less than 1% of the fish collected.

The limited to intermediate characterization of the fish community in Chacon Creek could possibly be attributed to nominal in-stream habitat, marginal water quality and/or limited in-stream flow. Consequently, it is recommended that future projects consider methods to enhance in-stream structure and/or in-stream flow to provide suitable conditions for the improvement of the fish habitat within Chacon Creek.

1.12 Summary

In general habitat suitability was less than optimal as assessed by each of the models, a summary is listed in Table 4. The absence of flows during some portion of the year limits the number of Riparian areas that support habitats suitable for the American coot, belted kingfisher, and slider turtle. The tributaries of Chacon Creek, except F13, were assessed as not suitable for these species due to a lack of flow during much of the year and high flow velocities following rainfall events. The lack of emergent vegetation, the poor mixture of emergent vegetation to open water, and lack of water for a substantial period of the year limit habitat suitability for the American coot in most reaches of Chacon Creek. Habitats in this cover type were low to moderately suitable for the eastern cottontail and other small, herbivorous or granivorous mammals in the study area. Where dense shrub and tree growth was associated with low herbaceous cover, or where recent disturbance was associated with sparse cover in all vegetation strata, suitability was low for the eastern cottontail. Stands with a more open canopy of shrub and tree growth were associated with higher herbaceous cover and moderate suitability for the eastern cottontail. Low water clarity, shallow depth, high cover of surface obstructions, lack of riffles, and lack of sufficient flows throughout the year all limit the suitability of habitats in the Riverine cover type.

Table 4. Chacon Creek Habitat Suitability Summary

Cover Type	Model	Average HSI
Riverine	American coot, belted kingfisher, slider turtle	0.28
Wetland	American coot, red-winged blackbird, slider turtle	0.31
Deciduous Shrubland	eastern cottontail	0.89
Deciduous Forest	eastern cottontail	0.65
Aquatic	IBI	0.49

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Future Without Project Conditions

The future without project condition (or no-action alternative) forecasts habitat conditions that would develop if no Corps restoration project is implemented. Future without project condition implies acceptance of the existing and future adverse impacts caused by increasing erosion, persistence of invasive species, continued flow of non-point source pollution into the creek and possibly further encroachment of development into the floodplain were considered in forecasting future without project conditions. The no-action alternative does not meet the planning objectives.

The City of Laredo has implemented zoning and building codes requiring the use of detention and drainage practices that prevent the increased runoff and erosion caused by storm water would not increase however the current erosion would continue. Further the wetland habitats would continue to suffer from the altered flows and low water quality.

Non-native species would be expected to persist if not proliferate in and along Chacon Creek. With the increased urban-riparian interface the potential for wildfire to affect commercial or residential property increases. Further, habitat values in the Chacon Creek drainage would continue to degrade as the invasive species proliferated.

1.13 Determination of Future Without Habitat Conditions

Acreages used in calculating Habitat Units (HU) and Average Annual Habitat Units (AAHU) were derived through a Geographic Information System (GIS). Species models used to determine baseline HSI values were first identified in the initial ECR (USACE 2007) and modified by the project team, which included USACE and USFWS. In 2017, HSI models were updated using current using the same species identified in 2007. The data used to generate AAHUs for the future without action can be found in Table 5. AAHUs were estimated using the IWR Planning Suite II software package, which include an Annualizer module, a USACE-certified IWR Planning Suite II software (IWRPS) version 2.0.9 (IWRPS 2017). The estimated HU by interval was input for each scale, and the software performs numerical integration of the resultant curve to estimate AAHUs.

Table 5. Future Without-Project AAHUs

Measure	HSI in Year					Acres	Habitat Units in Year (HSI x Acres)					AAHUs
	1	5	10	25	50		1	5	10	25	50	
Wetland Site A Restoration	0.23	0.20	0.20	0.10	0.10	1.66	0.38	0.33	0.33	0.17	0.17	0.229
Wetland Site B Restoration	0.23	0.20	0.20	0.10	0.10	1.95	0.45	0.39	0.39	0.20	0.20	0.268
Wetland Site C Restoration	0.23	0.20	0.20	0.10	0.10	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Riverine Reach D Restoration	0.21	0.20	0.25	0.20	0.25	0.36	0.08	0.07	0.09	0.07	0.08	0.078
Riverine Reach E Restoration	0.20	0.25	0.20	0.25	0.20	0.24	0.05	0.06	0.05	0.06	0.04	0.053
Riverine Reach F Restoration	0.23	0.25	0.20	0.25	0.20	0.36	0.08	0.09	0.07	0.09	0.07	0.08
Invasives Removal & Reforestation, G	0.45	0.50	0.40	0.50	0.40	401.12	180.50	200.56	160.45	200.56	160.45	181.307

1.14 Without Project Conditions Assumptions

USACE and USFWS PDT members participated in the projection of future without-project conditions for this study. From their opinions as experts, USFWS and USACE agreed on certain assumptions regarding the parameters used in the habitat assessment model and what trends might be expected in the study area if no project is implemented. While predicting exact future conditions is impossible, the PDT recognized that some estimate for future conditions must be made, to calculate future without-project conditions and to compare study alternatives. Relying on past experience, regional trends, and education, the PDT members used their best professional judgment to estimate likely future without conditions. This section presents the assumptions used during analysis and discussion.

A 50-year period of analysis will be used to calculate AAHUs for the “without-project” condition (and all subsequent “with-project” conditions).

It is expected that without restoration measures, invasive species will continue to spread through the project area. Fire risk would increase with increasing densities of buffelgrass. Increases in salt cedar would likely cause gradual changes to soil salinity and decrease groundwater availability.

Alternative Formulation

1.15 Ecosystem Restoration Problems and Opportunities

The problems in the Chacon Creek study area related to ecosystem restoration can be characterized as follows:

- Lost habitat and reduced habitat value due to urbanization along Chacon Creek.
- Impact of invasive species on the ecosystem.
- Continuing soil erosion contributing to headcuts.
- Degraded habitat values of wetlands due to urbanization.

Opportunities for Chacon Creek are characterized as follows:

- Restore lost and degraded habitat.
- Manage invasive species.
- Reduce soil erosion.
- Restore wetlands.

Within in the Chacon Creek study area, there is an opportunity to address ecosystem degradation. Erosion from storm water runoff occurring in much of the study area leads to losses of soil and vegetation and increased turbidity in aquatic habitats. The persistence of invasive plant species has significantly degraded the habitat value for wildlife and ecological function and prevented the reestablishment of desirable native species.

1.15.1 CAFO

A CAFO currently operates adjacent to Chacon Creek. This facility adds nutrient runoff to the system which degrades the habitat suitability in the area.

1.15.2 Urban Waste

Urban refuse scattered throughout the study area included concrete, building materials, and residential refuse. An abundance of refuse was associated with both residential and commercial properties adjacent to the study corridor. Fill material and waste concrete were common in F4 (Figure 3). The high flow volume of Chacon Creek following high rainfall events distributes waste throughout the study area, and an abundance of residential refuse was common in some reaches. From recent flood events, there was also an abundance of debris from a nearby recycling center in F5a (Figure 3). The removal of urban waste could improve herbaceous cover, support general suitability of riverine, wetland, and riparian habitats, and reduce wildlife impacts from the presence of waste.

1.15.3 Erosion/Storm Water Runoff

Storm water from residential and commercial areas adjacent to the study area often cause erosion at the transition from man-made to natural substrates. Storm water runoff collected in residential areas is concentrated in roadways and in most places, enters the study area without any man-made diversions or natural buffers. The lack of storm water detention/retention results in a loss of soils and vegetation, as well as increased turbidity in aquatic habitats. The placement of flow control devices or the creation of natural vegetative buffers could improve habitat conditions in riverine, wetland, and terrestrial habitats.

1.15.4 Invasive Species

Biological invasions of non-native plant species result in changes in vegetation structure and composition, which significantly degrade habitat value for wildlife, reduce ecological function, and preclude the establishment and persistence of native plant species (D'Antonio and Vitousek 1992, Pimentel et al. 2005, Vilà et al. 2011). Reduced biodiversity results in decreased ecosystem function and diminished species richness (Loreau et al. 2002). Alien plant species have escaped cultivated settings or were introduced as forage species and have subsequently proliferated in ecosystems lacking species specific disease and pests. Changes in the natural disturbance regime will often allow invasive plants to colonize areas forming dense monotypic stands over wide areas and have little value to native wildlife. These plants alter fire regimes (Brooks et al. 2004) and can outcompete native plant species (Williams and Baruch 2000, Gabbard and Fowler 2007).

The loss of herbaceous species diversity, and the low forage value of introduced species has contributed to biotically impoverished ecosystem conditions in south Texas and a reduced avian species richness and abundance (Flanders et al. 2006). Buffelgrass and saltcedar are the primary invasive non-native plant species found in the project area. Other invasive species include bermudagrass (*Cynodon dactylon*), Carrizo cane, chinaberry (*Melia azedarach*), guineagrass, kleingrass (*Panicum coloratum*), and castorbean (*Ricinus communis*). The removal of undesirable non-native vegetation is complicated due to the interspersed patches of invasive species mixed with native plant species as well as the potential for further invasive species spread due to ground disturbance during management activities.

In settings within the study area where these introduced species have invaded, nearly all of the herbaceous species richness has been replaced by monocultures of invasive species. The loss of herbaceous species diversity, and the low forage value of these introduced grasses to granivorous birds and rodents, has contributed to a decline in rangeland birds and biotically impoverished conditions (Flanders et al. 2006). These monotypic grass stands grow, senesce, and dry in total synchrony, unlike diverse mosaics of native vegetation where species avoid competition by partitioning phenological, or life cycle events, into dynamic niches. Although fire is present as a disturbance feature in south Texas and native plant communities are fire-tolerant (Jahrsdoerfer and Leslie 1988), buffelgrass is highly competitive, hindering the reestablishment of native flora, particularly woody canopy species, after fire events (Miller et al. 2010). Once established, the invasive grasses create an increased potential for wildfire and grass cover and a domino syndrome of loss of biodiversity and ecosystem collapse (Zouhar et al. 2008).

1.15.4.1 Buffelgrass

Buffelgrass is a perennial C_4 warm season bunchgrass introduced into areas of Texas from Africa as early as 1917, with increasing successful plantings occurring between 1949 and 1985 (Hanselka 1988). This species has infested areas in south Texas (Cox et al. 2008). The species is considered valuable for livestock and has led to increased cattle stocking rates but is of poor value for wildlife (Hanselka 1988). Species such as buffelgrass may lead to ecosystems that are biotically impoverished with severe impacts to native flora and fauna. Areas with abundant buffelgrass have been found to exhibit less vegetation diversity when compared to reference sites containing native grass composition (Sands et al. 2009). It has also been demonstrated that extensive buffelgrass coverage is associated with reduced arthropod and avian abundance (Flanders et al. 2006). Because buffelgrass reaches densities much greater than that of native grasses, it can displace native plant species and substantially increase the potential for catastrophic fires. Buffelgrass invasions have been demonstrated to create more intense fire behavior when compared to native vegetation (McDonald and McPherson 2011).

Buffelgrass is ubiquitous in the herbaceous vegetation stratum throughout the study area and generally forms the primary component of the herbaceous understory. Although the proportion cover of buffelgrass was as high as 80 percent in some areas, this species does little to prevent erosion and does not provide suitable forage for most species. The complete eradication of buffelgrass in the study area would require intense and sustained efforts, including physical, cultural, and chemical control (USFS 2017). Because the cover of buffelgrass is high, its replacement with native grass whose natural density is relatively low would not necessarily improve forage or cover conditions for common wildlife. Therefore, restoration efforts should focus on the establishment of native herbaceous species in tandem with native grass species to provide high quality forage.

1.15.4.2 Carrizo Cane

Carrizo cane, also known as giant reed, is native to Mediterranean regions of Europe and Africa (Hardion et al. 2014). The species was introduced to North America from Spain in the 1500's (Tarin et al. 2013) and is currently present in riparian areas throughout Texas, where it is displacing native vegetation (Rubio et al. 2014), Carrizo cane has created several monotypic stands in numerous riparian locations in the southern part of Chacon Creek. The presence of Carrizo cane diminishes habitat quality through reduced structural diversity and forage. Eradication and management of giant reed would be difficult. There are limited biological controls available, although some are currently being tested (Moran et al. 2017). Giant reed responds to mechanical removal such as mowing or roller chopping by sprouting from stems or roots remaining in place and biological control using arundo wasp (*Tetramesa* romana), which is under consideration (Moran et al. 2017). The best control methods are sustained chemical control methods during subsequent growing seasons (Bell 1997).

1.15.4.3 Salt Cedar

Salt cedar is small shrub and is the most common non-native woody species that has naturalized in riparian areas throughout the study area. Salt cedar was common in the riparian zone throughout the study area exists in isolated stands, and is generally codominant with other tree species. The species is native to Eurasia and has been present in Texas since the 1880's when it was introduced as an ornamental plant (Horton 1964). Salt cedar exhibits a competitive advantage compared to native species due to its deep root system, which makes it tolerant of extended periods of drought. It is also a halophyte (i.e. tolerant of saline soils) and has robust seed production and disperses seed throughout its extended growing season. These attributes have caused salt cedar to displace native vegetation communities in riparian systems throughout the western US. The presence of salt cedar in riparian systems has degraded ecosystem structure and function. Riparian areas in the lower Chacon Creek watershed do no not contain dense monotypic stands of salt cedar, however the spread of salt cedar may potentially occur following a disturbance to native vegetation. Salt cedar vigorously recovers after fire events, outcompeting native vegetation, which may result in the formation of dense salt cedar monocultures (Fox et al. 2001). The structure and function of riparian systems have been impacted by the spread of salt cedar. However, numerous avian species use salt cedar as breeding habitat (Sogge et al. 2008). Therefore, the removal of salt cedar must be accompanied with the replacement of high-quality native riparian habitat. The removal of salt cedar and planting of native herbs and grasses would improve foraging opportunities for common wildlife species. Depending upon the success and degree of removal, the resulting increase in availability of water and light for native plant species could also improve habitat conditions

The Tamarisk Leaf Beetle (*Diorahbda* spp.) is a biocontrol agent released in the Colorado River watershed in 2001 to suppress salt cedar infestations in the western US (Bean et al. 2013). Currently, the Tamarisk Leaf Beetle has expanded in the Rio Grande watershed, where it has been documented approximately 70 miles upstream from the confluence of the Rio Grande and Pecos River, which is approximately 350 miles from Laredo (Tamarisk Coalition 2018). Future potential expansion of the Tamarisk Leaf Beetle into the LRG will require modification to salt cedar management approaches, however the lack of monotypic stands of salt cedar in the Laredo area and unknown arrival, if at all, of the species do not warrant further inquiry at this time.

1.16 Loss or Degradation of Habitat

The decline in habitat suitability of the study area is impacted by all of the above-mentioned problems. Riverine and wetland habitat is declining in part due to nutrient runoff from the CAFO as well as erosion and storm water runoff. The terrestrial/riparian habitat is declining as invasive species proliferate, as well as from the impacts of urban waste scattered throughout the study area. Habitat suitability of the study area would be improved by removing the CAFO and urban waste, reducing erosion, and from the removal and control of invasive species, while planting native vegetation.

1.17 Restoration Goal and Objective

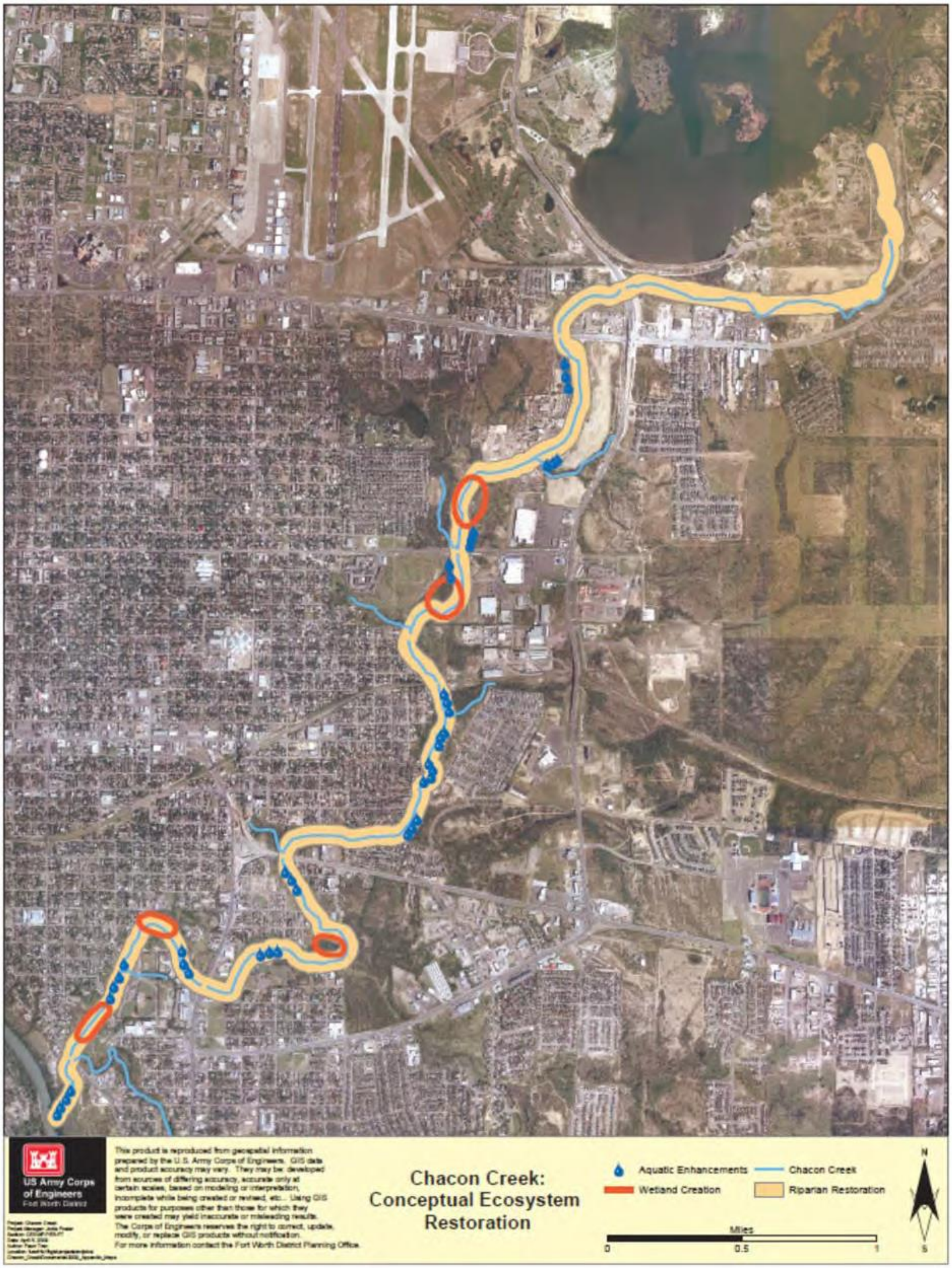
The project goal for ecosystem restoration is to provide a diverse and sustainable ecosystem for Chacon Creek. The primary objective is to improve the suitability and quality of the habitat in the study area in a manner that is sustainable and enhances the natural systems by repairing environmental degradation within the Chacon Creek corridor. The removal of problematic non-native vegetation and establishment of desirable native shrubs and trees is required to increase habitat suitability within the planning area. The increase in habitat quality will increase the amount of habitat for federal listed species and native wildlife.

The restoration features described below (wetland, riverine and riparian) describe those features types and habitat units of each type gained through implementation of the project. While the goal is to maintain these types of habitat in a sustainable fashion, the goal is also to provide this mosaic of different habitat types which can be utilized by different types of wildlife allowing an overall restoration project providing complexity in habitat for various species. Therefore, while each habitat type may show a slight decrease in value from TY25-TY50, these habitats will also be naturally converting to other habitat types (sometimes maintaining that balance between those types but also potentially converting to other types such as more upland or grass meadow, which can still provide habitat within the riparian system). This is further explained under each habitat type below.

Implementation of the required project monitoring (as described in the Monitoring and Adaptive Management Plan (Appendix K) and control of non-native species following successful establishment, will also aid in evaluating the success of creating and maintaining a diversity of habitat types.

1.18 Restoration Measures and Scales

All measures and scales are independent and combinable. The environmental restoration measures identified and considered include areas of wetland development, riverine habitat improvement, and riparian reforestation. Each measure considered was then evaluated to determine if it met the restoration objectives, as well as considering sponsor input, reasonableness of costs, professional judgments, and environmental benefits. On the next page, Figure 9 provides a conceptual depiction of the proposed ecosystem restoration measures within the study area.



(Image source: USACE, 2010)

Figure 9. Chacon Creek Conceptual Ecosystem Restoration

1.18.1 Wetland Measures

Wetland measures would contribute to ecosystem restoration by increasing the quantity and quality of wetland habitat and improving water quality. The wetland measure would create or expand existing wetland areas. This would be accomplished by constructing a weir/riffle structure that would hold a shallow pool of water upstream of the weir, expanding the area of existing wetlands. On the downstream side of the weir, a riffle structure would extend five feet downstream for every one-foot of weir height. This riffle structure would add oxygen to the system and improve water quality. However, its primary purpose would be to prevent scour and provide support to the weir structure. Initially, five areas were considered for wetland development. Wetland sites 1 (A) and 2 (B) were in-channel wetlands created by constructing a weir across the existing channel (Figures 10 and 11). Wetland site 3 (C) is an off-channel wetland that would be created by constructing a weir in an off-channel adjacent area that is low and seasonally may hold some water (Figure 12). This area has a small side channel and seasonal wetland. The weir would be located on the small side channel and expand the area of the existing seasonal wetland. Rain events would be the source for water. For each site, various weir heights were considered to create a wetland area. Wetland sites 4 and 5 were excluded from further analysis when it appeared that only minimal benefits could be gained regardless of scale.

As noted in Tables 6-8 below, all wetland habitat types would cause an increase in the HSI value at TY0 through TY10. Prior to TY25 it is anticipated that the habitat may start to shift to another habitat type, due to the natural cycling of wetlands. Some of the habitat may fill in and become more riparian. While this natural habitat progression is not a bad thing, that can cause the wetland HSI to decrease as it switches to another habitat type. If the City would like the wetland habitat to maintain a permanent basis, some periodic dredging of sediment build-up may be required. However, the overall HSI value still remains higher after 50 years than it was initially.

1.18.1.1 Wetland A

For Wetland A, three scales or weir heights were considered, ranging from one to three feet; created wetlands would range from 3.56 – 7.93 acres, respectively. The scales and associated acres and AAHUs are detailed in Table 6 and depicted in Figure 10.

Table 6. Wetland Site A Restoration Measures/Scales AAHUs

	Target Year	**0**	**1**	**5**	**10**	**25**	**50**	**AAHU**
Scale A0 No Action	HSI	0.23	0.23	0.20	0.20	0.10	0.10	
	Acres	1.66	1.66	1.66	1.66	1.66	1.66	
	Target Year HU	0.38	0.38	0.33	0.33	0.17	0.17	0.229
Scale A1 1-ft. Weir	HSI	0.50	0.50	0.80	1.00	0.80	0.60	
	Acres	3.56	3.56	3.56	3.56	3.56	3.56	
	Target Year HU	1.78	1.78	2.85	3.56	2.85	2.14	2.75

	Target Year	0	1	5	10	25	50	AAHU
Scale A2 2-ft. Weir	HSI	0.50	0.50	0.80	1.00	0.80	0.60	
	Acres	5.99	5.99	5.99	5.99	5.99	5.99	
	Target Year HU	3.00	3.00	4.79	5.99	4.79	3.59	4.623
Scale A3 3-ft. Weir	HSI	0.50	0.50	0.80	1.00	0.80	0.60	
	Acres	7.93	7.93	7.93	7.93	7.93	7.93	
	Target Year HU	3.97	3.97	6.34	7.93	6.34	4.76	6.121

(Image source: USACE, 2010)

Figure 10. Chacon Creek Wetland Restoration Site A, All Contours

1.18.1.2 *Wetland B*

For Wetland B, three weir heights were considered, ranging from one to three feet; and created wetlands would range from 3.65 – 8.69 acres respectively. The scales and associated acres and AAHUs are detailed in Table 7 and depicted in Figure 11 below.

Table 7. Wetland Site B Restoration Measures/Scales AAHUs

	Target Year	0	1	5	10	25	50	AAHU
Scale B0 No Action	HSI	0.23	0.23	0.20	0.20	0.10	0.10	
	Acres	1.95	1.95	1.95	1.95	1.95	1.95	
	Target Year HU	0.45	0.45	0.39	0.39	0.20	0.20	0.268
Scale B1 1-ft. Weir	HSI	0.46	0.46	0.80	1.00	0.80	0.60	
	Acres	3.65	3.65	3.65	3.65	3.65	3.65	
	Target Year HU	1.69	1.69	2.92	3.65	2.92	2.19	2.81
Scale B2 2-ft. Weir	HSI	0.46	0.46	0.80	1.00	0.80	0.60	
	Acres	6.05	6.05	6.05	6.05	6.05	6.05	
	Target Year HU	2.80	2.80	4.84	6.05	4.84	3.63	4.657
Scale B3 3-ft. Weir	HSI	0.46	0.46	0.80	1.00	0.80	0.60	
	Acres	8.69	8.69	8.69	8.69	8.69	8.69	
	Target Year HU	4.02	4.02	6.95	8.69	6.95	5.21	6.687

(Image source: USACE, 2010)

Figure 11. Chacon Creek Wetland Restoration Site B, All Contours

1.18.1.3 Wetland C

For Wetland C, three weir heights were considered, ranging from one to three feet; and created wetlands would range from 0.15 – 2.07 acres respectively. The scales and associated acres and AAHUs are detailed in Table 8 and depicted in Figure 12.

Table 8. Wetland Site C Restoration Measures/Scales AAHUs

	Target Year	**0**	**1**	**5**	**10**	**25**	**50**	**AAHU**
Scale C0 No Action	HSI	0.23	0.23	0.20	0.20	0.10	0.10	
	Acres	0.05	0.05	0.05	0.05	0.05	0.05	
	Target Year HU	0.01	0.01	0.01	0.01	0.01	0.01	.01
Scale C1 1-ft. Weir	HSI	0.38	0.38	0.75	0.90	0.75	0.60	
	Acres	0.15	0.15	0.15	0.15	0.15	0.15	
	Target Year HU	0.06	0.06	0.11	0.14	0.11	0.09	0.108
Scale C2 2-ft. Weir	HSI	0.38	0.38	0.75	0.90	0.75	0.60	
	Acres	1.17	1.17	1.17	1.17	1.17	1.17	
	Target Year HU	0.44	0.44	0.88	1.05	0.88	0.70	0.843
Scale C3 3-ft. Weir	HSI	0.38	0.38	0.75	0.90	0.75	0.60	
	Acres	2.07	2.07	2.07	2.07	2.07	2.07	
	Target Year HU	0.79	0.79	1.55	1.86	1.55	1.24	1.489

(Image source: USACE, 2010)

Figure 12. Chacon Creek Wetland Restoration Site C, All Contours

1.19 Riverine Measures

Riverine measures would consist of placing lengths of riffle structure along Chacon Creek. Riffle would vary in width from approximately 11 to 25 feet wide, depending on the width of the channel at the placement location. The total length of riffle structure placed would be considered as scales for this measure, and would range from 250 to 1,000 feet for each Riverine reach. The length of Chacon Creek in the study area was initially separated into six river segments. These segments were considered for Riverine measures. Three Riverine reaches were identified. Riverine Reach D includes river segment 2 (R2) and river segment 3 (R3). Riverine Reach E includes river segment 4 and 5a (R4 and R5a). Riverine Reach F includes river segment 5b and 6 (R5b and R6).

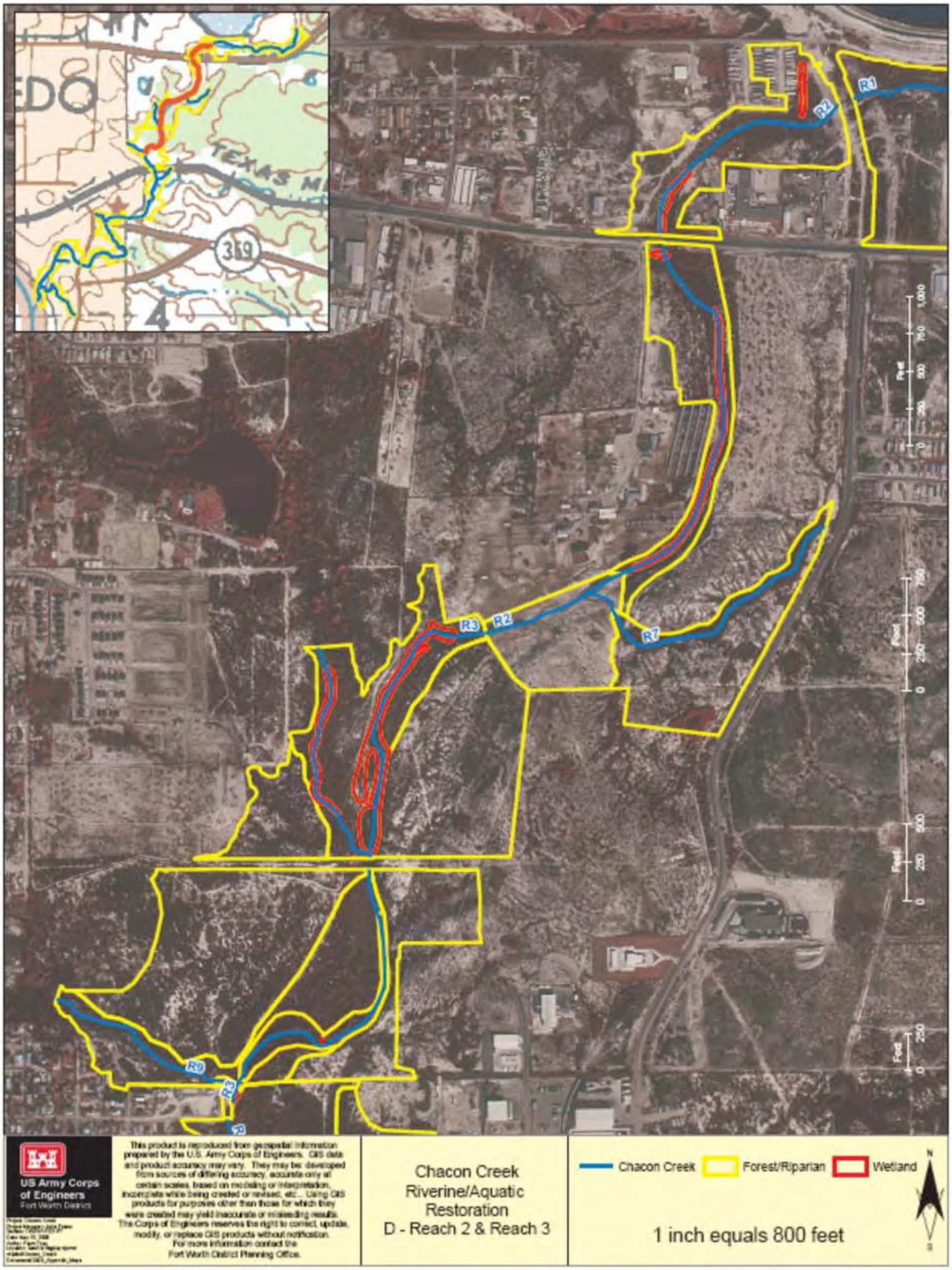
As shown in Tables 9-11, the riverine habitat value increases over time, but begins to decrease slightly prior to TY25. The reason for this decrease is similar to that described under wetland measures above. The riverine system will change naturally over time and evolve into other habitat types (most likely riparian vegetation will begin to grow along edges of riverine habitat where sediment drops out). This will cause a conversion of riverine habitat to riparian habitat. As noted in the tables, the decrease is fairly slow and minor, and the overall HIS value is still higher than as shown initially prior to project implementation (TY0). Again, if desired, with minimal maintenance, these areas can be maintained by removing sediment build-up.

1.19.1 Riverine Reach D

Riverine Reach D consists of river segments R2 and R3, and would consist of the construction of riffle structure within channel with scales ranging from 250 to 1,000 feet in length. The scales and associated acres and AAHUs are detailed in Table 9 and depicted in Figure 13.

Table 9. Riverine Reach D Restoration AAHUs

	Target Year	0	1	5	10	25	50	AAHU
Scale D0 No Action	HSI	0.21	0.21	0.20	0.25	0.20	0.25	
	Acres	0.36	0.36	0.36	0.35	0.34	0.33	
	Target Year HU	0.08	0.08	0.07	0.09	0.07	0.08	0.078
Scale D1 250 ft. Addtnl. Riffle	HSI	0.48	0.48	0.75	1.00	0.90	0.70	
	Acres	0.93	0.93	0.93	0.93	0.93	0.93	
	Target Year HU	0.44	0.44	0.70	0.93	0.84	0.65	0.774
Scale D2 500 ft. Addtnl. Riffle	HSI	0.48	0.48	0.75	1.00	0.90	0.70	
	Acres	1.51	1.51	1.51	1.51	1.51	1.51	
	Target Year HU	0.72	0.72	1.13	1.51	1.36	1.06	1.256
Scale D3 750 ft. Addtnl. Riffle	HSI	0.48	0.48	0.75	1.00	0.90	0.70	
	Acres	2.08	2.08	2.08	2.08	2.08	2.08	
	Target Year HU	0.99	0.99	1.56	2.08	1.87	1.46	1.729
Scale D4 1000 ft. Addtnl. Riffle	HSI	0.48	0.48	0.75	1.00	0.90	0.70	
	Acres	2.66	2.66	2.66	2.66	2.66	2.66	
	Target Year HU	1.26	1.26	2.00	2.66	2.39	1.86	2.209



(Image source: USACE, 2010)

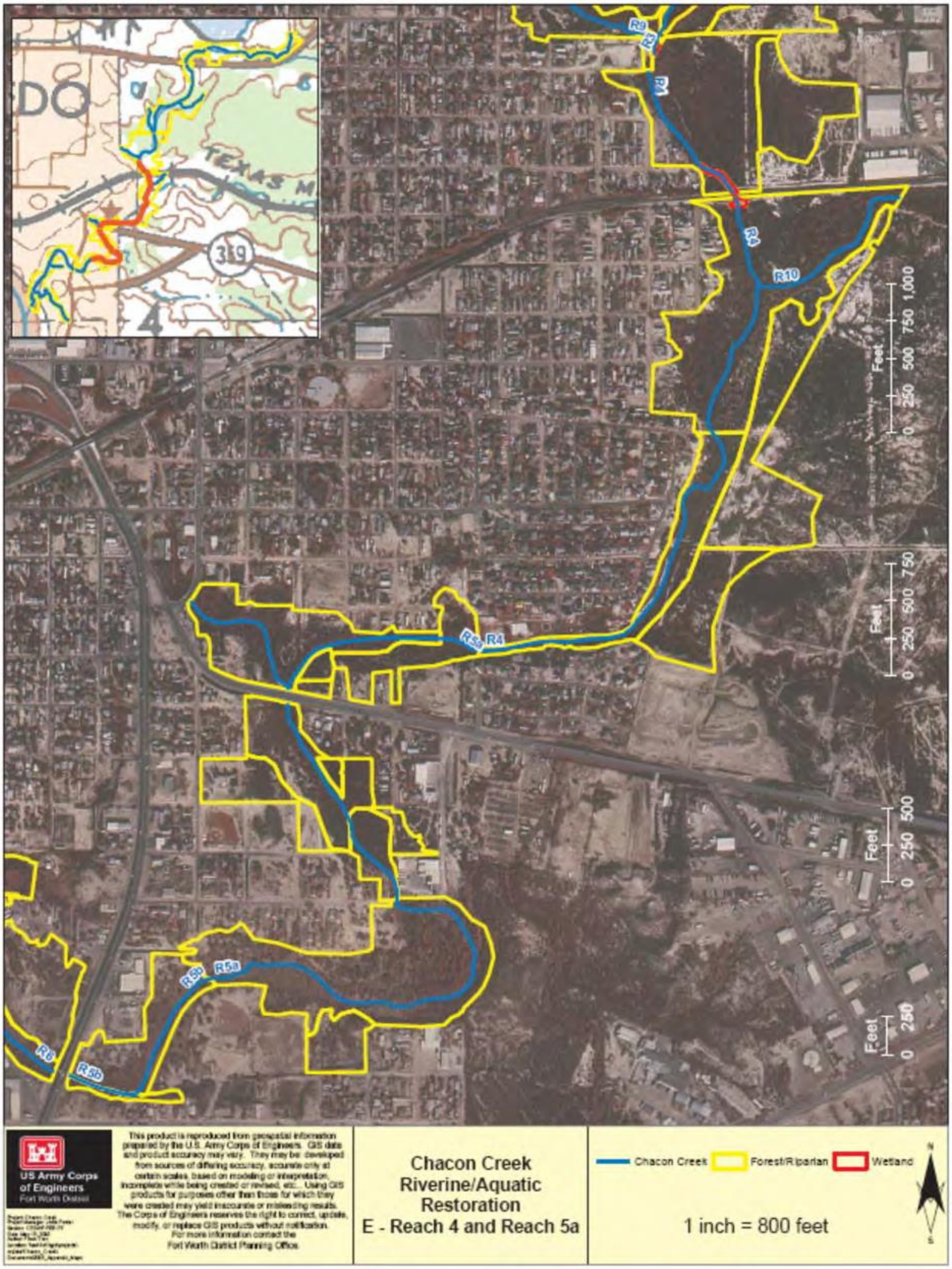
Figure 13. Chacon Creek Riverine Restoration Reach D2/3

1.19.2 Riverine Reach E

Riverine Reach E consists of segments R4 and R5a, and would consist of the construction of riffle structure within the channel with scales ranging from 250 to 1,000 feet in length. The scales and associated acres and AAHUs are detailed in Table 10 and depicted in Figure 14.

Table 10. Riverine Reach E Restoration AAHUs

	Target Year	**0**	**1**	**5**	**10**	**25**	**50**	**AAHU**
Scale E0 No Action	HSI	0.20	0.20	0.25	0.20	0.25	0.20	
	Acres	0.24	0.24	0.24	0.23	0.23	0.22	
	Target Year HU	0.05	0.05	0.06	0.05	0.06	0.04	0.053
Scale E1 250 ft. Addtnl. Riffle	HSI	0.44	0.44	0.70	1.00	0.90	0.70	
	Acres	0.58	0.58	0.58	0.58	0.58	0.58	
	Target Year HU	0.25	0.25	0.41	0.58	0.52	0.41	0.478
Scale E2 500 ft. Addtnl. Riffle	HSI	0.44	0.44	0.70	1.00	0.90	0.70	
	Acres	0.93	0.93	0.93	0.93	0.93	0.93	
	Target Year HU	0.41	0.41	0.65	0.93	0.84	0.65	0.768
Scale E3 750 ft. Addtnl. Riffle	HSI	0.44	0.44	0.70	1.00	0.90	0.70	
	Acres	1.27	1.27	1.27	1.27	1.27	1.27	
	Target Year HU	0.56	0.56	0.89	1.27	1.14	0.89	1.046
Scale E4 1000 ft. Addtnl. Riffle	HSI	0.44	0.44	0.70	1.00	0.90	0.70	
	Acres	1.62	1.62	1.62	1.62	1.62	1.62	
	Target Year HU	0.71	0.71	1.13	1.62	1.46	1.13	1.335



(Image source: USACE, 2010)

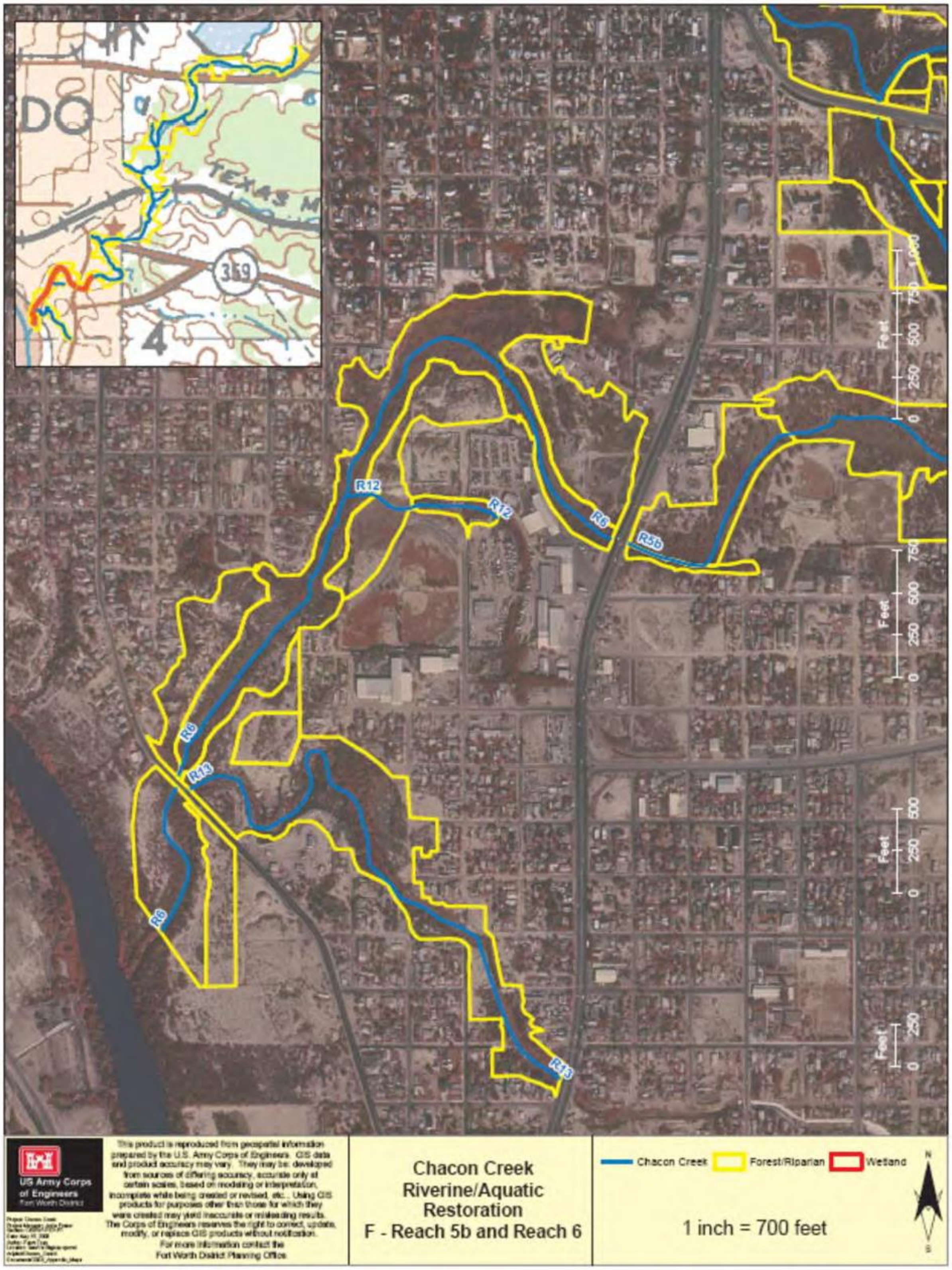
Figure 14. Chacon Creek Riverine Restoration Reach E4/5a

1.19.3 Riverine Reach F

Riverine Reach F consists of segments R5b and R6, and would consist of the construction of riffle structure within the channel with scales ranging from 250 to 1,000 feet in length. The scales and associated acres and AAHUs are listed in Table 11 and depicted in Figure 15.

Table 11. Riverine Reach F Restoration AAHUs

	Target Year	0	1	5	10	25	50	AAHU
Scale F0 No Action	HSI	0.23	0.23	0.25	0.20	0.25	0.20	
	Acres	0.36	0.36	0.36	0.35	0.34	0.33	
	Target Year HU	0.08	0.08	0.09	0.07	0.09	0.07	0.08
Scale F1 250 ft. Addtnl. Riffle	HSI	0.43	0.43	0.65	1.00	0.90	0.70	
	Acres	0.63	0.63	0.63	0.63	0.63	0.63	
	Target Year HU	0.27	0.27	0.41	0.63	0.57	0.44	0.517
Scale F2 500 ft. Addtnl. Riffle	HSI	0.43	0.43	0.65	1.00	0.90	0.70	
	Acres	0.90	0.90	0.90	0.90	0.90	0.90	
	Target Year HU	0.39	0.39	0.59	0.90	0.81	0.63	0.738
Scale F3 750 ft. Addtnl. Riffle	HSI	0.43	0.43	0.65	1.00	0.90	0.70	
	Acres	1.17	1.17	1.17	1.17	1.17	1.17	
	Target Year HU	0.51	0.51	0.76	1.17	1.05	0.82	0.958
Scale F4 1000 ft. Addtnl. Riffle	HSI	0.43	0.43	0.65	1.00	0.90	0.70	
	Acres	1.44	1.44	1.44	1.44	1.44	1.44	
	Target Year HU	0.62	0.62	0.94	1.44	1.30	1.01	1.182



(Image source: USACE, 2010)

Figure 15. Chacon Creek Riverine Restoration Reach F5b/6

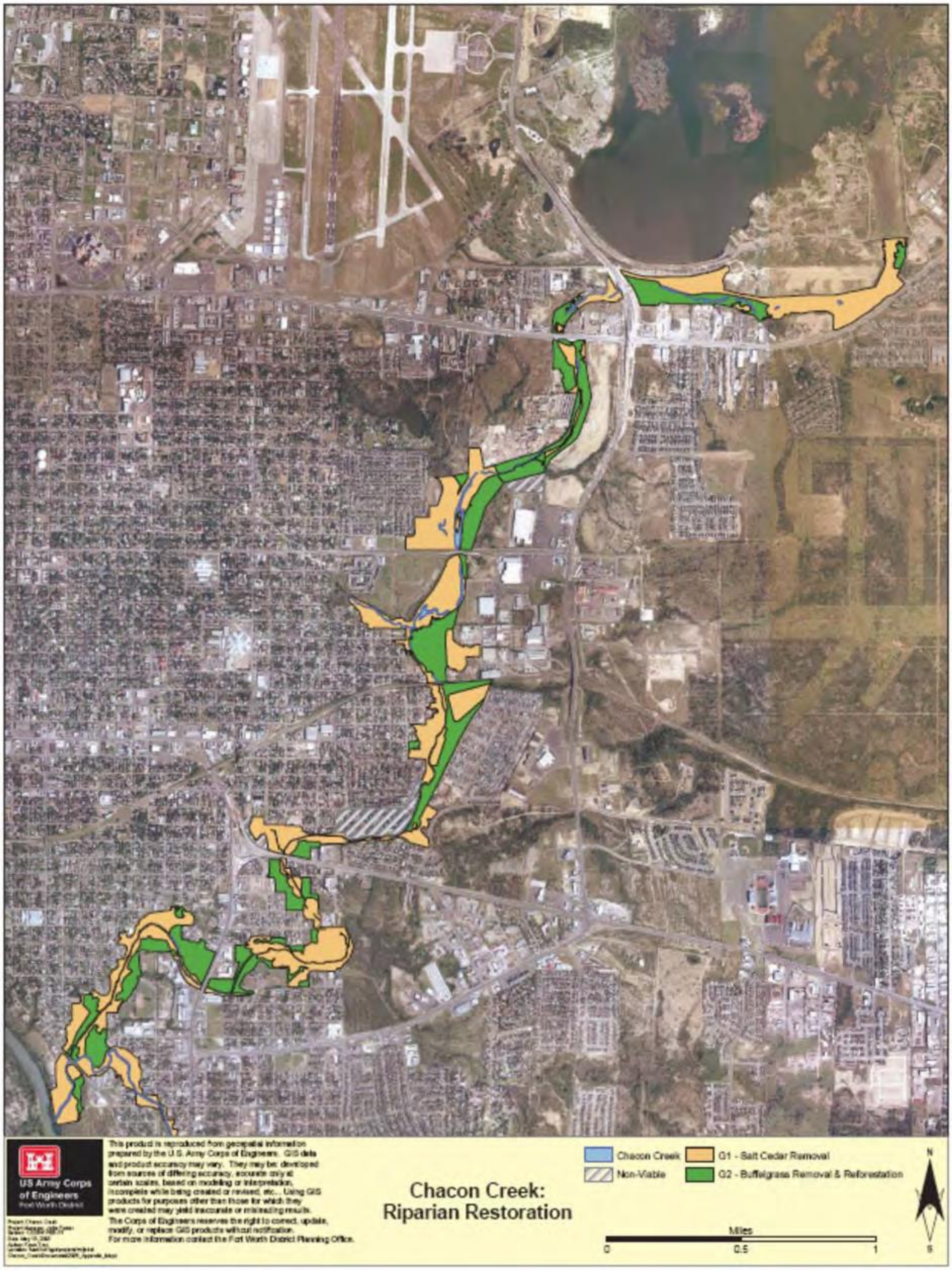
1.19.4 Riparian Measures

The remainder of the study area, the area not included for Wetland or Riverine Measures, was identified as “Forested” Riparian and “Non-forested” Riparian, and these areas were then used as scales for the riparian measure. The Riparian Measure, measure G, includes three scales. For the area identified as “Non-forested,” the alternative (G1) includes removal and control of buffelgrass, as well as planting native species and would include irrigation. An access road will be installed to support maintenance. G1 would support 295.225 AAHUs on 401.12 acres. For the area identified as “Forested,” the alternative (G2) consists of the selective removal and control of salt cedar, an invasive species, as well as the removal of debris. G2 would support 208.181 AAHUs on 401.12 acres. The third scale or alternative, G3, would be a combination of G1 and G2. G3 would support 332.931 AAHUs on 401.12 acres. The scales and associated acres and AAHUs for riparian restoration are detailed in Table 12; these scales are depicted in Figure 16.

It is well known that management of invasive species will require some ongoing treatment of resprouts in order to maintain a reduced population within the system. Again, over time, invasives may move back in (or new invasives may very well come about) and a small decrease begins to occur at TY25-TY50 (as shown in Table 12). Through proper management, the overall habitat value can be maintained so that this does not occur. Or, as with the other habitat types, they may convert to a different habitat type (such as upland vegetation) which can cause the HIS to go down, but still provides valuable habitat for wildlife.

Table 12. Riparian Invasives Removal and Reforestation AAHUs

	Target Year	0	1	5	10	25	50	
Scale G0 No Action	HSI	0.45	0.45	0.50	0.40	0.50	0.40	
	Acres	401.12	401.12	401.12	401.12	401.12	401.12	
	Target Year HU	180.50	180.50	200.56	160.45	200.56	160.45	181.307
Scale G1 Exotic Removal, Revegetati	HSI	0.45	0.45	0.60	0.80	0.80	0.70	
	Acres	401.12	401.12	401.12	401.12	401.12	401.12	
	Target Year HU	180.50	180.50	240.67	320.90	320.90	280.78	295.225
Scale G2 Salt Cedar Removal	HSI	0.45	0.45	0.30	0.50	0.60	0.50	
	Acres	401.12	401.12	401.12	401.12	401.12	401.12	
	Target Year HU	180.50	180.50	120.34	200.56	240.67	200.56	208.181
Scale G3 G1 and G2	HSI	0.45	0.45	0.70	0.90	0.90	0.80	
	Acres	401.12	401.12	401.12	401.12	401.12	401.12	
	Target Year HU	180.50	180.50	280.78	361.01	361.01	320.90	332.931



(Image source: USACE, 2010)

Figure 16. Chacon Creek Riparian Restoration

1.19.5 Ecosystem Restoration Summary

In total, there are three general ecosystem restoration activities in this study, the creation and restoration of wetlands, improvement to riverine habitat, and reforestation of riparian habitat. To evaluate these actions, the activities were separated into seven measures, each measure with a series of scales. Table 13 provides a summary of these measures and scales.

Table 13. Ecosystem Restoration Summary

Measure	Scale	Description
Wetland Site A	A1	Weir height 1 foot, width 110 feet, to create approximately 3.56 acres of wetland
	A2	Weir height 2 feet, width 120 feet, to create approximately 5.99 acres of wetland
	A3	Weir height 3 feet, width 250 feet, to create approximately 7.93 acres of wetland
Wetland Site B	B1	Weir height 1 foot, width 55 feet, to create approximately 3.65 acres of wetland
	B2	Weir height 2 feet, width 150 feet, to create approximately 6.05 acres of wetland
	B3	Weir height 3 feet, width 190 feet, to create approximately 8.69 acres of wetland
Wetland Site C	C1	Weir height 1 foot, width 45 feet, to create approximately 0.15 acre of wetland, debris removal
	C2	Weir height 2 feet, width 55 feet, to create approximately 1.17 acres of wetland, debris removal
	C3	Weir height 3 feet, width 65 feet, to create approximately 2.07 acres of wetland, debris removal
Riverine Reach D	D1	Addition of a 250 x 25 foot riffle structure, to create a total of 0.93 acre of riffle benefit
	D2	Addition of a 500 x 25 foot riffle structure, to create a total of 1.51 acres of riffle benefit
	D3	Addition of a 750 x 25 foot riffle structure, to create a total of 2.08 acres of riffle benefit
	D4	Addition of a 1,000 x 25 foot riffle structure, to create a total of 2.66 acres of riffle benefit
Riverine Reach E	E1	Addition of a 250 x 15 foot riffle structure, to create a total of 0.58 acre of riffle benefit
	E2	Addition of a 500 x 25 foot riffle structure, to create a total of 0.93 acre of riffle benefit
	E3	Addition of a 750 x 25 foot riffle structure, to create a total of 1.27 acres of riffle benefit
	E4	Addition of a 1,000 x 25 foot riffle structure, to create a total of 1.62 acres of riffle benefit
Riverine Reach F	F1	Addition of a 250 x 11 foot riffle structure, to create a total of 0.63 acre of riffle benefit, removal of concrete structure partially obstructing flow
	F2	Addition of a 500 x 11 foot riffle structure, to create a total of 0.90 acre of riffle benefit, removal of concrete structure partially obstructing flow
	F3	Addition of a 750 x 11 foot riffle structure, to create a total of 1.17 acres of riffle benefit, removal of concrete structure partially obstructing flow
	F4	Addition of a 1,000 x 11 foot riffle structure, to create a total of 1.44 acres of riffle benefit
Riparian G	G1	Reforestation of non-forested area, including buffelgrass control, planting, and irrigation
	G2	Removal of salt cedar from forested areas
	G3	G1 + G2

1.20 Cost of Alternative Measures and Scales

Cost estimates have been developed and were used to compare the measures and scales of ecosystem restoration alternatives. The estimated costs were originally prepared in TRACES MII Version 3.0 as part of the previous phases of study. These costs have been updated to current prices (FY18) using the Civil Works Construction Cost Index System (USACE 2017) and have been updated to reflect the currently (FY18) interest rate of 2.75%. Costs for the ecosystem restoration alternatives are summarized in Tables 14 – 20.

Table 14. Economic Summary for Wetland Site A Restoration

Project Cost Items	A0	A1	A2	A3
First Cost	$0	$181,322	$284,282	$560,377
Project Life (years)	50	50	50	50
Construction Period (months)	12	12	12	12
Interest During Construction	$0	$2,303	$3,611	$7,117
Investment Cost	$0	$183,625	$287,893	$567,495
Annualized Investment Cost	$0	$6,802	$10,664	$21,021
Annual O&M	$0	$530	$837	$1,743
Total Annual Costs	$0	$7,332	$11,500	$22,764
With-Project Acres	1.66	3.56	5.99	7.93
With-Project AAHU	0.229	2.75	4.623	6.121
No-Action AAHU	0.229	0.229	0.229	0.229
Plan AAHU Gain	0	2.521	4.394	5.892
Annual Cost per AAHU Gain	$0	$2,908	$2,617	$3,864
Annual Cost per Acre	$0	$2,060	$1,920	$2,871
First Cost per Acre	$0	$50,933	$47,459	$70,665

Table 15. Economic Summary for Wetland Site B Restoration

Project Cost Items	B0	B1	B2	B3
First Cost	$0	$144,579	$316,004	$483,327
Project Life (years)	50	50	50	50
Construction Period (months)	12	12	12	12
Interest During Construction	$0	$1,836	$4,014	$6,139
Investment Cost	$0	$146,415	$320,017	$489,466
Annualized Investment Cost	$0	$5,423	$11,854	$18,130
Annual O&M	$0	$265	$917	$1,080
Total Annual Costs	$0	$5,689	$12,771	$19,210
With-Project Acres	1.95	3.65	6.05	8.69
With-Project AAHU	0.268	2.81	4.657	6.687
No-Action AAHU	0.268	0.268	0.268	0.268
Plan AAHU Gain	0	2.542	4.389	6.419
Annual Cost per AAHU Gain	$0	$2,238	$2,910	$2,993
Annual Cost per Acre	$0	$1,559	$2,111	$2,211
First Cost per Acre	$0	$39,611	$52,232	$55,619

Table 16. Economic Summary for Wetland Site C Restoration

Project Cost Items	C0	C1	C2	C3
First Cost	$0	$50,243	$98,886	$143,107
Project Life (years)	50	50	50	50
Construction Period (months)	12	12	12	12
Interest During Construction	$0	$638	$1,256	$1,818
Investment Cost	$0	$50,881	$100,142	$144,924
Annualized Investment Cost	$0	$1,885	$3,709	$5,368
Annual O&M	$0	$217	$336	$536
Total Annual Costs	$0	$2,102	$4,046	$5,904
With-Project Acres	0.05	0.15	1.17	2.07
With-Project AAHU	0.01	0.108	0.843	1.489
No-Action AAHU	0.01	0.01	0.01	0.01
Plan AAHU Gain	0	0.098	0.833	1.479
Annual Cost per AAHU Gain	$0	$21,449	$4,857	$3,992
Annual Cost per Acre	$0	$14,013	$3,458	$2,852
First Cost per Acre	$0	$334,951	$84,518	$69,134

Table 17. Economic Summary for Riverine Site D Restoration

Project Cost Items	D0	D1	D2	D3	D4
First Cost	$0	$291,245	$558,510	$825,472	$1,092,738
Project Life (years)	50	50	50	50	50
Construction Period (months)	12	12	12	12	12
Interest During Construction	$0	$3,699	$7,094	$10,484	$13,879
Investment Cost	$0	$294,944	$565,604	$835,957	$1,106,617
Annualized Investment Cost	$0	$10,925	$20,950	$30,965	$40,990
Annual O&M	$0	$227	$454	$681	$909
Total Annual Costs	$0	$11,152	$21,405	$31,646	$41,899
With-Project Acres	0.33	0.93	1.51	2.08	2.66
With-Project AAHU	0.078	0.774	1.256	1.729	2.209
No-Action AAHU	0.078	0.078	0.078	0.078	0.078
Plan AAHU Gain	0	0.696	1.178	1.651	2.131
Annual Cost per AAHU Gain	$0	$16,022	$18,171	$19,168	$19,662
Annual Cost per Acre	$0	$11,991	$14,175	$15,214	$15,752
First Cost per Acre	$0	$313,166	$369,874	$396,862	$410,804

Table 18. Economic Summary for Riverine Site E Restoration

Project Cost Items	E0	E1	E2	E3	E4
First Cost	$0	$194,204	$373,411	$552,312	$731,521
Project Life (years)	50	50	50	50	50
Construction Period (months)	12	12	12	12	12
Interest During Construction	$0	$2,467	$4,743	$7,015	$9,291
Investment Cost	$0	$196,670	$378,154	$559,327	$740,812
Annualized Investment Cost	$0	$7,285	$14,007	$20,718	$27,440
Annual O&M	$0	$137	$272	$409	$546
Total Annual Costs	$0	$7,422	$14,279	$21,127	$27,986
With-Project Acres	0.22	0.58	0.93	1.27	1.62
With-Project AAHU	0.053	0.478	0.768	1.046	1.335
No-Action AAHU	0.053	0.053	0.053	0.053	0.053
Plan AAHU Gain	0	0.425	0.715	0.993	1.282
Annual Cost per AAHU Gain	$0	$17,462	$19,971	$21,276	$21,830
Annual Cost per Acre	$0	$12,796	$15,354	$16,635	$17,275
First Cost per Acre	$0	$334,834	$401,517	$434,891	$451,556

Table 19. Economic Summary for Riverine Site F Restoration

Project Cost Items	F0	F1	F2	F3	F4
First Cost	$0	$161,362	$305,792	$450,221	$594,651
Project Life (years)	50	50	50	50	50
Construction Period (months)	12	12	12	12	12
Interest During Construction	$0	$2,049	$3,884	$5,718	$7,553
Investment Cost	$0	$163,411	$309,676	$455,940	$602,203
Annualized Investment Cost	$0	$6,053	$11,471	$16,888	$22,306
Annual O&M	$0	$100	$200	$300	$400
Total Annual Costs	$0	$6,153	$11,670	$17,189	$22,706
With-Project Acres	0.33	0.63	0.9	1.17	1.44
With-Project AAHU	0.08	0.517	0.738	0.958	1.182
No-Action AAHU	0.08	0.08	0.08	0.08	0.08
Plan AAHU Gain	0	0.437	0.658	0.878	1.102
Annual Cost per AAHU Gain	$0	$14,081	$17,736	$19,577	$20,604
Annual Cost per Acre	$0	$9,767	$12,967	$14,691	$15,768
First Cost per Acre	$0	$256,129	$339,769	$384,805	$412,952

Table 20. Economic Summary for Riparian Restoration

Project Cost Items	G0	G1	G2	G3
First Cost	$0	$23,243,365	$11,315,657	$25,071,241
Project Life (years)	50	50	50	50
Construction Period (months)	12	12	12	12
Interest During Construction	$0	$295,213	$143,720	$318,428
Investment Cost	$0	$23,538,577	$11,459,377	$25,389,669
Annualized Investment Cost	$0	$871,891	$424,466	$940,457
Annual O&M	$0	$1,691	$708	$2,399
Total Annual Costs	$0	$873,581	$425,174	$942,855
With-Project Acres	401.12	401.12	401.12	401.12
With-Project AAHU	181.307	295.225	208.181	332.931
No-Action AAHU	181.307	181.307	181.307	181.307
Plan AAHU Gain	0	113.918	26.874	151.624
Annual Cost per AAHU Gain	$0	$7,669	$15,821	$6,218
Annual Cost per Acre	$0	$2,178	$1,060	$2,351
First Cost per Acre	$0	$57,946	$28,210	$62,503

1.21 Cost Effectiveness and Incremental Cost Analysis

This analysis includes a cost effectiveness and incremental cost analysis (CE/ICA) which utilizes the latest USACE-certified IWR Planning Suite II software (IWRPS) version 2.0.9 (IWRPS 2017) and the current interest rate of 2.75 percent (FY18). The analysis relies upon the results of the HEP analysis to estimate habituate output for each measure and scale. Planning level costs have been developed at current price levels (FY18). The following narrative describes the new CE/ICA and its results in detail.

Cost Effectiveness (CE) and Incremental Cost Analysis (ICA) techniques were used to determine the most cost-effective restoration alternatives or plans. In a CE/ICA analysis, restoration alternatives are comprised of a suite of measures. By selecting and combining different scales of each measure, the CE/ICA evaluates and compares all possible alternatives based on cost and habitat output.

The CE portion of the analysis refers to the process of identifying the subset of all possible alternatives which are cost effective, as only cost effective alternatives are carried forward. An alternative is cost effective when no other alternative can achieve the same level of habitat output at a lower cost, or a greater level of output at the same or less cost. Once cost effective alternatives have been identified, the ICA portion of the analysis is performed. The purpose of the ICA is to identify “best-buy” plans, or the horizon of cost effective plans which includes those alternatives that provide the greatest increase in habitat output for the least increase in cost per habitat unit, at each successive level of total output. The best-buy alternatives or plans are then evaluated using tabular and graphical summaries to consider cost and benefits not accounted for in the HEP and ICA analyses to determine the NER or recommended Ecosystem Restoration Plan for the study.

Alternative formulation cost and output were evaluated for each of the 32,000 possible combinations of the seven proposed management measures (A–G), including the no-action alternative for each measure.

Output was measured in average AAHUs as assessed using HEP analysis for a 50-year period of analysis. Benefits would be expected to increase and then level off over the period as habitats reach their full restoration potential. All plans were sorted by AAHU production to identify the cost-effective and non-cost-effective plans.

Cost was measured in Average Annual Cost, which includes total costs related to lands, easements, rights-of-way, relocation, and disposal areas (LERRDs); general construction; post project monitoring; support and administration (S&A); contingency; and operation, maintenance, repair, replacement, and rehabilitation (OMRRR) using a 50-year period of analysis with a 2.75 percent interest rate. Costs for each scale were escalated to current FY18 price level using the Civil Works Construction Cost Index System (Corps 2017).

Table 21 provides the input data that was fed into the IWRPS software. For each measure and scale, the key variables are average annual cost and AAHUs (net of the No Action). Based on the formulation of the measure and scales, all measures were combinable, and there were no dependencies.

Table 21. CE/ICA Input Data

Measure / Scale Code	Average Annual Cost $	Net AAHU
A0	0	0.000
A1	7,332	2.521
A2	11,500	4.394
A3	22,764	5.892
B0	0	0.000
B1	5,689	2.542
B2	12,771	4.389
B3	19,210	6.419
C0	0	0.000
C1	2,102	0.098
C2	4,046	0.833
C3	5,904	1.479
D0	0	0.000
D1	11,152	0.696
D2	21,405	1.178
D3	31,646	1.651
D4	41,899	2.131
E0	0	0.000
E1	7,422	0.425
E2	14,279	0.715
E3	21,127	0.993

Measure / Scale Code	Average Annual Cost $	Net AAHU
E4	27,986	1.282
F0	0	0.000
F1	6,153	0.437
F2	11,670	0.658
F3	17,189	0.878
F4	22,706	1.102
G0	0	0.000
G1	873,581	113.918
G2	425,174	26.874
G3	942,855	151.624

The IWRPS software generated 32,000 total possible combinations (plans). From this set of all possible combinations of measures and scales, 259 cost effective plans were identified, shown below in Table 22.

Table 22. All Cost Effective Plans

#	Plan	Average Annual Cost	Total AAHU Gain
1	No Action Plan	$0	0
2	A2B0C0D0E0F0G0	$11,500	4.394
3	A0B1C0D0E0F0G0	$5,689	2.542
4	A1B1C0D0E0F0G0	$13,021	5.063
5	A2B1C0D0E0F0G0	$17,189	6.936
6	A2B2C0D0E0F0G0	$24,271	8.783
7	A1B3C0D0E0F0G0	$26,542	8.94
8	A2B3C0D0E0F0G0	$30,710	10.813
9	A3B3C0D0E0F0G0	$41,974	12.311
10	A0B0C1D0E0F0G0	$2,102	0.098
11	A0B0C2D0E0F0G0	$4,046	0.833
12	A2B0C2D0E0F0G0	$15,546	5.227
13	A0B1C1D0E0F0G0	$7,791	2.64
14	A0B1C2D0E0F0G0	$9,735	3.375
15	A1B1C1D0E0F0G0	$15,123	5.161
16	A2B1C1D0E0F0G0	$19,291	7.034
17	A2B2C1D0E0F0G0	$26,373	8.881
18	A2B3C1D0E0F0G0	$32,812	10.911
19	A1B1C2D0E0F0G0	$17,067	5.896
20	A2B1C2D0E0F0G0	$21,235	7.769
21	A2B2C2D0E0F0G0	$28,317	9.616
22	A2B3C2D0E0F0G0	$34,756	11.646
23	A3B3C2D0E0F0G0	$46,020	13.144
24	A2B1C3D0E0F0G0	$23,093	8.415
25	A2B2C3D0E0F0G0	$30,175	10.262
26	A2B3C3D0E0F0G0	$36,614	12.292
27	A3B3C3D0E0F0G0	$47,878	13.79
28	A3B3C3D1E0F0G0	$59,030	14.486
29	A3B3C3D2E0F0G0	$69,283	14.968
30	A2B3C3D0E0F1G0	$42,767	12.729
31	A3B3C3D0E0F1G0	$54,031	14.227
32	A3B3C3D0E0F3G0	$65,067	14.668
33	A3B3C3D1E0F1G0	$65,183	14.923
34	A3B3C3D2E0F1G0	$75,436	15.405
35	A3B3C3D3E0F1G0	$85,677	15.878
36	A3B3C3D4E0F1G0	$95,930	16.358
37	A3B3C3D1E0F2G0	$70,700	15.144
38	A3B3C3D0E1F1G0	$61,453	14.652
39	A3B3C3D0E2F1G0	$68,310	14.942
40	A3B3C3D1E1F1G0	$72,605	15.348
41	A3B3C3D2E1F1G0	$82,858	15.83
42	A3B3C3D3E1F1G0	$93,099	16.303
43	A3B3C3D4E1F1G0	$103,352	16.783
44	A3B3C3D1E2F1G0	$79,462	15.638
45	A3B3C3D2E2F1G0	$89,715	16.12
46	A3B3C3D3E2F1G0	$99,956	16.593

#	Plan	Average Annual Cost	Total AAHU Gain
47	A3B3C3D4E2F1G0	$110,209	17.073
48	A3B3C3D1E3F1G0	$86,310	15.916
49	A3B3C3D2E3F1G0	$96,563	16.398
50	A3B3C3D3E3F1G0	$106,804	16.871
51	A3B3C3D4E3F1G0	$117,057	17.351
52	A3B3C3D3E4F1G0	$113,663	17.16
53	A3B3C3D4E4F1G0	$123,916	17.64
54	A3B3C3D1E1F2G0	$78,122	15.569
55	A3B3C3D2E1F2G0	$88,375	16.051
56	A3B3C3D3E1F2G0	$98,616	16.524
57	A3B3C3D4E1F2G0	$108,869	17.004
58	A3B3C3D1E2F2G0	$84,979	15.859
59	A3B3C3D2E2F2G0	$95,232	16.341
60	A3B3C3D3E2F2G0	$105,473	16.814
61	A3B3C3D4E2F2G0	$115,726	17.294
62	A3B3C3D1E3F2G0	$91,827	16.137
63	A3B3C3D2E3F2G0	$102,080	16.619
64	A3B3C3D3E3F2G0	$112,321	17.092
65	A3B3C3D4E3F2G0	$122,574	17.572
66	A3B3C3D3E4F2G0	$119,180	17.381
67	A3B3C3D4E4F2G0	$129,433	17.861
68	A3B3C3D4E1F3G0	$114,388	17.224
69	A3B3C3D4E2F3G0	$121,245	17.514
70	A3B3C3D4E3F3G0	$128,093	17.792
71	A3B3C3D4E4F3G0	$134,952	18.081
72	A3B3C3D4E1F4G0	$119,905	17.448
73	A3B3C3D4E2F4G0	$126,762	17.738
74	A3B3C3D4E3F4G0	$133,610	18.016
75	A3B3C3D4E4F4G0	$140,469	18.305
76	A0B0C0D0E0F0G1	$873,581	113.918
77	A0B0C0D0E0F0G2	$425,174	26.874
78	A0B0C0D0E0F0G3	$942,855	151.624
79	A2B0C0D0E0F0G1	$885,081	118.312
80	A2B0C0D0E0F0G2	$436,674	31.268
81	A2B0C0D0E0F0G3	$954,355	156.018
82	A0B1C0D0E0F0G1	$879,270	116.46
83	A0B1C0D0E0F0G2	$430,863	29.416
84	A0B1C0D0E0F0G3	$948,544	154.166
85	A1B1C0D0E0F0G1	$886,602	118.981
86	A2B1C0D0E0F0G1	$890,770	120.854
87	A2B2C0D0E0F0G1	$897,852	122.701
88	A1B3C0D0E0F0G1	$900,123	122.858
89	A2B3C0D0E0F0G1	$904,291	124.731
90	A3B3C0D0E0F0G1	$915,555	126.229
91	A1B1C0D0E0F0G2	$438,195	31.937
92	A2B1C0D0E0F0G2	$442,363	33.81
93	A2B2C0D0E0F0G2	$449,445	35.657

#	Plan	Average Annual Cost	Total AAHU Gain
94	A1B3C0D0E0F0G2	$451,716	35.814
95	A2B3C0D0E0F0G2	$455,884	37.687
96	A3B3C0D0E0F0G2	$467,148	39.185
97	A1B1C0D0E0F0G3	$955,876	156.687
98	A2B1C0D0E0F0G3	$960,044	158.56
99	A2B2C0D0E0F0G3	$967,126	160.407
100	A1B3C0D0E0F0G3	$969,397	160.564
101	A2B3C0D0E0F0G3	$973,565	162.437
102	A3B3C0D0E0F0G3	$984,829	163.935
103	A0B0C1D0E0F0G1	$875,683	114.016
104	A0B0C2D0E0F0G1	$877,627	114.751
105	A0B0C1D0E0F0G2	$427,276	26.972
106	A0B0C2D0E0F0G2	$429,220	27.707
107	A0B0C1D0E0F0G3	$944,957	151.722
108	A0B0C2D0E0F0G3	$946,901	152.457
109	A2B0C2D0E0F0G1	$889,127	119.145
110	A2B0C2D0E0F0G2	$440,720	32.101
111	A2B0C2D0E0F0G3	$958,401	156.851
112	A0B1C1D0E0F0G1	$881,372	116.558
113	A0B1C2D0E0F0G1	$883,316	117.293
114	A0B1C1D0E0F0G2	$432,965	29.514
115	A0B1C2D0E0F0G2	$434,909	30.249
116	A0B1C1D0E0F0G3	$950,646	154.264
117	A0B1C2D0E0F0G3	$952,590	154.999
118	A1B1C1D0E0F0G1	$888,704	119.079
119	A2B1C1D0E0F0G1	$892,872	120.952
120	A2B2C1D0E0F0G1	$899,954	122.799
121	A2B3C1D0E0F0G1	$906,393	124.829
122	A1B1C2D0E0F0G1	$890,648	119.814
123	A2B1C2D0E0F0G1	$894,816	121.687
124	A2B2C2D0E0F0G1	$901,898	123.534
125	A2B3C2D0E0F0G1	$908,337	125.564
126	A3B3C2D0E0F0G1	$919,601	127.062
127	A2B1C3D0E0F0G1	$896,674	122.333
128	A2B2C3D0E0F0G1	$903,756	124.18
129	A2B3C3D0E0F0G1	$910,195	126.21
130	A3B3C3D0E0F0G1	$921,459	127.708
131	A1B1C1D0E0F0G2	$440,297	32.035
132	A2B1C1D0E0F0G2	$444,465	33.908
133	A2B2C1D0E0F0G2	$451,547	35.755
134	A2B3C1D0E0F0G2	$457,986	37.785
135	A1B1C2D0E0F0G2	$442,241	32.77
136	A2B1C2D0E0F0G2	$446,409	34.643
137	A2B2C2D0E0F0G2	$453,491	36.49
138	A2B3C2D0E0F0G2	$459,930	38.52
139	A3B3C2D0E0F0G2	$471,194	40.018
140	A2B1C3D0E0F0G2	$448,267	35.289

#	Plan	Average Annual Cost	Total AAHU Gain
141	A2B2C3D0E0F0G2	$455,349	37.136
142	A2B3C3D0E0F0G2	$461,788	39.166
143	A3B3C3D0E0F0G2	$473,052	40.664
144	A1B1C1D0E0F0G3	$957,978	156.785
145	A2B1C1D0E0F0G3	$962,146	158.658
146	A2B2C1D0E0F0G3	$969,228	160.505
147	A2B3C1D0E0F0G3	$975,667	162.535
148	A1B1C2D0E0F0G3	$959,922	157.52
149	A2B1C2D0E0F0G3	$964,090	159.393
150	A2B2C2D0E0F0G3	$971,172	161.24
151	A2B3C2D0E0F0G3	$977,611	163.27
152	A3B3C2D0E0F0G3	$988,875	164.768
153	A2B1C3D0E0F0G3	$965,948	160.039
154	A2B2C3D0E0F0G3	$973,030	161.886
155	A2B3C3D0E0F0G3	$979,469	163.916
156	A3B3C3D0E0F0G3	$990,733	165.414
157	A3B3C3D1E0F0G1	$932,611	128.404
158	A3B3C3D1E0F0G2	$484,204	41.36
159	A3B3C3D2E0F0G2	$494,457	41.842
160	A3B3C3D1E0F0G3	$1,001,885	166.11
161	A3B3C3D2E0F0G3	$1,012,138	166.592
162	A2B3C3D0E0F1G1	$916,348	126.647
163	A3B3C3D0E0F1G1	$927,612	128.145
164	A3B3C3D0E0F3G1	$938,648	128.586
165	A2B3C3D0E0F1G2	$467,941	39.603
166	A3B3C3D0E0F1G2	$479,205	41.101
167	A3B3C3D0E0F3G2	$490,241	41.542
168	A2B3C3D0E0F1G3	$985,622	164.353
169	A3B3C3D0E0F1G3	$996,886	165.851
170	A3B3C3D0E0F3G3	$1,007,922	166.292
171	A3B3C3D1E0F1G1	$938,764	128.841
172	A3B3C3D1E0F1G2	$490,357	41.797
173	A3B3C3D2E0F1G2	$500,610	42.279
174	A3B3C3D3E0F1G2	$510,851	42.752
175	A3B3C3D4E0F1G2	$521,104	43.232
176	A3B3C3D1E0F2G2	$495,874	42.018
177	A3B3C3D1E0F1G3	$1,008,038	166.547
178	A3B3C3D2E0F1G3	$1,018,291	167.029
179	A3B3C3D3E0F1G3	$1,028,532	167.502
180	A3B3C3D4E0F1G3	$1,038,785	167.982
181	A3B3C3D1E0F2G3	$1,013,555	166.768
182	A3B3C3D0E1F1G1	$935,034	128.57
183	A3B3C3D0E2F1G1	$941,891	128.86
184	A3B3C3D0E1F1G2	$486,627	41.526
185	A3B3C3D0E2F1G2	$493,484	41.816
186	A3B3C3D0E1F1G3	$1,004,308	166.276
187	A3B3C3D0E2F1G3	$1,011,165	166.566

#	Plan	Average Annual Cost	Total AAHU Gain
188	A3B3C3D1E1F1G2	$497,779	42.222
189	A3B3C3D2E1F1G2	$508,032	42.704
190	A3B3C3D3E1F1G2	$518,273	43.177
191	A3B3C3D4E1F1G2	$528,526	43.657
192	A3B3C3D1E2F1G2	$504,636	42.512
193	A3B3C3D2E2F1G2	$514,889	42.994
194	A3B3C3D3E2F1G2	$525,130	43.467
195	A3B3C3D4E2F1G2	$535,383	43.947
196	A3B3C3D1E3F1G2	$511,484	42.79
197	A3B3C3D2E3F1G2	$521,737	43.272
198	A3B3C3D3E3F1G2	$531,978	43.745
199	A3B3C3D4E3F1G2	$542,231	44.225
200	A3B3C3D3E4F1G2	$538,837	44.034
201	A3B3C3D4E4F1G2	$549,090	44.514
202	A3B3C3D1E1F2G2	$503,296	42.443
203	A3B3C3D2E1F2G2	$513,549	42.925
204	A3B3C3D3E1F2G2	$523,790	43.398
205	A3B3C3D4E1F2G2	$534,043	43.878
206	A3B3C3D1E2F2G2	$510,153	42.733
207	A3B3C3D2E2F2G2	$520,406	43.215
208	A3B3C3D3E2F2G2	$530,647	43.688
209	A3B3C3D4E2F2G2	$540,900	44.168
210	A3B3C3D1E3F2G2	$517,001	43.011
211	A3B3C3D2E3F2G2	$527,254	43.493
212	A3B3C3D3E3F2G2	$537,495	43.966
213	A3B3C3D4E3F2G2	$547,748	44.446
214	A3B3C3D3E4F2G2	$544,354	44.255
215	A3B3C3D4E4F2G2	$554,607	44.735
216	A3B3C3D4E1F3G2	$539,562	44.098
217	A3B3C3D4E2F3G2	$546,419	44.388
218	A3B3C3D4E3F3G2	$553,267	44.666
219	A3B3C3D4E4F3G2	$560,126	44.955
220	A3B3C3D4E1F4G2	$545,079	44.322
221	A3B3C3D4E2F4G2	$551,936	44.612
222	A3B3C3D4E3F4G2	$558,784	44.89
223	A3B3C3D4E4F4G2	$565,643	45.179
224	A3B3C3D1E1F1G3	$1,015,460	166.972
225	A3B3C3D2E1F1G3	$1,025,713	167.454
226	A3B3C3D3E1F1G3	$1,035,954	167.927
227	A3B3C3D4E1F1G3	$1,046,207	168.407
228	A3B3C3D1E2F1G3	$1,022,317	167.262
229	A3B3C3D2E2F1G3	$1,032,570	167.744
230	A3B3C3D3E2F1G3	$1,042,811	168.217
231	A3B3C3D4E2F1G3	$1,053,064	168.697
232	A3B3C3D1E3F1G3	$1,029,165	167.54
233	A3B3C3D2E3F1G3	$1,039,418	168.022
234	A3B3C3D3E3F1G3	$1,049,659	168.495

#	Plan	Average Annual Cost	Total AAHU Gain
235	A3B3C3D4E3F1G3	$1,059,912	168.975
236	A3B3C3D3E4F1G3	$1,056,518	168.784
237	A3B3C3D4E4F1G3	$1,066,771	169.264
238	A3B3C3D1E1F2G3	$1,020,977	167.193
239	A3B3C3D2E1F2G3	$1,031,230	167.675
240	A3B3C3D3E1F2G3	$1,041,471	168.148
241	A3B3C3D4E1F2G3	$1,051,724	168.628
242	A3B3C3D1E2F2G3	$1,027,834	167.483
243	A3B3C3D2E2F2G3	$1,038,087	167.965
244	A3B3C3D3E2F2G3	$1,048,328	168.438
245	A3B3C3D4E2F2G3	$1,058,581	168.918
246	A3B3C3D1E3F2G3	$1,034,682	167.761
247	A3B3C3D2E3F2G3	$1,044,935	168.243
248	A3B3C3D3E3F2G3	$1,055,176	168.716
249	A3B3C3D4E3F2G3	$1,065,429	169.196
250	A3B3C3D3E4F2G3	$1,062,035	169.005
251	A3B3C3D4E4F2G3	$1,072,288	169.485
252	A3B3C3D4E1F3G3	$1,057,243	168.848
253	A3B3C3D4E2F3G3	$1,064,100	169.138
254	A3B3C3D4E3F3G3	$1,070,948	169.416
255	A3B3C3D4E4F3G3	$1,077,807	169.705
256	A3B3C3D4E1F4G3	$1,062,760	169.072
257	A3B3C3D4E2F4G3	$1,069,617	169.362
258	A3B3C3D4E3F4G3	$1,076,465	169.64
259	A3B3C3D4E4F4G3	$1,083,324	169.929

Next, the cost-effective plans were then compared based on incremental cost per unit output (incremental average annual cost divided by incremental AAHU) to identify the best-buy plans. Best-buy plans are those that have the lowest incremental cost per output at a given cost level. IWRPS generates graphs that illustrate where each of the plans falls in relation to each other plan, in a comparison of plan cost versus plan benefits or output in habitat units. Figure 17 graphs all possible plans, including cost-effective, non-cost-effective, and best-buy. As shown in the figure, the No Action plan is at the origin (zero cost, zero output). This reflects that all plans are compared relative to the No Action in the CE/ICA. As such, AAHU's for action alternatives are net of the AAHU's that would be achieved under the No Action alternative.

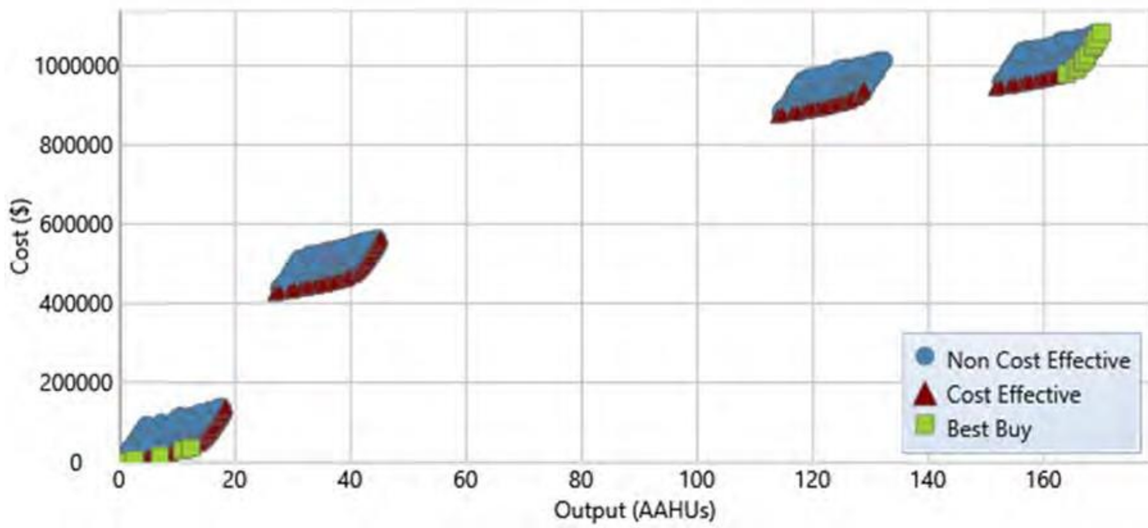


Figure 17. All Possible Plans Differentiated

The next best buy is then identified as the plan which achieves the next largest total output at the least cost per unit of additional output. Plans that produce less output than the best-buy plan are removed from the analysis, and the last identified best-buy plan becomes the baseline for comparison of successive plans. Selected best-buy plans can then be evaluated using tabular and graph summaries such as those shown in Table 23 and Figure 18 to consider costs and benefits not accounted for in the HEP and ICA assessments.

The ICA procedure identified 15 best buy plans. For each best-buy plan, Table 23 on the next page provides an outline of the plan's restoration components (measures and scales), along with the Total Cost, Total Output, Average Annual Cost, Incremental Average Annual Cost, Incremental Output, and Incremental Average Annual Cost per Output.

Table 23. Best-buy Plans Cost/Output Summary

Plan	Measure and Scale							Output	Cost		Incremental …		
	A	B	C	D	E	F	G		Annual	Average ($/HU)	Annual Cost	Output (HU)	Cost per Output
1	0	0	0	0	0	0	0	0	$0	$0	$0	0	$0
2	0	1	0	0	0	0	0	2.542	$5,689	$2,238	$5,689	2.542	$2,238
3	2	1	0	0	0	0	0	6.936	$17,189	$2,478	$11,500	4.394	$2,617
4	2	3	0	0	0	0	0	10.813	$30,710	$2,840	$13,521	3.877	$3,487
5	2	3	3	0	0	0	0	12.292	$36,614	$2,979	$5,904	1.479	$3,992
6	**2**	**3**	**3**	**0**	**0**	**0**	**3**	**163.916**	**$979,469**	$5,975	**$942,855**	**151.624**	**$6,218**
7	3	3	3	0	0	0	3	165.414	$990,733	$5,989	$11,264	1.498	$7,519
8	3	3	3	0	0	1	3	165.851	$996,886	$6,011	$6,153	0.437	$14,080
9	3	3	3	1	0	1	3	166.547	$1,008,038	$6,053	$11,152	0.696	$16,023
10	3	3	3	1	1	1	3	166.972	$1,015,460	$6,082	$7,422	0.425	$17,464
11	3	3	3	2	1	1	3	167.454	$1,025,713	$6,125	$10,253	0.482	$21,272
12	3	3	3	4	1	1	3	168.407	$1,046,207	$6,212	$20,494	0.953	$21,505
13	3	3	3	3	2	1	3	168.697	$1,053,064	$6,242	$6,857	0.29	$23,645
14	3	3	3	4	4	1	3	169.264	$1,066,771	$6,302	$13,707	0.567	$24,175
15	3	3	3	4	4	4	3	169.929	$1,083,324	$6,375	$16,553	0.665	$24,892

NER Plan Selection

While there is no rule for selecting the most cost-effective plan, decisions are generally based on output targets, output thresholds, cost limits, or breakpoints. Because there is no maximum or minimum required output and the most expensive plan is within the budget constraints, the first three criteria for decision making are not applicable to this project. However, in the Best-buy Plan graph below, Plan 6 is seen to be preceded by and followed by breakpoints, as represented in Figure 18.

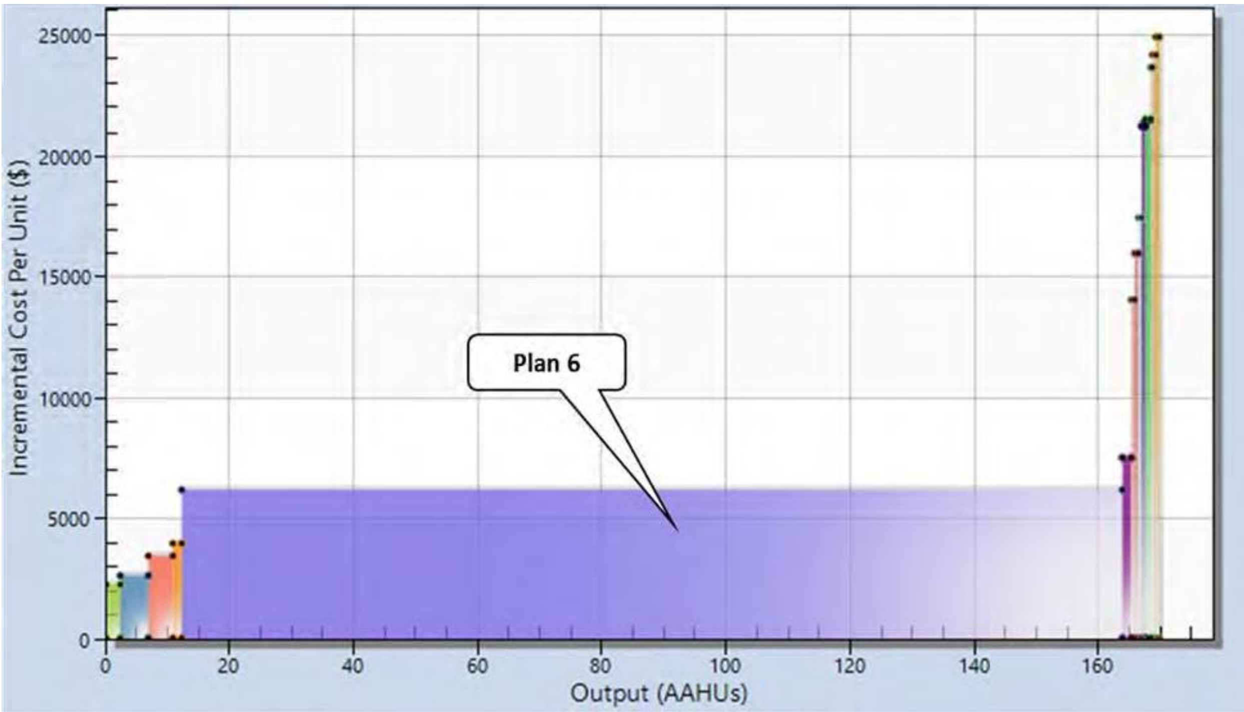


Figure 18. Best-buy Plans Incremental Cost Breakpoints

To guide the decision process, the question "*Is it worth it*?" is used to focus on the plans that cause abrupt changes in the incremental cost curve as shown in the previous graph. This analysis compared the best-buy plans in succession.

Beginning with Plan 1, the No-Action Plan, each successive plan requires additional cost over the previous plan. Plan 1 is the future without a project alternative. Under this alternative, none of the proposed restoration measures would be implemented. Study area conditions would remain in their degraded status. The No-Action Plan would not meet any of the stated goals and objectives for this study.

Plan 2 provides an additional 2.54 AAHUs over the No-Action Plan, at an incremental cost per incremental output of $2,238. These additional AAHUs would be due to implementation of Wetland Site B Scale 1, which includes a 1-foot high weir. Thus, the study team found that the 2.54 additional AAHUs provided by implementation of Plan 2 for the improvement of wetland habitat are worth $2,238 per unit. This plan addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 2 with Plan 3, Plan 3 provides an additional 4.39 AAHUs at an average incremental cost per incremental output of $2,617. These additional AAHU gains come from Wetland Site A Scale 2, which includes a 2-foot high weir. The addition of another wetland site furthers pursuit of the planning objectives. Thus, the study team found that the 4.39 additional AAHUs provided by implementation of Plan 3 for additional wetland restoration are worth $2,617 per unit. This plan, in addition to Plan 2, addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 3 with Plan 4, Plan 4 provides an additional 3.88 AAHUs at an average incremental cost per incremental output of $3,487. These additional AAHU gains come from a change in the selected scale for Wetland B, choosing Scale 2 instead of Scale 1, which would increase the weir size to 2-feet high, furthering pursuit of the planning objectives by creating additional wetland acreage. Thus, the study team found that the 3.88 additional AAHUs provided by implementation of Plan 4 for additional wetland restoration are worth $3,487 per unit. This plan, similar to Plan 3, addresses some of the potential for wetland restoration, but does not completely fulfill the planning objectives.

When comparing Plan 4 with Plan 5, Plan 5 provides an additional 1.48 AAHUs at an average incremental cost per incremental output of $3,992. These additional AAHU gains come the addition of Wetland Site C Scale 3, which includes a 3-foot high weir. The addition of the third wetland site helps to meet planning objectives which address wetland restoration. Thus, the study found that the 1.48 additional AAHUs provided by implementation of Plan 5 for additional wetland restoration at Site C are worth $3,992 per unit. This plan, in addition to Plan 4, addresses most of the wetland restoration potential, but still does not completely fulfill the planning objectives.

When comparing Plan 5 with Plan 6, Plan 6 provides an additional 151.62 AAHUs at an average incremental cost per incremental output of $6,218, corresponding to the large horizontal purple rectangle in Figure 18. These additional AAHU gains come from the addition of the Scale 3 of the Riparian Measure G, which includes implementation of both the Scale 1 and Scale 2. This addition would provide for reforestation of non-forested areas, including buffelgrass control, planting, and irrigation, as well as removal of salt cedar from forested areas. The combination of applying several restoration measures, including creating and restoring three wetland sites with riffle structures, debris removal, removal of exotic species, and revegetation, creates a continuous corridor from Lake Casa Blanca to the Rio Grande. These measures provide a more systemic restoration by providing and improving aquatic, wetland, and riparian habitats. The measures would improve water quality and stream function, as well as reduce risk of fire from invasive buffelgrass. Thus, the study team found that the 151.62 additional AAHUs provided by implementation of Plan 6 for riparian restoration are worth $6,218 per unit. This plan, in addition to Plan 5, implements wetland restoration at all sites and maximizes riparian restoration potential, and meets the planning objectives.

When comparing Plan 6 with Plan 7, Plan 7 provides an additional 1.498 AAHU at an average incremental cost per unit of $7,519. These additional AAHU gains come from applying a larger scale for Wetland A. While this plan would provide some additional benefit to wetland and aquatic habitat and meets the planning objects, the small gains cost approximately 21 percent more per output unit than what the previous plan would cost for only a 1% increase in total output. Therefore, the study team found that the 1.498 additional AAHUs provided by implementation of Plan 7 are not worth the cost of $7,519 per unit.

In summary, the No-Action Plan, Plan 1, does not address any of the restoration objectives. Plan 6 has the greatest potential to improve habitat conditions and achieve the bulk of the potential benefits. The potential to control invasive species, improve water quality, increase the quality and quantity of aquatic, wetland, and riparian habitats makes Plan 6 worth the additional cost. Though Plan 7 is within the budget constraints and meets restoration objectives, the minimal additional benefit for Plan 7 is not considered worth the higher incremental cost per incremental output. Therefore, Plan 6, depicted in Figure 9, is identified as the National Ecosystem Restoration Plan or recommended NER Plan in this study.

Plan 6 is the NER Plan and includes elements for improving water quality, improving herbaceous cover, reduction in erosion and turbidity, controlling invasive species, and enhancing the quality of wetland, riverine, and riparian habitats. Table 24 outlines the economic summary for the NER Plan.

Table 24. Economic Summary for NER Plan Measures (2.75%)

Project Cost Items	Scale A2	Scale B3	Scale C3	Scale G3	Total
First Cost	$284,282	$483,327	$143,107	$25,071,241	$25,981,957
Project Life (years)	50	50	50	50	50
Construction Period (months)	12	12	12	12	12
Interest During Construction	$3,611	$6,139	$1,818	$318,428	$329,996
Investment Cost	$287,893	$489,466	$144,924	$25,389,669	$26,311,952
Annualized Investment Cost	$10,664	$18,130	$5,368	$940,457	$974,619
Annual O&M Replacements	$837	$1,080	$536	$2,399	$4,852
Total Annual Charges	$11,500	$19,210	$5,904	$942,855	$979,469
With-Project Acres	5.99	8.69	2.07	401.12	417.870
With-Project AAHU	4.623	6.687	1.489	332.931	345.73
No-Action AAHU	0.229	0.268	0.01	181.307	181.814
Plan AAHU Gain	4.394	6.419	1.479	151.624	163.916
Annual Cost per AAHU Gain	$2,617.21	$2,992.68	$3,991.89	$6,218.38	$5,975.43
Annual Cost per Acre	$1,919.87	$2,210.59	$2,852.17	$2,350.56	$2,343.96
First Cost per Acre	$47,459.43	$55,618.76	$69,133.82	$62,503.09	$62,177.13
Average Annual O&M per Acre	$139.73	$124.28	$258.94	$5.98	$11.61

1.22 Wetland Measures

The recommended plan includes three wetland areas that will total approximately 16.75 acres, which is an addition of 13.09 acres. This will create 12.29 AAHUs versus the No Action at an average cost of $2,979 per AAHU gained.

1.22.1 Wetland A, Scale A2

For Wetland A, a weir would be constructed that would raise water levels by two feet. A downstream riffle will be constructed that will primarily prevent scour and support the weir structure. This riffle structure will also enhance riverine habitat by adding oxygen to the water and provide positive changes to the habitat suitability in the area. In this area, upstream from the proposed weir, facility CAFO exists that adds nutrient runoff to the system. As part of the riparian measure, this facility will be removed in the study area.

1.22.2 Wetland B, Scale B3

For wetland B, a weir would also be constructed that would add approximately three feet of permanent water to the site; again, a riffle structure downstream from the weir would be constructed.

1.22.3 Wetland C, Scale C3

For wetland C, an off-channel weir would be constructed that seasonally would add up to three feet of water to the site, and a riffle structure downstream from the weir would be constructed. Extensive debris removal is included in this area. There were several woody species in the area; impacts to these will be avoided and minimized.

1.23 Riverine Measures

The recommended plan does not include any additional riffle structures in the three identified riverine reaches.

1.24 Riparian Measure

The remaining portions of the study area were considered for riparian restoration, including removal and control of invasive species, as well as riparian reforestation. These areas will total approximately 401.12 acres and create 151.624 AAHUs versus the No Action at an average cost of $6,218 per AAHU gained.

1.24.1 Riparian G, Scale G3

For this measure, scale G3 is a combination of scales G1 and G2. Scale G1 includes portions of the study area identified as non-forested riparian, and vegetation consists primarily of buffelgrass, an invasive species. In these areas, native species will be avoided, but otherwise this area will be cleared, grubbed, and treated for control of buffelgrass, followed by the installation of an irrigation system and replanting of native species, as described in the USFWS Site Visit Report in Appendix E, “U.S. Fish and Wildlife Service Coordination.” G2 includes areas identified as forested riparian, and for this measure includes selective removal and stump treatment of salt cedar, as described in the USFWS Site Visit Report.

The significance of the recommended habitat restoration can be described in a number of ways, including technical recognition (importance based on scientific knowledge or judgment of critical resource characteristics) in terms of scarcity, representativeness, status and trends, connectivity, critical habitat, and biodiversity; institutional recognition (importance of environmental resource is acknowledged in laws, adopted plans, and other policy statements of public agencies); or public recognition (segment of general public recognizes the importance of the environmental resource). It is also important to design measurable project objectives to detect ecosystem changes over time and monitor restoration approaches. A robust monitoring plan, which contains repeatable monitoring techniques, will also provide a means of demonstrating improvements to ecosystem function and judging the effectiveness of restoration techniques outlined in this report.

The USACE also assesses additional information on restoration projects for budgetary processes and ranking of importance of the outputs. These criteria are similar in nature and some are discussed at length included in the discussions of the three significance criteria above. However, there are five budgetary criteria. These criteria include scarcity, connectivity, special status species, plan recognition, and self-sustaining. The scarcity criterion relates habitat to how nationally scarce the habitat is and if it is becoming scarcer as demonstrated by a Federal, regional, or state/Tribal report, or general scientific agreement as documented by professional publications/societies. Connectivity relates to habitat that makes a significant connection between existing habitat areas in a corridor or larger landscape contributing to reduction of population isolation, larger ranges, and population movement recognized by or demonstrated by community or species models. The special status species criterion requires that a restoration effort provide significant contribution to some key life requisite of a species. Plan recognition emphasizes restoration efforts that contribute to watershed or basin plans. The highest scores for this criterion are given to ecosystem restoration studies that contribute to a multi-agency, comprehensive watershed plan developed in support of Federal priorities as demonstrated in laws or specifically authorized programs, such as a recovery plan for an endangered species. The self-sustaining criterion emphasizes the restoration of a self-sustaining ecosystem consisting of natural processes. A ratio of average annual Operation and Maintenance costs to the average annual total project cost will be used as justification. As noted above, the habitat types for the most part are self-sustaining. Over the long term they may begin to convert to other habitat types but would still provide a sustaining balanced diversity of habitats for wildlife.

1.25 Technical Recognition

From a technical recognition perspective, the recommended habitat is significant because it addresses habitat scarcity and diversity. River corridors, such as Chacon Creek, maintain regional biodiversity, contain high potential ecological value, and a diverse array of species, but are often severely altered and exhibit reduced ecological function. River corridors also provide vital habitat for migrating species (Naiman et al. 1993). The structure of riparian ecosystems also influence watershed scale nutrient and pollutant transport processes. Riparian buffers regulate nutrient and pollutant movement to receiving water bodies and provide influence water quality (Vidon et al. 2010).

Nationally, the loss of aquatic and riparian habitats is widely recognized. Freshwater animal species are disappearing five times faster than terrestrial animals, due (in part) to the widespread physical alteration of rivers (Ricciardi and Rasmussen 1999). Of 860,000 river miles within the United States, approximately 24 percent have been impacted by channelization, impoundment, or navigation. The USFWS estimates 70 percent of the riparian habitats nationwide have been lost or altered, and 50 percent of all listed threatened or endangered species depend on rivers and streams for their continued existence. In some geographic areas, loss of natural riparian vegetation is as much as 95 percent, indicating that riparian areas are some of the most severely altered landscapes in the country (NRC, 2002). The National Research Council (NRC) has stated that restoration of riparian functions along America's water bodies should be a national goal (NRC, 2002). Urban riparian buffers are the framework for healthy streams and water quality and also provide social benefits and improved quality of life for citizens (Groffman et al. 2003).

Riparian forests, including bottomland hardwood forests, especially those occurring in the south, were designated as a nationally threatened ecosystem. There has been an 84 percent decline in riparian forests on a national scale since early settlement (Noss et al, 1995). Prior to European settlement, the bottomland hardwood ecosystem in Texas once extended over 6.5 million hectares. It is estimated that less than 40 percent of this original extent remains (Frye, 1986), with only a few small and isolated patches of old growth scattered among the floodplains of the eastern third of the state. Losses of intact bottomland hardwoods in the past 50 years have at times been greater than 120,000 ha per year (Barry and Knoll 1999). For the most part, factors such as urbanization, channelization, timber harvest, agriculture, and the introduction of exotic species have all contributed to the degradation and declining trend of riparian forests.

The study area consists primarily of riparian habitat, yet the approximately 401 acres provide only 63 AAHUs. Exotic species have become established in the riparian area. The riparian areas that are relatively non-forested are nearly monoculture of buffelgrass. In the forested riparian areas, salt cedar is becoming established. Specific measures such as exotic species removal and revegetation in the riparian area could directly increase the AAHUs to 304.53 and improve the health of the riparian forest habitat within the study area.

Based on analysis of more than 21,000 plant and animal species, The Nature Conservancy's (TNC) Ranking of America's Biodiversity (Stein 2002), within the 50 states and the District of Columbia, shows four states as having exceptional levels of biodiversity, with Texas ranked second overall, but ranked first for diversity of birds and reptiles. Unfortunately, Texas ranks fourth in the number of extinctions, and is ranked eleventh overall for species at risk.

The national and state trend for habitat loss is evident in the Laredo area. The Chacon Creek Watershed corridor is divided by the dam creating Lake Casa Blanca. The remaining corridor between the Lake Casa Blanca and the Rio Grande River is crossed by a CAFO and the habitat is being further degraded by the introduction of exotic species. The introduction of exotic plant and animal species has had a substantial effect on riparian areas, leading to displacement of native species and the subsequent alteration of ecosystem properties (NRC, 2002). Problematic non-native woody and herbaceous plant species are found throughout the project area. Local elimination of these species has been recommended by the USFWS and TPWD. This trend in the loss of habitat and species is expected to continue unless proactive restoration measures are taken.

Migratory birds are of great ecological value and contribute immensely to biological diversity. Over 300 species of birds are listed as Nearctic-Neotropical migrants in North America, and over 98 percent of those have been recorded in Texas. Meaning, of the more than 600 species of birds documented in Texas, 54 percent of them are neotropical species that depend on Texas to provide habitat for nesting or migration, and many of those are dependent on southwest Texas riparian areas specifically. Neotropical migratory birds have been declining in numbers for several decades. Initially, the focus of conservation for this important group of birds was focused on breeding habitat and wintering grounds. However, recently it has been recognized that the loss, fragmentation, and degradation of stopover habitat is potentially the greatest threat to the survival and conservation of neotropical birds (Smithsonian Migratory Bird Center). In arid areas of the United States, stopover sites are restricted to small defined habitats along shelter belts, hedgerows, desert oases, and riparian corridors. The riparian corridors of Texas provide an opportunity for the birds to replenish fat reserves, obtain shelter from predators, and find water for re-hydration prior to continuing, which is a trip of over 1,000 miles one-way for most neotropical birds.

Desirable habitat for migratory waterfowl and neotropical migrants is limited in the Laredo area. However, the project area is located along the Rio Grande River, which runs from Colorado to the Gulf of Mexico, and provides an important corridor through the southwest. The Rio Grande and its tributaries is a major migratory flyway for avian species (Yong and Finch 2002). Hundreds of species migrate through the region. The Chacon Creek Project, centrally located along the Rio Grande would increase the amount of highly used, but scarce habitat along a migratory bird corridor.

The identified plan makes a significant contribution to restoring one of the last natural stream corridors in the City of Laredo. In addition to this study, there are several planning initiatives within the Rio Grande Basin, and also a number of basin studies, restoration projects, and research groups, as described under “Plan Recognition.”

The habitat along Chacon Creek restored from the identified plan would contribute to and benefit from the goals of the various projects listed above. As part of the larger watershed plan, the identified restoration project provides significant watershed level outputs that will contribute to sustainability, connectivity, biodiversity, and completeness of the ecosystem.

1.26 Institutional Recognition

The importance of migratory non-game birds to the nation is embodied in numerous laws, executive orders, and partnerships. The Fish and Wildlife Conservation Act demonstrates the Federal commitment to conservation of non-game species. Amendments to the Act adopted in 1988 and 1989 direct the Secretary to undertake activities to research and conserve migratory non-game birds. Executive Order 13112 directs Federal agencies to promote the conservation of migratory bird populations, including restoring and enhancing habitat. The Birds of Conservation Concern is a list maintained by the USFWS. The list helps fulfill a primary goal of the USFWS to conserve avian diversity in North America. Additionally, the USFWS Migratory Bird Plan is a draft strategic plan to strengthen and guide the agency’s Migratory Bird Program. The proposed ecosystem restoration would contribute directly to the U.S. Fish and Wildlife Service Migratory Bird Program goals to protect, conserve, and restore migratory bird habitats to ensure long-term sustainability of all migratory bird populations. Range-wide protection and restoration, and restoration of riparian and riverine habitats and landscapes, are crucial to maintain and conserve migratory birds.

The USFWS has divided North America into 37 regions known as Bird Conservation Regions (BCR). It was determined that the project area for this study lies in BCR 36 (Tamaulipan Brushlands) near the boundary of BCR 35 (Chihuahuan Desert). According to the list in Table 25, 29 species are listed in BCR 35, 21 of which are also listed of National Concern. There are 29 species listed in BCR 36, 16 of which are listed of National Concern. One species in BCR 35 is likely to become a candidate for listing under the Endangered Species Act of 1973 without additional conservation actions.

While none of these species were observed during site visits to Chacon Creek, many of these species could migrate within the region. The ecosystem restoration measures identified for possible alternative selection, including development of wetland and addition of riffle structures, removal of exotic species, and revegetation with native plants, could serve to improve the riverine, wetland, and riparian habitats within the study area. This could benefit those species listed in the Bird Conservation Regions. Based on this information, it is evident that ecosystem outputs gained from the proposed alternatives are significant at the institutional level.

Table 25. Study Area Bird Conservation Regions

Species	BCR 35	BCR 36	USFWS Region 2
Altamira Oriole		x	
American Oystercatcher			x
Audubon's Oriole		x	x
Bachman's Sparrow			x
Baird's Sparrow (nb)	x		x
Bald Eagle (b)	x		x
Bell's Vireo (c)	x	x	x
Bendire's Thrasher	x		x
Black Rail			x
Black Skimmer			x
Black-chinned Sparrow	x		x
Botteri's Sparrow			x
Brown-headed Nuthatch			x
Buff-bellied Hummingbird		x	
Buff-breasted Flycatcher			x
Buff-breasted Sandpiper (nb)			x
Burrowing Owl	x	x	x
Cassin's Sparrow	x	x	
Cerulean Warbler			x
Chestnut-collared Longspur (nb)	x	x	x
Colima Warbler	x		x
Common Black-Hawk	x		x
Costa's Hummingbird			x
Curve-billed Thrasher		x	
Dickcissel		x	
Elf Owl	x	x	x
Ferruginous Hawk (nb)	x		
Five-striped Sparrow			x
Flammulated Owl	x		x
Gilded Flicker			x
Golden Eagle	x		x
Grace's Warbler	x		x
Grasshopper Sparrow (ammolegus)			x
Gray Vireo	x		x
Green Parakeet (d)		x	
Gull-billed Tern		x	x
Harris's Sparrow (nb)			x
Henslow's Sparrow (nb)			x
Hudsonian Godwit (nb)			x
Kentucky Warbler			x
Lark Bunting			x

Species	BCR 35	BCR 36	USFWS Region 2
Lark Bunting (nb)	x	x	
LeConte's Sparrow (nb)			x
LeConte's Thrasher			x
Lesser Prairie-Chicken (a)			x
Lesser Yellowlegs (nb)		x	x
Lewis's Woodpecker			x
Loggerhead Shrike	x		x
Long-billed Curlew			x
Long-billed Curlew (nb)	x	x	
Lucifer Hummingbird	x		x
Lucy's Warbler			x
McCown's Longspur (nb)	x		x
Mountain Plover	x		x
Mountain Plover (nb)		x	x
Nelson's Sharp-tailed Sparrow			x
Northern Beardless-Tyrannulet		x	x
Olive Warbler			x
Painted Bunting	x	x	x
Peregrine Falcon (b)	x		x
Pinyon Jay			x
Prairie Warbler			x
Prothonotary Warbler			x
Red Knot (roselaari)			x
Red Knot (rufa)			x
Red-billed Pigeon		x	
Red-crowned Parrot (d)		x	
Reddish Egret			x
Red-faced Warbler	x		x
Red-headed Woodpecker			x
Rose-throated Becard		x	
Rufous-winged Sparrow			x
Rusty Blackbird (nb)			x
Sandwich Tern			x
Seaside Sparrow (c)			x
Sedge Wren (nb)			x
Short-billed Dowitcher (nb)			x
Smith's Longspur (nb)			x
Snowy Plover (c)	x	x	x
Solitary Sandpiper (nb)		x	x
Sprague's Pipit (nb)	x	x	x
Summer Tanager		x	
Swainson's Hawk		x	

Species	BCR 35	BCR 36	USFWS Region 2
Swainson's Warbler			x
Swallow-tailed Kite			x
Tropical Parula		x	
Upland Sandpiper			x
Varied Bunting	x	x	x
Verdin		x	
Virginia's Warbler	x		
Whimbrel (nb)			x
White-collared Seedeater		x	
White-tailed Hawk			x
Wilson’s Plover			x
Wood Thrush			x
Worm-eating Warbler			x
Yellow Rail (nb)			x
Yellow Warbler (sonorana ssp.)	x		X
Yellow-billed Cuckoo (w. US DPS) (a)	x		x

[a] ESA candidate

[b] ESA delisted

[c] Non-listed subspecies or population of ESA listed species

[d] MBTA protection uncertain or lacking

nb – non-breeding in the BCR

Source: Birds of Conservation Concern 2008, USFWS.

The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. These migratory bird conventions impose substantial obligations on the U.S. for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act, the U.S. has implemented these migratory bird conventions with respect to the U.S. The Migratory Bird Treaty Act prohibits the taking, possessing, importing/exporting, selling, and transporting of any listed migratory bird, its parts, nest, or eggs. Included in the protection provided by this act is all North American diurnal birds of prey, except bald and golden eagles. The North American Waterfowl Management Plan (USFWS, 1998), signed by the United States, Canada, and Mexico, lists wetlands, aquatic systems, grasslands, forests, and riparian areas as habitats critical to waterfowl. Between 1986 and 1997 over $1.5 billion was invested to secure, protect, restore, enhance, and manage waterfowl priority landscapes in North America. Thirty-six Important Waterfowl Habitat Areas have been identified by the USFWS, three of which are represented within Texas, and include east Texas, the Gulf coast, and the playa lakes region. Central Texas provides a critical link between the three priority waterfowl habitat areas.

1.27 Public Recognition

In addition to the Recommended Plan’s significance to scarce habitats, migratory birds, endangered species, and institutional recognition, significant public recognition and tangible support are demonstrated in the importance of implementing the Recommended Plan. The riparian corridor within the city of Laredo is publicly recognized as being a significant resource. This was evident during public meetings attended by residents in the area, who publicly stated that they do not want their creeks destroyed. In addition, the city has purchased land consisting of creeks and rivers for the purpose of establishing greenbelts and parks.

Regarding sustainability and relatively low maintenance costs, the Recommended Plan achieves both. After the restoration measures are in place, ecological succession would take over. The restoration project would require very little routine maintenance except for invasive species removal and occasional thinning of understory.

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Addendum A. 2017 HEP Report

CHAPTER 3: BIOLOGICAL FIELD SURVEYS

The Chacon Creek, from Lake Casa Blanca, to the Rio Grande, is an area subject to rapid urban development, the spread of invasive species, and flooding. These conditions have affected the terrestrial and aquatic habitats associated with Chacon Creek. Chacon Creek south of Lake Casa Blanca is listed as an intermittent stream, with small ponds that hold water for longer periods of time. The main channel is primarily used for flood conveyance, but water is present most of the year in the lower reaches of the creek. The creek corridor is predominantly riparian vegetation, both native and invasive species, and occasional herbaceous wetlands. The riparian vegetation contrasts with the arid environments outside the city.

The current feasibility study is designed to identify potential measures that could be implemented that would reduce the risk of flooding and restore degraded aquatic and adjacent terrestrial ecosystems. To facilitate evaluation, biological field surveys were designed to collect data to determine the current conditions of the study area and to determine approximately where invasive plant species are dominant in the landscape. A previous study by the U.S. Army Corps of Engineers (USACE 2007) used Habitat Evaluation Procedure (HEP) models to develop a Habitat Suitability Index (HSI) for species that are representative of habitats in the area. The purpose of this project is to revise and update the baseline from the USACE (2007) report.

Study Area

Chacon Creek from Lake Casa Blanca approximately 3 miles to the Rio Grande is within the Texas-Tamaulipan thornscrub within the southern Texas plains ecoregion (Griffith et al. 2007). Immediately north of the Rio Grande, the ecoregion transitions to the Rio Grande Floodplains and Terraces (Griffith et al. 2007). The southern Texas plains is characterized by grassland and savanna that varied during wet and dry cycles, but due to long continued grazing, fire suppression and drought, the brush habitats are dominated by thorny brush such as honey mesquite (*Prosopis glandulosa*). The Texas-Tamaulipan thornscrub is an area that extends into Mexico, where there is convergence of vegetation from the Chihuahuan Desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande to the south, and the coastal grasslands to the east. The area is characterized by drought-tolerant, small-leaved, and often thorny small trees and shrubs, including honey mesquite, and where suitable habitat is present, the understory shrubs include Brazilian bluewood (*Condalia hookeri*), lime pricklyash (*Zanthoxylum fagara*), Texas persimmon (*Diospyros texana*), lotebush (*Ziziphus obtusifolia*), spiny hackberry (*Celtis ehrenbergiana*), kidneywood (*Eysenhardtia texana*), coyotillo (*Karwinskia humboldtiana*), Texas paloverde (*Parkinsonia texana*), anacahuita (*Cordia boissieri*), and various species of cacti (Griffith et al. 2007). Xerophytic brush species, such as blackbrush (*Vachellia rididula*), guajillo (*Senegalia berlandieri*), and Texas barometer bush (*Leucophyllum frutescens*), are typical on the rocky, gravelly ridges and uplands. The Rio Grande Floodplains and Terraces are a relatively narrow band adjacent to the river, but the river is an important natural and cultural feature that drains large portions of Mexico and the United States (Griffith et al. 2007). In the Floodplains and Terraces, floodplain forests may occur, which include such species as sugarberry (*Celtis laevigata*), cedar elm (*Ulmus crassifolia*), and Mexican ash (*Fraxinus berlandieriana*). Because the water in the Rio Grande is controlled by upstream dams, riparian forests have declined in areal extent, and upland species such as honey mesquite, sweet acacia (*Vachellia farnesiana*), blackbrush, and lotebush encroach on forest margins. Wetter areas in the region include such species as black willow (*Salix nigra*), black mimosa (*Mimosa pigra*), common reed (*Phragmites australis*), giant reed (*Arundo donax*), and hydrophytes such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and sedges (*Carex* spp.).

Study Design

The USACE 2007 survey divided Chacon Creek into seven river reaches, and then subdivided the river reaches into specific vegetation cover types utilizing aerial photographs, prior investigations, and field surveys. The vegetation was divided into 5 cover types:

- Riverine (R),
- Palustrine wetland (PW),
- Herbaceous wetland (HW),
- Deciduous shrubland (DS), and
- Deciduous forest (DF)

The riverine cover type was used to assess the aquatic system, and was subdivided into seven reaches identified by number (e.g. Riverine Reach 1 = R1). The palustrine and herbaceous wetland cover types were used to assess the wetlands systems present in the study area. No PW points were evaluated because none of the points were identified as PW. The DS and DF cover types were used to describe upland terrestrial systems within the study area.

Within each of the cover types, the areas were further subdivided into stands identified by unique numbers (e.g. herbaceous wetland stand 1 = HW1; deciduous shrubland stand 1 = DS1). If possible, the stands were addressed by visiting sampling points within a stand (USACE 2007).

The purpose of this study is to update the baseline delineation of the vegetation communities along the length of Chacon Creek. To do this, the same project boundaries, river reaches, and cover type stands created in the USACE (2007) report were used. Plot assessment locations were used as habitat conditions and where accessibility permitted. The plot assessment locations retained from the previous study were referred to as original points, and the plot numbering was retained. Additional plot assessment locations were created in areas not previously sampled or where not enough data was collected. More detail is described below.

Field Sampling

Using the study area boundaries established for the previous study (USACE 2007), the field sampling design was developed to update the baseline vegetation survey. Initial field sampling was conducted from October 16 through October 20, 2017, and additional field sampling was conducted from October 30 through November 3, 2017.

Not all points from the previous survey were accessible. Where possible, the plot location was shifted to a similar area immediately surrounding the original location. The plots shifted are identified with a "_B". The points from previous studies that were resampled during this field effort are shown in **Figures 3.1** through **3.7**.

Some of the stands were not sampled in the previous study (USACE 2007). Where right-of-entry was available, and where the stands were accessible, additional sampling points were selected as representative of the stand. New points were selected, and the point numbering used the following conventions: sample points numbered in the 600 series (e.g., 602, 603) were areas classified as deciduous forest (DF); sample points numbered in the 700 series were areas classified as herbaceous wetland (HW); sample points in the 900 series were classified as deciduous shrub (DS); and sample points in the 800 series were numbered according to the river reach and classified as riverine (R) (e.g., 805a is within R5a), and when possible, each end of the river segment was sampled, and labeled as _N or _S, to indicate the north end or the south end of the river segment.

Each point was located by using a global positioning system (GPS) receiver. At each point, a 0.25-acre plot was created. If the vegetation surrounding the point was relatively homogenous, a circular 0.25-acre plot with a radius of 59 feet was established. In locations with linear vegetation variations, such as the vegetation gradients near streams, a 0.25-acre rectangular plot measuring 65 feet by 164 feet was created. A rectangular plot was also used for wetland areas that were found along the linear channelized portions of the creek. The riverine plots were assessed by surveying a 164 feet length within and along the creek. The width of the plot corresponded with the width of the creek along that length.

Within each plot, the dominant vegetation in each stratum was noted by species. The overstory stratum included all trees greater than 16 feet, the understory stratum included all woody species from 1 to 16 feet tall, and the herbaceous stratum included all non-woody species. The herbaceous stratum includes tall species such as giant reed. In addition to the dominant species, the absolute cover of each species and of each stratum was recorded. The cover classes for each species were divided into 5 classes as follows:

1. 1 to 10% cover,
2. 11 – 25 % cover,
3. 26 – 50% cover,
4. 51 – 75% cover, and
5. 76 – 100% cover.

Species that occurred in the plots at low frequency were noted as <1%, but were not included in the estimates of absolute cover of each stratum.

The riverine reaches were surveyed both on the ground and from aerial photographs. For each reach, the average width of the channel, from bank to bank, was estimated from aerial photographs.

1.28 Habitat Evaluation Procedures

The Habitat Evaluation Procedure (HEP) method was used to evaluate the suitability of habitats for wildlife species that are likely to occur in the area. In a HEP study, a number of evaluation species are chosen for each habitat type (e.g., wetland, deciduous shrubland) within the study area. During the previous evaluation (USACE 2007), five species were selected because of their ecological, recreational, or economic value, or because these species utilize the existing and future habitat conditions of the area. The suitability of habitats for each species is described by a HSI. Habitat conditions for each variable in an HSI model are measured from maps, aerial photography, or onsite sampling. The models were reviewed prior to field surveys, and data appropriate for each model was collected at each sampling point. At each sampling point, the HSI model results represent the suitability of habitats on a scale from 0.0 (unsuitable) to 1.0 (suitable). The availability of habitats in the study area is quantified as Habitats Units (HU). HUs are derived for evaluation species and cover type by multiplying the HSI value (suitability) of a given habitat or cover type by the number of acres (area) in the study area.

The same species used in the USACE (2007) study were used again for this evaluation, because they are representative of wildlife species likely to utilize habitats found in small drainages in the southern Texas plains ecoregion. The five species were;

- American coot (*Fulica americana*) (USFWS 1985a),
- belted kingfisher *(Ceryle alcylon*) (USFWS 1985b),
- eastern cottontail (*Sylvilagus floridanus*) (USFWS 1984),
- red-winged blackbird (*Agelaius phoeniceus*) (USFWS 1985c), and
- slider turtle (*Pseudemys scripta*) (USFWS 1986).

Cover types for each stand were determined, including riverine, herbaceous wetland, deciduous shrubland, and deciduous forest (USFWS 1981). Although the HSI models do not include a category for developed areas, developed areas were identified, to more precisely determine the habitat units available for the species evaluated and to show changes in land use from the 2007 survey. Developed areas included houses, roads, and other obvious man-made structures. The hike-and-bike path along most of Chacon Creek was not included in the developed areas calculations, because the path is narrow and it is assumed to have a negligible effect on habitat conditions for the species evaluated. The area of the habitats within each stand was the total from the previous study (USACE 2007), minus the area of developed areas. **Figures 3.1** through **3.7** show each stand labeled with the current cover type (DS, DF, etc.).

Table 1 lists all the variables needed for evaluation of habitat suitability for the subject species and the variables were measured by the methods suggested by the model authors. The data collected in the field surveys was evaluated with the specific HSI model for each species (**Attachment 1**). The HSI value was calculated for each plot. If there was more than one plot within a stand, the HSI values were averaged.

Table 2. Variables Used for Evaluation of HSI Models for Each Selected Species

Variable	Model				
	American Coot	Belted kingfisher	Slider Turtle	Red-Winged blackbird	Eastern cottontail
Percent cover of wetland dominated by EHV	✓				
Length of Edge of wetland boundary EV	✓				
Water regime	✓		✓	✓	
Percent shoreline subject to severe waves		✓			
Water transparency (feet)		✓			
Percent water surface obstruction		✓			
Percent water area ≤ 24 inches deep within 50 feet from shore		✓			
Percent riffles		✓			
Number perch sites		✓			
Percent cover of emergent vegetation (EV) and submerged vegetation (SV)			✓		
Velocity (feet/second)			✓		
Water depth (feet)			✓		
Water temperature (oF)			✓		
Type of available emergent herbaceous vegetation				✓	
Presence of water				✓	
Presence of carp				✓	
Presence of damselfly or dragonfly larvae				✓	
Suitable foraging habitat				✓	
Mix of open water and emergent herbaceous vegetation				✓	
Percent shrub crown closure					✓
Percent tree crown closure					✓
Percent canopy closure of persistent herbaceous vegetation					✓

1.29 Invasive Species

During the field sampling efforts, if invasive species such as castorbean (*Ricinus communis*), saltcedar (*Tamarix* spp.), and giant reed (*Arundo donax*) were observed outside of the plots, their approximate location was noted on the field maps or GPS. Buffelgrass (*Pennesetum ciliare*) was observed in most open areas with direct sun, and was observed on the fringes of shrub clusters, but was not common in the herbaceous layer if under dense shrubs or trees.

CHAPTER 4: HABITAT ASSESSMENT

Data collected in the field was used to determine the average condition of each polygon. Dominant species in each polygon were used to develop a current baseline condition, used to determine if there have been changes in condition over time.

1.30 Results of Vegetation Survey

Most of the areas evaluated in the current study are classified as deciduous shrub (DS) (**Figures 3.1** through **3.7**). The common and scientific names of all plant species identified throughout the study area are listed in **Attachment 2**.

1.30.1 Riverine Section R1

The northernmost section (riverine section 1 [R1]) of the study area, immediately south of the Casa Blanca Lake spillway (**Figure 3.1**), is dominated by the DS habitat. Casa Blanca Lake is outside of the study area, but to determine the source of water for Chacon Creek, the lake was visited during the field surveys. The Chacon Creek channel from Casa Blanca Lake to at least U.S. Highway 59 is dry in most areas. There was extensive rainfall and localized flooding in the Laredo area in late May/early June of 2017, and Casa Blanca Lake appeared to be full. However, despite recent rains, most of the creek channel was dry, or nearly dry, and water, if present, was in a very narrow corridor less than 2 feet wide, and did not appear to be flowing. There were limited areas in this section of the creek that had ponded water. One small pond was observed adjacent to U.S. Highway 59 (**Photo 1**), and the ponded area fringes were dominated by saltcedar, honey mesquite, Jerusalem thorn (*Parkinsonia aculeata*) and bushy seaside tansy (*Borrichia frutescens*). Any areas along the dry creek that retained water for a small portion of time had a fringe of saltcedar and some southern cattail (*Typha* spp.) (**Photo 2**). The DS upland areas were dominated by honey mesquite, spiny hackberry and sweet acacia. Much of stand DS1 was not accessible because there was no right-of-entry available, thus dominant species within the western end of the stand could not be verified.

1.30.2 Riverine Section R2

South of U.S. Highway 59, along R2, the project area is relatively narrow (**Figure 3.2**), and there was no right-of-entry within most sections of this reach. The wetland HW2 was accessed from a parking lot. The wetland was dominated by saltcedar along the creek banks, but no herbaceous wetland vegetation was present (**Photo 3**). This area is degraded, and covered with saltcedar, flood debris, and trash. The areas adjacent to HW2 were generally cleared, or mostly cleared and primarily covered with rock and gravel that was brought to the area by truck. HW3 was observed from the bridge on Business U.S. Highway 59Z. There was water in the creek bed, but the water had no discernable flow, and the banks were dominated by saltcedar, buffelgrass, and other woody species included baccharis (*Baccharis* spp.), Jerusalem thorn, sweet acacia, and big sacaton (*Sporobolus wrightii*), all of which may occur in uplands and wetlands (**Photo 4**). As with HW2, HW3 wetland is degraded and inundated with flood debris and trash. The remainder of the reach was not accessible.

1.30.3 Riverine Section R3

The R3 segment of Chacon Creek was immediately north and south of Texas State Highway 400 (Clark Road) (**Figure 3.3**). To the north of Clark Road and west of Chacon Creek, DS6 and DS7 were characterized by dense stands of shrubs dominated by honey mesquite, spiny hackberry, blackbrush and whitebrush (*Aloysia gratissima*) (**Photo 5**). There were also a large number of shrub species present in smaller percentages. Within DS8 area north of Clark Road and east of Chacon Creek, there were areas of dense shrubs with high species diversity (**Photo 6**) and open areas where the shrubs were shorter stature and farther apart (**Photo 7**). Chacon creek in this segment north of Clark Road included cattails in herbaceous wetlands and saltcedar along the banks of the creek. The previous study (USACE 2007) identified the HW7 stand as containing both herbaceous wetland and palustrine wetland. The water in Chacon Creek in this reach was deeper and is present for more of the year than areas near Casa Blanca Lake (**Photo 8**). However, while there were woody species adjacent to the creek, it was evaluated as only an herbaceous wetland in this study, and not as a palustrine wetland.

The section of R3 south of Clark Road was an area that has undergone extensive restoration and wetland mitigation in approximately 18 acres (HW8 in **Figure 3.3**). The area was cleared of over 2000 tires, then replanted with herbaceous wetland species, including cattail (G. Cantu 2017, personal communication). The area shown as HW8 on **Figure 3.3** was reclassified from DS cover type to HW cover type, and expanded to the west. The area shown as HW8 had dense stands of cattail and areas of open water (**Photo 9**). Due to the flooding in May/June 2017, the area closest to the hike-and-bike trail was still holding water during the October/November field surveys, although that is not the normal condition (G. Cantu 2017 personal communication). Water is present throughout the year in the deeper part of this wetland restoration area (G. Cantu 2017, personal communication). During the field visits, ducks, American coots, and great egrets (*Ardea alba*) were observed in the area of HW8. Shrubs, primarily saltcedar, were restricted to the fringes of the wetland restoration area. The average depth of water in the center of the wetland restoration area may be as much as 4 feet (G. Cantu, personal communication). The wetland area is dominated by cattail, and the area was evaluated as an herbaceous wetland, not as a palustrine wetland. Although standing water was present in the wetland area during the October/November field surveys, at the outlet of the wetlands in HW10, there was no measurable creek flow, indicating that the water was pooled, but not flowing into Chacon Creek.

1.30.4 Riverine Section R4

The R4 segment of Chacon Creek is immediately north and south of the railroad tracks that cross the City of Laredo from east to west (**Figure 3.4**). The surrounding DS stands (DS12, DS13, and DS14) are similar to other stands observed, with dominant overstory species that include sweet acacia, and shrub species that include honey mesquite, spiny hackberry and coyotillo. The herbaceous layer in this area typically includes buffelgrass and big sacaton grass (**Photo 10**).

1.30.5 Riverine Section R5

The segment of Chacon Creek identified as R5a and the tributaries that drain into segment R5a (**Figure 3.5**) was north of Texas State Highway 359, and continued south and west to U.S. highway 83 (**Figure 3.5**). The reach includes areas of DS cover types, that were dominated by honey mesquite, sweet acacia, and spiny hackberry in the overstory and shrub layers. The herbaceous later in this area is dominated by the introduced invasive kleingrass (*Panicum coloratum*) and some big sacaton grass. Within this reach, there were small areas identified as deciduous forest, but field observations indicated that these areas were more accurately classified as DS cover types, because the overstory tree cover was less than 50%, and the individuals were less than approximately 30 feet tall. These areas were reclassified as DS cover types (DS35 and DS36) (**Figure 3.5**) (**Photo 11**). Chacon Creek in this reach contained shallow water, in most places between 12 and 24 inches deep, but there was no measurable water flow. The banks of the creek adjacent to the riverine sample points had a narrow band of trees adjacent to the bank, including ash species (*Fraxinus* spp.), and saltcedar. In areas where woody species were not present, the banks of Chacon Creek are dominated by common reed. Within this reach, there were two small areas that are considered deciduous forest (DF2 and DF4), totaling less than 1.5 acres (**Photo 12**). The forested areas are dominated by Mexican ash, spiny hackberry, and Jerusalem thorn. Within DF4, there are also invasive white leadtrees (*Leucaena leucocephala*) present at low abundance. The herbaceous layer of the DF habitats included kleingrass and pigeonberry (*Rivina humilis*).

1.30.6 Riverine Section R6

Riverine reach R6 from U.S. Highway 83 to just south of Meadow Road (**Figure 3.6**) includes a narrow band of DS cover types on either side of Chacon Creek, and includes portions of the Chacon Bat Park at the southernmost end of the project area. The observed DS points in this reach were similar to other DS points in the project area, and dominated by honey mesquite, spiny hackberry, sweet acacia, Jerusalem thorn, and blackbrush. The herbaceous layer was dominated by species including Kleberg's bluestem (*Dichanthium annulatum*), buffelgrass, and kleingrass. The area along Chacon Creek within Chacon Bat Park is covered on both sides of the creek with stands of both common reed and giant reed (**Photo 13**).

1.30.7 Riverine Section R13

The R13 riverine reach was a tributary of Chacon Creek and likely had similar DS cover types as observed throughout the project area. However, most of R13was not accessible from either side and the banks of the tributary were too steep to determine the specific plants present in the area. R13 was evaluated only at the intersection of the tributary with Chacon Creek.

1.31 Results of HSI Models

Data collected in the field was used to determine the average conditions in each stand or river reach, for each species that occupies that habitat. Habitat suitability was evaluated using the formulas provided for each HSI model. If there was data collected at more than one point within a stand, the HSI values were calculated for each point, and the HSI values averaged and the average HSI value was multiplied by the size of the stand to obtain the HUs available in each stand. HUs were calculated for each species (**Tables 2** through **11**).

Table 3. Summary of Deciduous Shrubland Habitat Suitability by Stand as Evaluated by the Eastern Cottontail Model

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.1	DS1	915	1.0	1.0	68.7	68.7
Subtotal					***68.7***	***68.7***
3.2	DS2	-	-	-	14.5	-
3.2	DS3	-	-	-	14.9	-
3.2	DS4	-	-	-	11.0	-
3.2	DS5	-	-	-	7.1	-
Subtotal					***40.4***	***-***
3.3	DS6	911	1.0	-	16.9	16.9
3.3	DS7	908	1.0	-	7.6	7.6
3.3	DS8	909	1.0	1.0	26.1	26.1
3.3	DS8	910	1.0		26.1	
3.3	DS9	-	-	-	18.2	-
3.3	DS10	289_B	1.0		11.2	11.2
3.3	DS11	74	0.8		19.6	7.7
Subtotal					***125.5***	***69.4***
3.4	DS12	505	1.0	1.0	15.4	15.4
3.4	DS12	507	1.0		15.4	
3.4	DS12	509	1.0		15.4	
3.4	DS13	500	1.0	1.0	6.5	6.5
3.4	DS13	503	1.0		6.5	
3.4	DS14	166	1.0	1.0	29.5	28.8
3.4	DS14	314	1.0		29.5	
3.4	DS14	321	1.0		29.5	
3.4	DS14	512	1.0		29.5	
3.4	DS14	513	0.8		29.5	
3.4	DS14	518	1.0		29.5	
3.4	DS14	524	1.0		29.5	
3.4	DS15	-	-	-	8.6	-
3.4	DS16	907	1.0	1.0	9.3	9.3
3.4	DS17	906	1.0	0.9	7.2	6.8
3.4	DS17	913	0.9		7.2	
Subtotal					***297.7***	***66.8***
3.5	DS18	76_B	1.0	1.0	12.4	12.4
3.5	DS19	162	1.0	1.0	6.3	6.3
3.5	DS19	369	1.0		6.3	
3.5	DS20	914	0.5	0.5	4.1	2.0
3.5	DS21	389	0.7	0.4	8.9	3.4
3.5	DS21	393	0.2		8.9	

Table 3. Summary of Deciduous Shrubland Habitat Suitability by Stand as Evaluated by the Eastern Cottontail Model

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.5	DS21	394_B	0.2		8.9	
3.5	DS22	-	-	-	0.97	-
3.5	DS23	185	1.0	1.0	25.4	25.4
3.5	DS23	193	1.0		25.4	
3.5	DS23	400	1.0		25.4	
3.5	DS23	409	1.0		25.4	
3.5	DS23	194_B	1.0		25.4	
3.5	DS24	211	0.6	0.6	7.8	4.3
3.5	DS24	212	0.5		7.8	
3.5	DS25	-	-	-	0.4	-
3.5	DS35	367	1.0	1.0	3.1	0.8
3.5	DS36	59	1.0	1.0	0.9	3.1
3.5	DS36	602	1.0		0.9	
3.5	DS36	603	1.0		0.9	
Subtotal					***205.6***	***57.8***
3.6	DS26	49	1.0	1.0	28.4	28.4
3.6	DS26	903	1.0		28.4	
3.6	DS27	11	1.0	0.8	9.8	8.0
3.6	DS27	12	0.7		9.8	
3.6	DS28	30	0.8	0.9	6.5	5.9
3.6	DS28	449	1.0		6.5	
3.6	DS29	904	1.0	1.0	1.3	1.3
3.6	DS30	46	0.7	0.8	6.5	5.3
3.6	DS30	460	1.0		6.5	
3.6	DS30	477_B	0.6		6.5	
3.6	DS30	482_B	0.9		6.5	
3.6	DS31	25	0.2	0.5	8.9	4.8
3.6	DS31	209	0.9		8.9	
3.6	DS32	488	1.0	1.0	2.6	2.6
Subtotal					***137.3***	***56.2***
3.7	DS33	902	1.0	1.0	2.4	2.4
3.7	DS34	901	1.0	1.0	23.8	23.8
Subtotal					***26.2***	***26.2***
Total					**901.4**	**345.1**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 4. Summary of Deciduous Forest Suitability by Stand as Evaluated by the Eastern Cottontail Model

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.5	DF2	52	0.6	0.6	0.8	0.3
3.5	DF4	439	0.7	0.7	0.5	0.6
Subtotal					***1.4***	***0.9***
Total					**1.4**	**0.9**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 5. Summary of Riverine Suitability by Stand as Evaluated by the American Coot

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.3	HW10	145	0.8	0.6	0.3	0.2
3.3	HW10	809	0.4			
Subtotal					***0.3***	***0.2***
3.4	HW11	804_S	0.4	0.4	0.3	0.1
3.4	DS12	804_N	0.4	0.4	15.4	6.4
3.4	DS14	810	0.7	0.7	29.5	19.7
Subtotal					***45.2***	***26.2***
3.5	DS18	805a_N	0.4	0.4	12.4	5.1
3.5	DS23	805a_S	0.3	0.3	25.4	7.2
3.5	DS24	805b	0.3	0.3	7.8	2.2
Subtotal					***45.6***	***14.6***
3.6	DS26	806_N	0.5	0.5	28.4	14.6
3.6	DS31	813	0.4	0.3	8.9	2.6
3.6	DS31	806_S	0.2			
Subtotal					***37.4***	***17.2***
Total					**128.4**	**58.2**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 6. Summary of Riverine Suitability by Stand as Evaluated by the Belted Kingfisher

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.3	HW10	145	0.1	0.1	0.3	0.0
	HW10	809	0.2			
Subtotal					***0.3***	***0.0***
3.4	HW11	804_S	0.2	0.2	0.3	0.1
3.4	DS12	804_N	0.2	0.2	15.4	3.5
3.4	DS14	810	0.2	0.2	29.5	4.9
Subtotal					***45.2***	***8.5***

Table 6. Summary of Riverine Suitability by Stand as Evaluated by the Belted Kingfisher

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.5	DS18	805a_N	0.2	0.2	12.4	2.7
3.5	DS23	805a_S	0.2	0.2	25.4	5.5
3.5	DS24	805b	0.2	0.2	7.8	1.6
Subtotal					***45.6***	***9.8***
3.6	DS26	806_N	0.2	0.2	28.4	5.8
3.6	DS31	813	0.2	0.2	8.9	1.8
3.6	DS31	806_S	0.2			
Subtotal					***37.4***	***7.6***
Total					128.4	25.9

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 7. Summary of Riverine Suitability by Stand as Evaluated by the Slider Turtle

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.3	HW10	145	0.4	0.3	0.3	0.1
3.3	HW10	809	0.2			
Subtotal					***0.3***	***0.1***
3.4	HW11	804_S	0.2	0.2	0.3	0.1
3.4	DS12	804_N	0.2	0.2	15.4	3.5
3.4	DS14	810	0.1	0.1	29.5	3.7
Subtotal					***45.2***	***7.2***
3.5	DS18	805a_N	0.2	0.2	12.4	3.0
3.5	DS23	805a_S	0.2	0.2	25.4	4.8
3.5	DS24	805b	0.2	0.2	7.8	1.5
Subtotal					***45.6***	***9.3***
3.6	DS26	806_N	0.3	0.3	28.4	`
3.6	DS31	813	0.2	0.3	8.9	2.4
3.6	DS31	806_S	0.3			
Subtotal					***37.4***	***2.4***
Total					**128.4**	**19.0**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 8. Summary of Riverine Suitability for all Species

Figure	Stand	Average HSI for American Coot	Average HSI for Belted Kingfisher	Average HSI for Slider Turtle	Area (acres)	Habitat Units
3.3	HW10	0.6	0.1	0.3	0.3	0.3
Subtotal					***0.3***	***0.3***
3.4	HW11	0.4	0.2	0.2	0.3	0.3
3.4	DS12	0.4	0.2	0.2	15.4	13.4
3.4	DS14	0.7	0.2	0.1	29.5	28.2
Subtotal					***45.2***	***41.9***
3.5	DS18	0.4	0.2	0.2	12.4	10.8
3.5	DS23	0.3	0.2	0.2	25.4	17.5
3.5	DS24	0.3	0.2	0.2	7.8	5.3
Subtotal					***45.6***	***33.6***
3.6	DS26	0.5	0.2	0.3	28.4	28.6
3.6	DS31	0.3	0.2	0.3	8.9	6.9
Subtotal					***37.4***	***35.4***
Total					**128.4**	**111.3**

Table 9. Summary of Herbaceous Wetland Suitability by Stand as Evaluated by the American Coot

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.2	HW2	-	-	-	0.4	-
3.2	HW3	-	-	-	0.1	-
3.2	HW4	-	-	-	1.3	-
Subtotal					***1.8***	
3.3	HW6	706	0.6	0.6	2.7	1.7
3.3	HW7	704	0.6	0.6	0.9	0.5
3.3	HW8	152_B	0.8	0.8	17.7	13.8
3.3	HW10	150	0.9	0.7	0.3	0.2
3.3	HW10	702	0.4			
3.3	DS7	808_S	0.5	0.5	7.6	3.9
3.3	DS10	289_B	0.9	0.9	11.2	10.1
3.3	DS11	803	0.6	0.6	9.4	5.2
Subtotal					***49.7***	***35.3***
3.4	HW11	149	0.4	0.4	0.3	0.1
3.4	DS12	804_N	0.4	0.4	15.4	6.4
Subtotal					***15.7***	***6.5***
Total					**67.2**	**41.8**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 10. Summary of Herbaceous Wetland Suitability by Stand as Evaluated by the Slider Turtle

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.2	HW2	-	-	-	0.4	-
3.2	HW3	-	-	-	0.1	-
3.2	HW4	-	-	-	1.3	-
Subtotal					***1.8***	
3.3	HW6	706	0.4	0.4	2.7	1.0
3.3	HW7	704	0.4	0.4	0.9	0.3
3.3	HW8	152_B	0.4	0.4	17.7	6.9
3.3	HW10	150	0.4	0.3	0.3	0.1
3.3	HW10	702				
3.3	DS7	808_S	0.1	0.1	7.6	0.5
3.3	DS10	289_B	0.1	0.1	11.2	1.4
3.3	DS11	803	0.1	0.1	9.4	1.2
Subtotal					***49.7***	***11.4***
3.4	HW11	149	0.2	0.2	0.3	0.1
3.4	DS12	804_N	0.2	0.2	15.4	3.8
Subtotal					***15.7***	***3.8***
Total					**67.2**	**15.2**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 11. Summary of Herbaceous Wetland Suitability by Stand as Evaluated by the Red-winged Blackbird

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.2	HW2	-	-	-	0.4	-
3.2	HW3	-	-	-	0.1	-
3.2	HW4	-	-	-	1.3	-
Subtotal					***1.8***	
3.3	HW6	706	0.0	0.0	2.7	0.1
3.3	HW7	704	0.0	0.0	0.9	0.0
3.3	HW8	152_B	0.0	0.0	17.7	0.5
3.3	HW10	150	0.1	0.6	0.3	0.2
3.3	HW10	702	1.0			
3.3	DS7	808_S	0.1	0.1	7.6	0.8
3.3	DS10	289_B	0.0	0.0	11.2	0.3
3.3	DS11	803	0.0	0.0	9.4	0.3
Subtotal					***49.7***	***2.2***

Table 11. Summary of Herbaceous Wetland Suitability by Stand as Evaluated by the Red-winged Blackbird

Figure	Stand	Sample Point	HSI for each point	Average HSI for stand	Stand Area (acres)	Habitat Units
3.4	HW11	149	0.0	0.0	0.3	0.0
3.4	DS12	804_N	0.0	0.0	15.4	0.2
Subtotal					***15.7***	***0.2***
Total					**67.2**	**2.3**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

Table 12. Summary of Herbaceous Wetland Suitability for all Species

Figure	Stand	Average HSI for American Coot	Average HSI Slider Turtle	Average HSI for Red-winged Blackbird	Stand Area (acres)	Habitat Units for all species
3.2	HW2	-	-	-	0.4	-
3.2	HW3	-	-	-	0.1	-
3.2	HW4	-	-	-	1.3	-
Subtotal					***1.8***	
3.3	HW6	0.6	0.4	0.0	2.7	2.8
3.3	HW7	0.6	0.4	0.0	0.9	0.8
3.3	HW8	0.8	0.4	0.0	17.7	21.2
3.3	HW10	0.7	0.3	0.6	0.3	0.4
3.3	DS7	0.5	0.1	0.1	7.6	5.1
3.3	DS10	0.9	0.1	0.0	11.2	11.8
3.3	DS11	0.6	0.1	0.0	9.4	6.6
Subtotal					***49.7***	***48.8***
3.4	HW11	0.4	0.2	0.0	0.3	0.2
3.4	DS12	0.4	0.2	0.0	15.4	10.3
Subtotal					***15.7***	***10.5***
Total					**67.2**	**59.4**

Note: - indicates that the stand was not sampled. Blanks indicate that the area or HSI was not recorded because there was more than one point in the stand, and the HSI values were averaged.

1.31.1 Deciduous Shrubland

The deciduous shrub areas were evaluated with the eastern cottontail HSI model. The eastern cottontail requires a variety of habitats, including herbaceous feeding cover, and dense shrub cover for resting and escape cover (USFWS 1984). The abundance of shrubs and trees is assumed in the model to indicate suitable winter habitat. Although eastern cottontail rabbits in the southern part of the range may not rely on woody vegetation for winter forage as much as rabbits in the northern part of their range, the model was used as presented (USFWS 1984). A total of 28 deciduous shrubland stands were evaluated, and an additional 8 DS stands were identified, but not evaluated due to lack of access. The total DS area of all sites combined was 901 acres (**Table 2**), and the areas evaluated provided a total of 345 HUs for the eastern cottontail. Stands that provide a high cover of herbaceous vegetation, and some shrub vegetation were evaluated as the most suitable habitat for eastern cottontail.

1.31.2 Deciduous Forest

The eastern cottontail models were also used to evaluate deciduous forest. In general, forested areas have less persistent herbaceous vegetation, and are less suitable habitat for the eastern cottontail. In this evaluation two stands were identified as DF, totaling 1.4 acres, and 0.9 HUs (**Table 3**). Two stands in the previous evaluation were identified as DF, but inspection of the areas indicated that these stands (DF1 and DF4) were no longer forested, and they were converted to DS (DS35 and DS36) and included in the DS evaluation.

1.31.3 Riverine

The habitat suitability of the riverine segments of the project area were evaluated with three models, the American coot, the belted kingfisher, and the slider turtle. Each of these species was dependent on the presence of flowing or standing water during most of the year. Several reaches of the Chacon Creek did not have water during the survey, or did not have water present most of the year, and these areas were not evaluated.

American coot habitat requirements include a stable source of surface water and emergent vegetation to provide suitable reproductive habitat. The highest nest success rates have been reported for permanently flooded to intermittently exposed wetlands (USFWS 1985a). Most of the riverine areas were of relatively low quality for the American coot (**Table 4**), with HSI values less than 0.5 in most reaches, primarily limited by the lack of emergent vegetation interspersed with open water. There are 58 HUs for American Coots in the riverine segments of Chacon Creek.

Belted kingfishers are generally found along stream courses and lake and pond edges where the waters are clear and not overgrown with thick vegetation. Nests of the belted kingfisher are excavated in burrows on high vertical cutbanks of relatively friable soil. Belted kingfishers do not nest in the Laredo area, but nesting requirements are generally similar for the ringed kingfisher (*Megaceryle torquata*) and green kingfisher (*Chloroceryle americana*), which do nest in the area. Kingfishers forage by perching over open water where they can locate prey before diving (USFWS 1985b). The belted kingfisher had limited suitable habitat within the riverine sections of Chacon Creek (**Table 5**). Previous studies (USACE 2007) indicated that suitable soils were present for kingfisher nesting burrows, but few vertical cutbanks were observed during this investigation. Further, most of the water was overgrown by herbaceous and woody vegetation, with few perch sites. For kingfishers in riverine sections of the study area there were 26 HUs. It is not expected that belted kingfishers would occur with the areas of Chacon Creek surveyed during this investigation.

Slider turtles are predominantly aquatic turtles that inhabit virtually all water types, including rivers, ditches, lakes and ponds), but prefer waters that are between 3 and 10 feet deep, with a soft bottom, abundant vegetation, and suitable basking sites (USFWS 1986). Slider turtles are most commonly found in areas with aquatic vegetation such as algae and floating aquatic plants (e.g., milfoil and lily pads). The riverine sections of Chacon Creek have relatively low habitat quality for slider turtles (**Table 6**), with HSI value consistently less than 0.3. The portions of Chacon Creek evaluated as riverine were relatively shallow, generally less than 2 feet deep, and did not contain floating aquatic vegetation There were 19 HUs for slider turtles in riverine sections of the study area. It is not expected that Chacon Creek would provide much suitable habitat for slider turtles.

To summarize the combined suitable habitat for all riverine species evaluated, the average HSI values were summed and multiplied by the total number of acres to obtain a combined HU value for each stand, and the HUs were summed overall to obtain the total number of HUs for the riverine habitat. In general, Chacon Creek does not provide much, if any, suitable habitat for the riverine species evaluated (**Table 7**). There was a total area of approximately 128 acres of riverine habitat, which provided 111 habitat units. The creek was shallow, narrow, and during the surveys of this investigation, the waters were clear to only about 12 inches.

1.31.4 Herbaceous Wetland

Herbaceous wetlands were assessed using three species, the American coot, the slider turtle, and the red-winged blackbird. These species require permanent to semi-permanent water and emergent vegetation.

The American coot requires a stable source of water, as noted above. The HSI values for American coots throughout the project area were higher than for riverine systems, based on the presence of emergent vegetation (**Table 8**). In fact, American coots were observed in an area near HW8, the Clark Road wetland restoration area (**Figure 3.3**). The central part of this wetland restoration area was not accessible and not directly evaluated, but this area was likely to provide the most suitable habitat for American coots. However, the area near the hike-and-bike trail where the coots were observed had water from the flooding in May/June 2017, and the area closet to the trail does not generally hold water all year (G. Cantu, personal communication). The area of point 289_B also contained habitat with a higher HSI (0.9) than other wetland areas in this reach, primarily due to the interspersion of open water and emergent vegetation (**Photo 14**). Most other wetlands were less suitable for coots, because there was limited emergent vegetation, or emergent vegetation was restricted to a narrow band adjacent to the creek, with limited open water areas. American coots in herbaceous wetlands had 42 HUs available.

The slider turtle is an aquatic turtle that requires permanent water sources, as noted above. The habitat suitability for slider turtles in wetlands associated with Chacon Creek were relatively low (**Table 9**). The wetland areas were generally shallow, less than 2 feet deep, and did not contain floating aquatic vegetation. There were 15 HUs available for slider turtles in herbaceous wetlands.

The red-winged blackbird nests most commonly in fresh and brackish wetlands, or in upland bushes and small trees adjacent to water courses. Blackbirds tend to construct nests in areas with dense stands of broad-leaved monocots (i.e., cattail) over open water where they can forage. Blackbirds prefer habitats near wetlands for foraging (USFWS 1985c). Blackbirds most commonly forage for emergent aquatic insects, and the presence of aquatic insect larvae is an indicator of suitable habitat. The HSI values for blackbirds along Chacon Creek were very low (**Table 10**). The herbaceous vegetation in the area was generally restricted to a narrow band along the both sides of the creek, without interspersion of vegetation and open water, and insect larvae were not found in most reaches of the creek, indicating limited food supply for the blackbirds. In addition, the wetlands in most areas may lack water during some portion of the year, and upland forage areas are of lower quality for the blackbirds. There was a total of 65 HUs available for red-winged blackbirds in the herbaceous wetlands of Chacon Creek.

To summarize the combined suitable habitat for all herbaceous wetland species evaluated, the average HSI values were summed and multiplied by the total number of acres to obtain a combined HU value for each stand, and the HUs were summed overall to obtain the total number of HUs for the herbaceous wetland habitat. The herbaceous wetlands adjacent to Chacon Creek provide suitable habitat for the wetland species evaluated in limited areas, but not throughout the length of the creek (**Table 11**). The most suitable habitat for the species evaluated was in the area of the Clark Road wetland restoration. In general, wetland habitats were most suitable for American coots, slider turtles had some habitat areas available, and red-winged blackbirds had very little suitable foraging habitat available. For herbaceous wetlands, there were approximately 67 acres available, with a total of 59 habitat units.

1.32 Invasive Species

As invasive species were encountered during field surveys, the location of each species was noted on the field maps or GPS. The locations of the most common invasive species were mapped (**Figures 4.1** through **4.7**). The most common invasive species in the study area and within individual plots were buffelgrass, saltcedar, castorbean, and giant reed. The occurrence of these species within each of the study plots is summarized in **Attachment 3**. The individual species occurrence in the project area are described below.

1.32.1 Buffelgrass

Buffelgrass was present throughout the project area in open areas with limited shade. Buffelgrass occurred in plots with cover as high as 80%, and formed extensive monocultures. Buffelgrass has been introduced and used as pasture forage; it has high tolerance of grazing and drought, and responds rapidly to rain events (Marshall et al. 2012). Eradication of buffelgrass would require an intensive, sustained effort, using a combination of chemical and mechanical methods (U.S. Department of Agriculture [USDA] 2014a). Further, extensive cleaning of equipment after mechanical treatment would need to occur between treatment areas, to prevent spread of seeds. Because buffelgrass responds to disturbance and is already established in disturbed areas, native grasses would not establish as quickly and would likely be out-competed by buffelgrass.

1.32.2 Saltcedar

Saltcedar was common in riparian areas throughout the project area. Saltcedars are small trees or shrubs with long tap roots that intercept deep water tables and have a high water consumption rate (Texas Invasive Species Institute 2017). Saltcedar has a competitive advantage over native species, due to its water use efficiency and its ability to obtain water from unsaturated soil layers during drought conditions. Saltcedar also accumulates salt in its leaves and excretes these salts onto the leaf surface, which accumulates in the surface layer of soil. The increased soil salinity changes the soil chemistry in a way that is detrimental to other species not suited for saline soils (Zouhar 2003). In addition, saltcedar does not support avian species foraging and tends to reduce avian population sizes where dense stands of saltcedar occur (Texas Invasive Species Institute 2017). Saltcedar seeds are spread by wind and water, and the plants produce thousands of seeds during the growing season. Eradication of saltcedar requires a long-term, sustained effort, and likely is most efficient when using a combination of biological, chemical, and mechanical control methods (USDA 2010). If saltcedar were removed from an area, then aggressive revegetation of native plants would be required before saltcedar can re-establish in the area.

1.32.3 Giant Reed

Giant reed occurred in the southernmost parts of the project area, in dense stands along the banks of Chacon Creek and the tributaries that drain to Chacon Creek (**Photo 13**). Dense stands of giant reed may grow adjacent to stands of the native common reed (*Phragmites*), but the two species were not interspersed. Giant reed is an exceptionally fast-growing plant that can grow to over 20 feet tall, and can dominate an area within a growing season. The plants are generally dense monocultures, and provide little to no habitat for avian species. This plant has high rates of water use, and the large amount of biomass can create a wildfire hazard (USDA 2014b). Giant reed primarily spreads vegetatively, and sprouts from disturbed stems and rhizomes. Eradication and management of giant reed would be difficult. There are limited biological controls available, although some are currently being tested (Goosby 2017). Giant reed responds to mechanical removal such as mowing or roller chopping by sprouting from stems or roots remaining in place (USDA 2014b). The best control methods are sustained chemical control methods during subsequent growing seasons (USDA 2014b).

1.32.4 Castor Bean

Castor bean was observed near the railroad tracks (**Figure 4.4**) and within some of the sampling points south of this area. Castor bean is a plant of roadsides and disturbed areas, and is an annual shrub or small tree that can grow to 10 feet or more during the growing season (**Photo 14**). The seeds and to a lesser degree, the foliage, contain ricin which is highly toxic to humans and animals. The seeds disperse near the parent plant, or can be moved short distances by ants. Due to rapid growth, castor bean will outcompete native shrubs for space and water. Effective eradication can be conducted with mechanical methods such as pulling or digging small plants, or chemical control (DiTomaso et al 2013).

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BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Sample Points (Current Study)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine (R#-Segment Number)

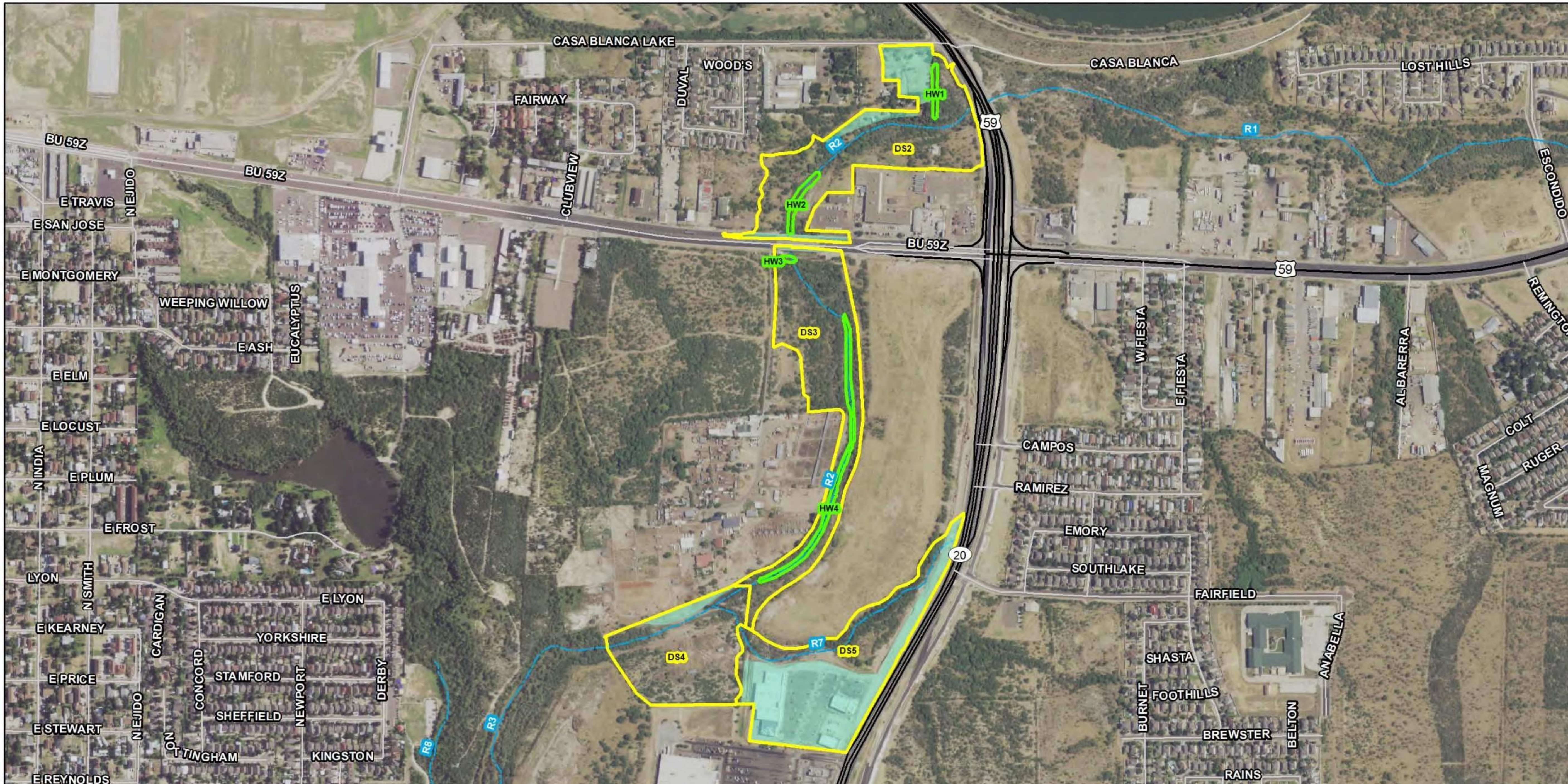
Note: Not all areas were accessible.

1:6,000

0 250 500 1,000 1,500 2,000

Feet

Figure 3.1
Vegetation Survey
Reach 1
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine (R#-Segment Number)

Note: Not all areas were accessible.

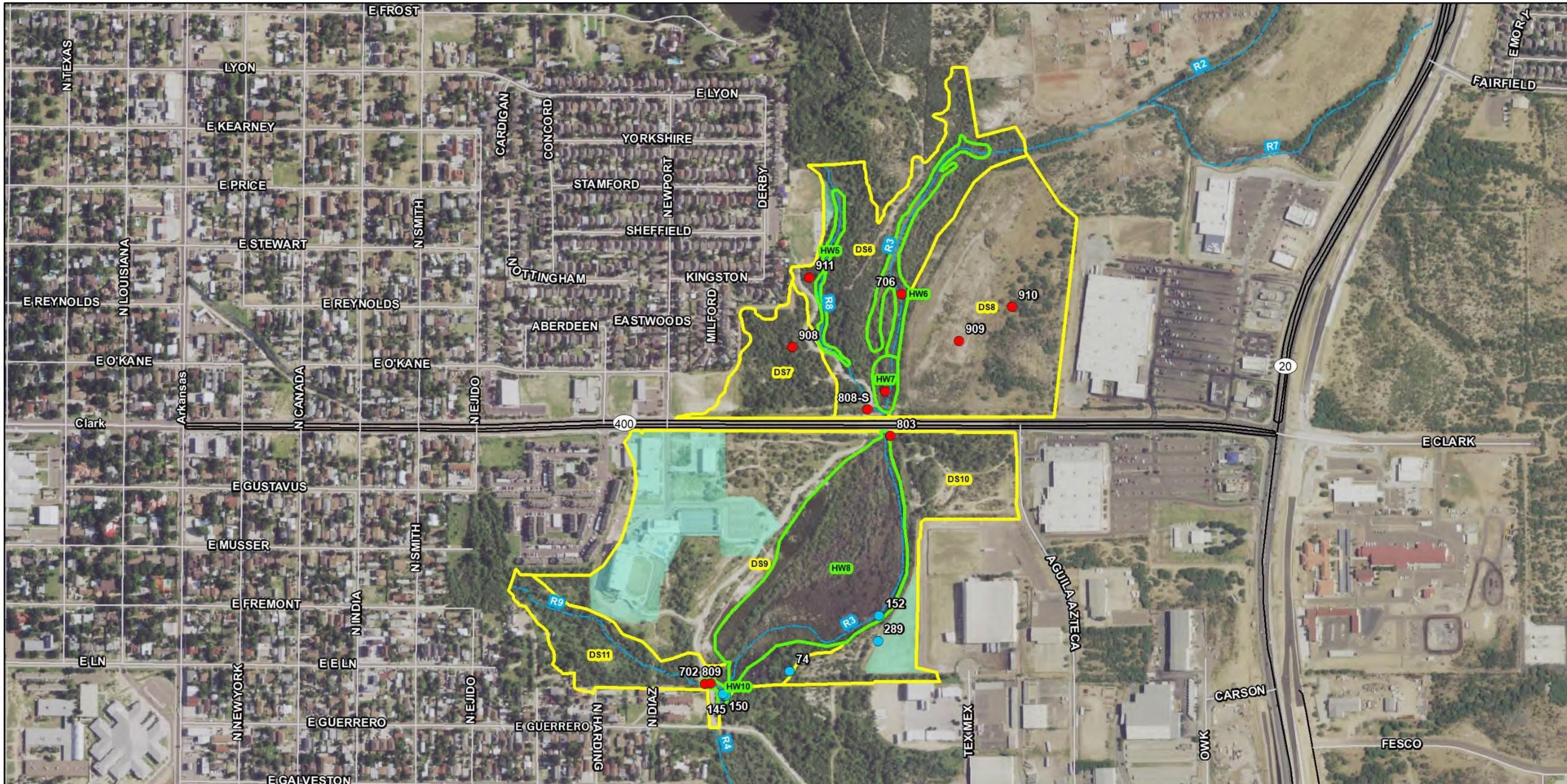
N W E S

1:8,400

0 250 500 1,000 1,500 2,000

Feet

Figure 3.2
Vegetation Survey
Reach 2
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

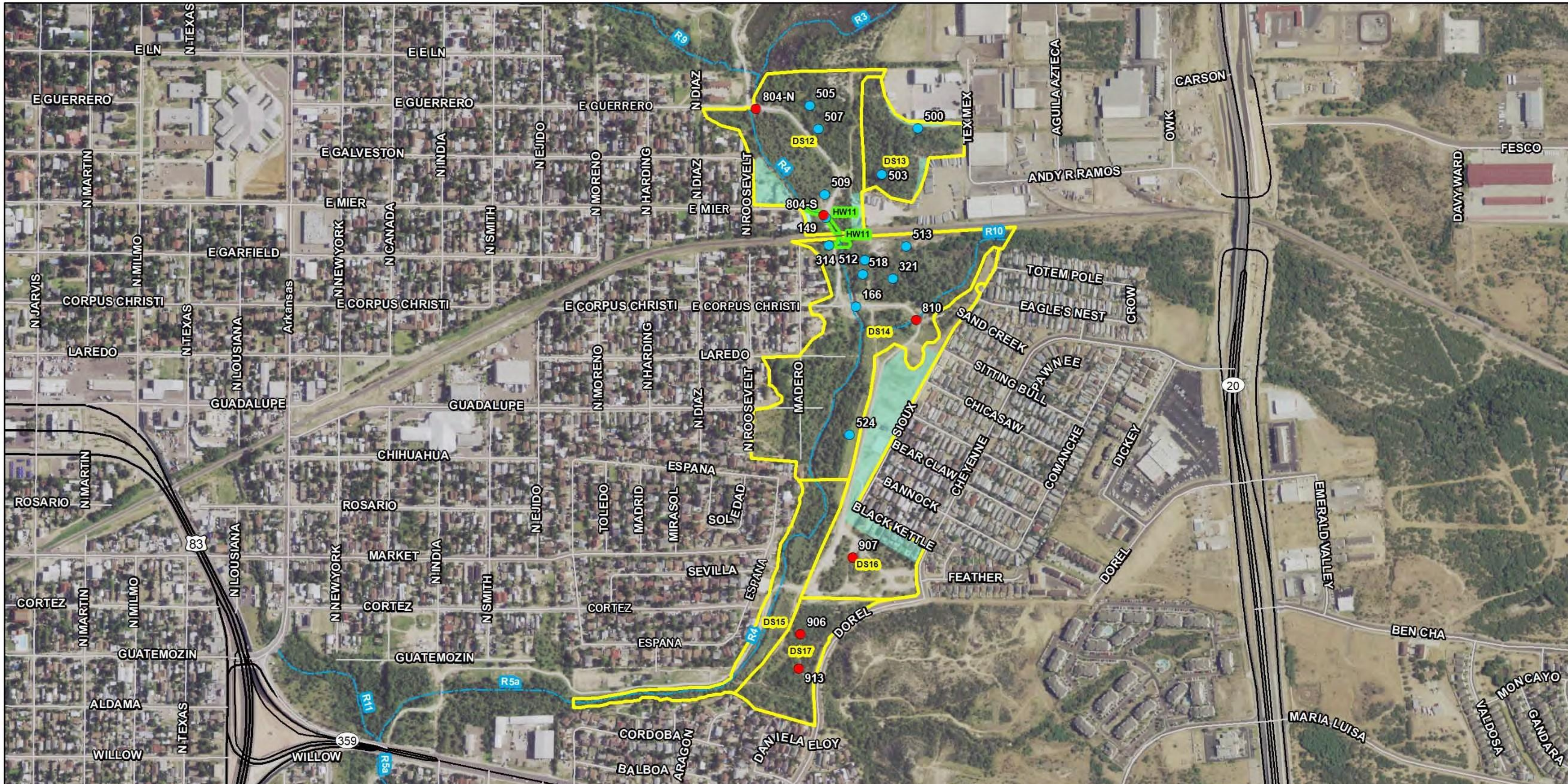
- Sample Points (USACE 2007)
- Sample Points (Current Study)
- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine (R#-Segment Number)

Note: Not all areas were accessible.

1:7,200

0 250 500 1,000 1,500 2,000
Feet

Figure 3.3
Vegetation Survey
Reach 3
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Sample Points (USACE 2007)
- Sample Points (Current Study)
- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine (R#-Segment Number)

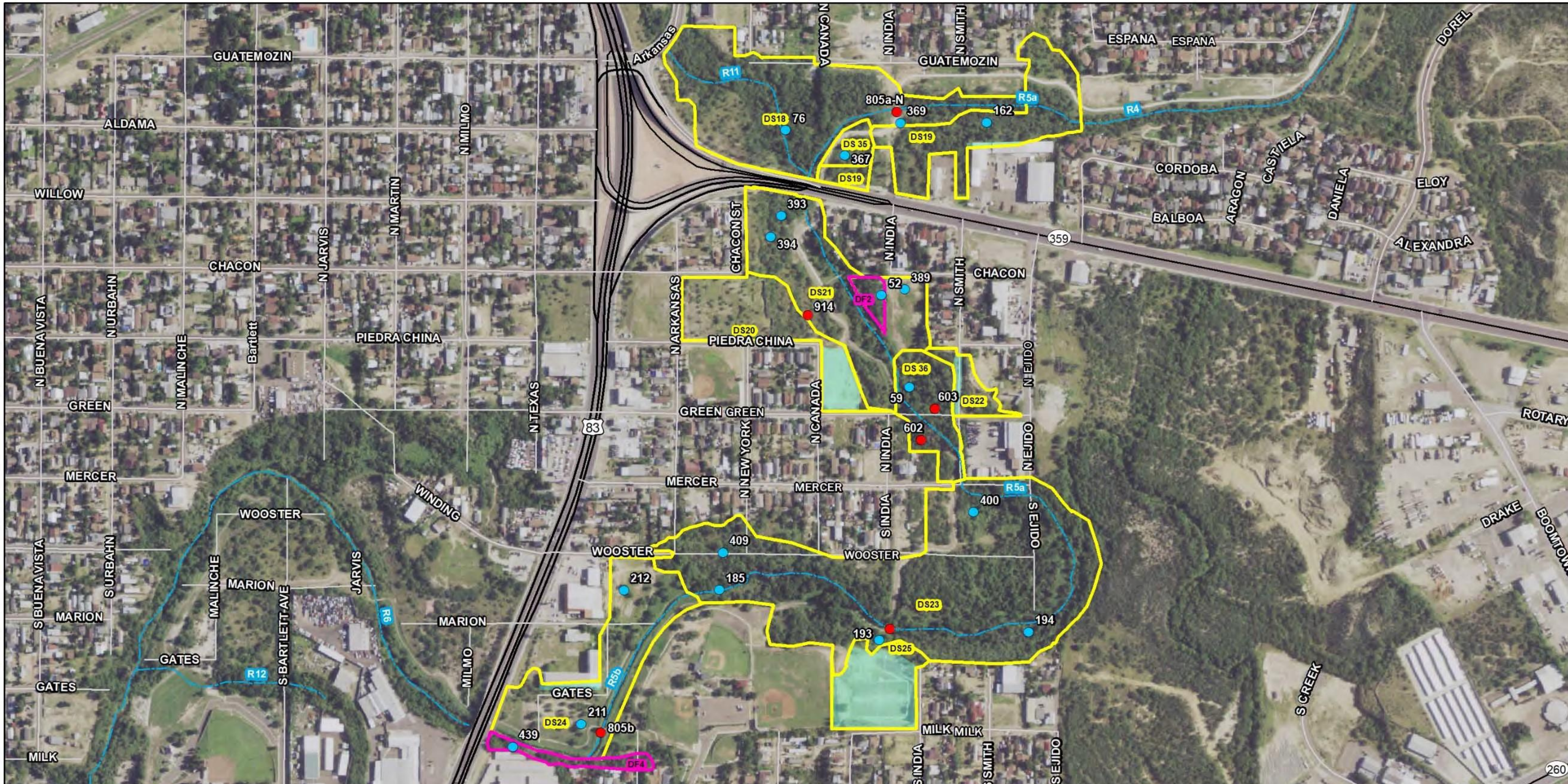
Note: Not all areas were accessible.

N W E S

1:8,400

0 250 500 1,000 1,500 2,000
Feet

Figure 3.4
Vegetation Survey
Reach 4
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

Sample Points (USACE 2007)
Sample Points (Current Study)
Deciduous Forest (DF#-Stand Number)
Deciduous Shrubland (DS#-Stand Number)
Developed Area
Riverine (R#-Segment Number)

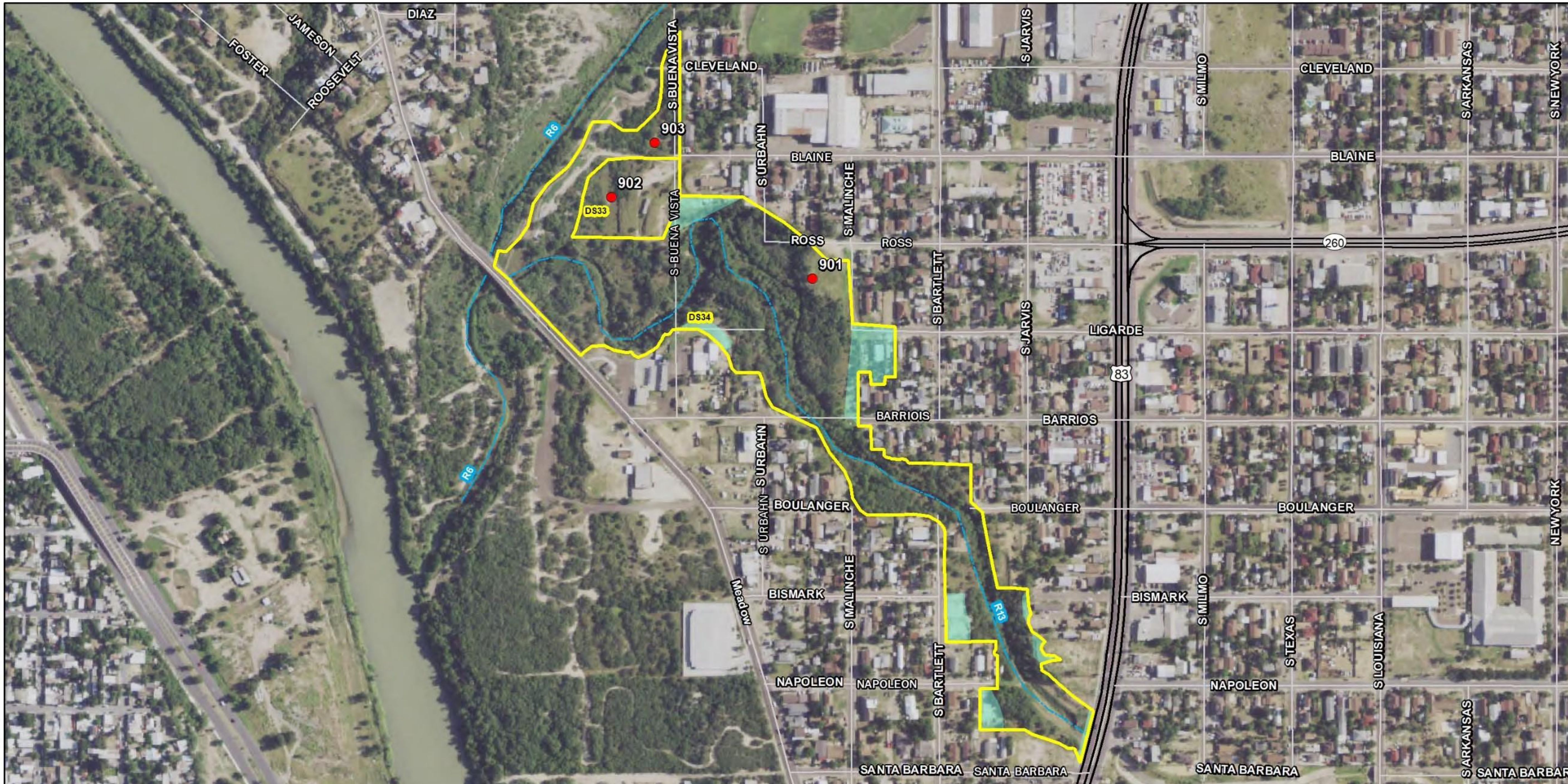
Note: Not all areas were accessible.

1:6,000

0 250 500 1,000 1,500 2,000
Feet

Figure 3.5
Vegetation Survey
Reach 5
Chacon Creek
City of Laredo
Webb County, Texas

Figure 3.6
Vegetation Survey
Reach 6
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

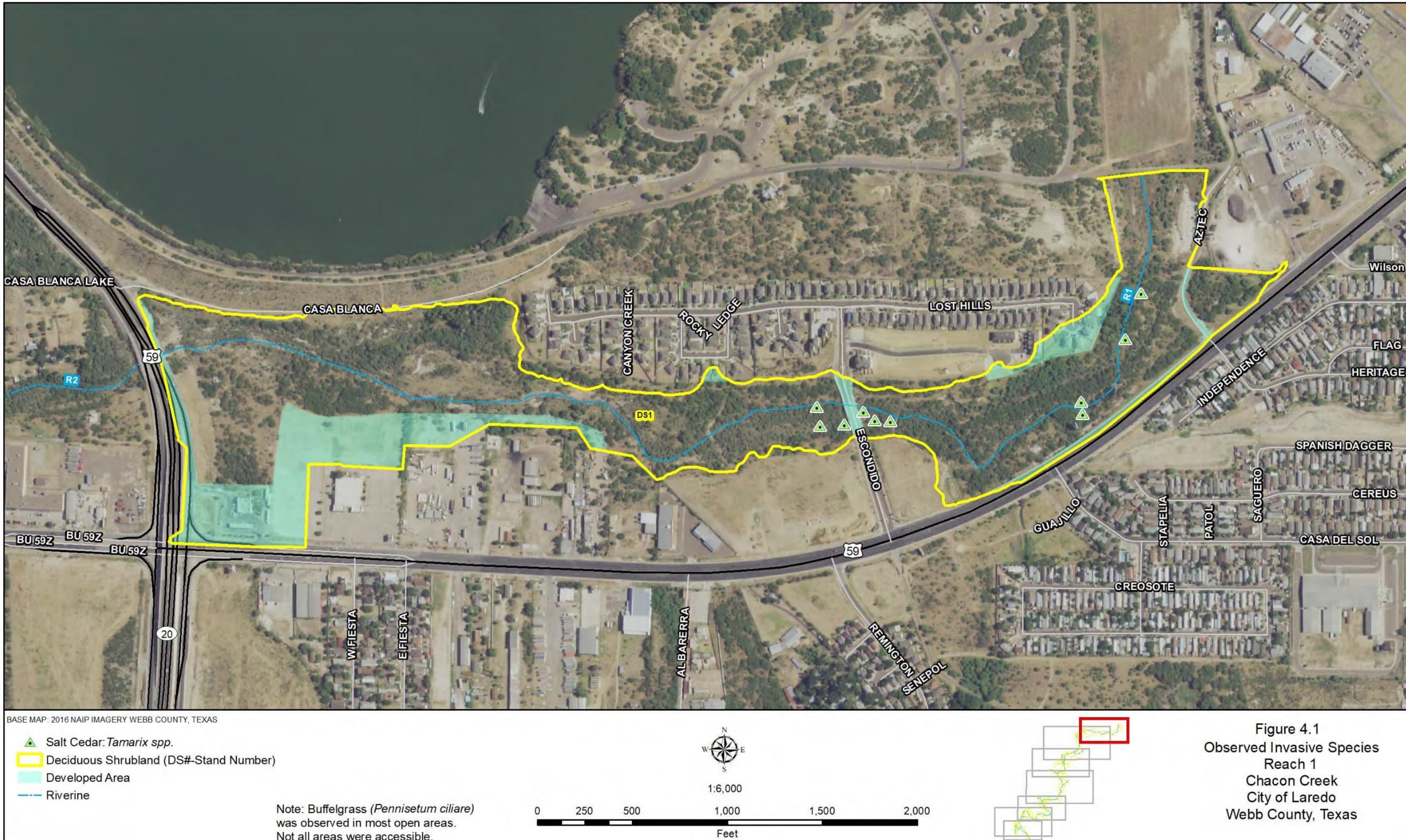
- Sample Points (Current Study)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine (R#-Segment Number)

Note: Not all areas were accessible.

1:4,800

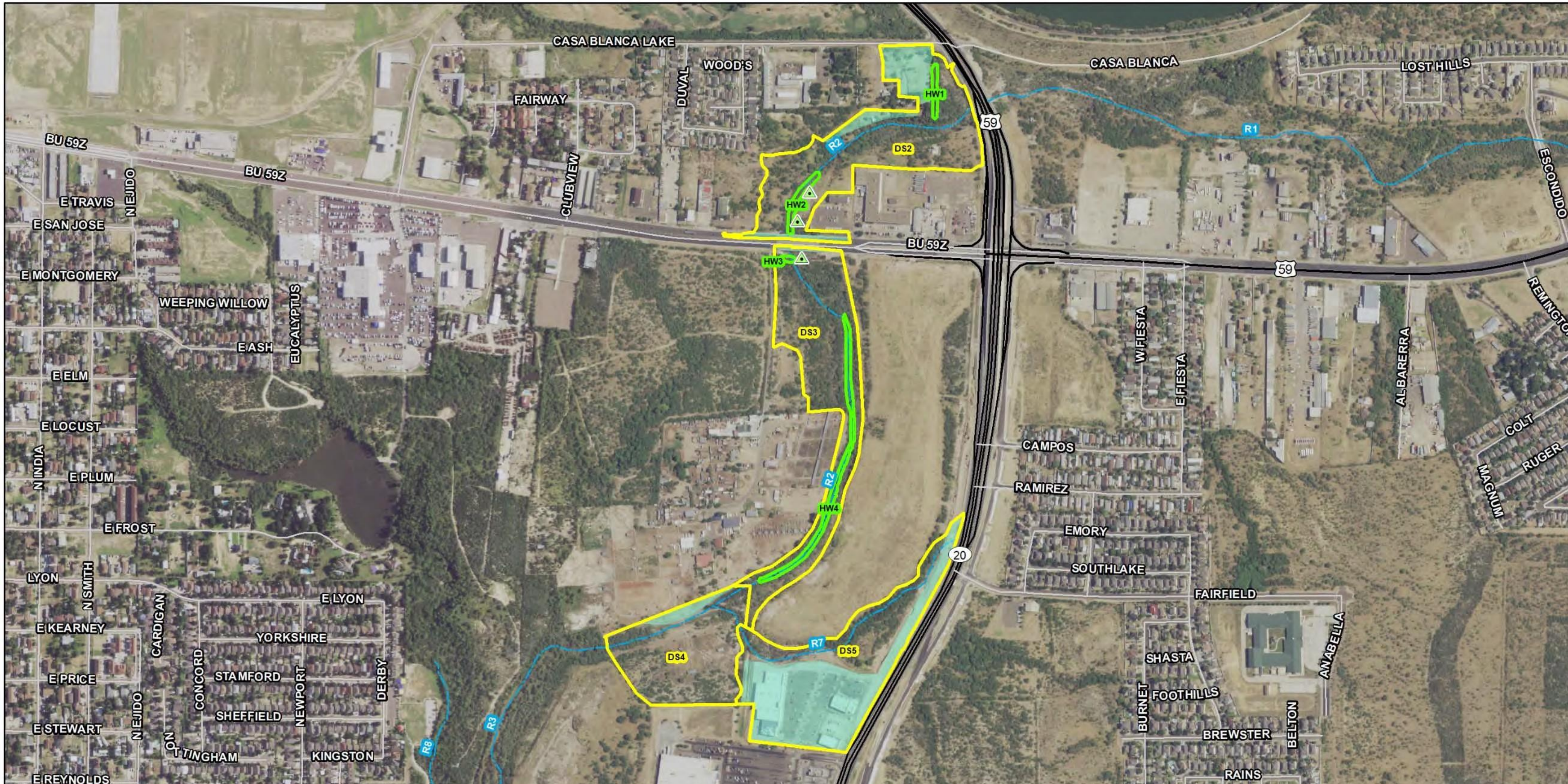
0 250 500 1,000 1,500 2,000
Feet

Figure 3.7
Vegetation Survey
Reach 7
Chacon Creek
City of Laredo
Webb County, Texas



Note: Buffelgrass *(Pennisetum ciliare)* was observed in most open areas. Not all areas were accessible.

Figure 4.1
Observed Invasive Species
Reach 1
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Salt Cedar: *Tamarix spp.*
- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine

Note: Buffelgrass *(Pennisetum ciliare)* was observed in most open areas. Not all areas were accessible.

N W E S

1:8,400

0 250 500 1,000 1,500 2,000
Feet

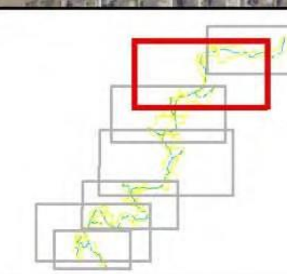
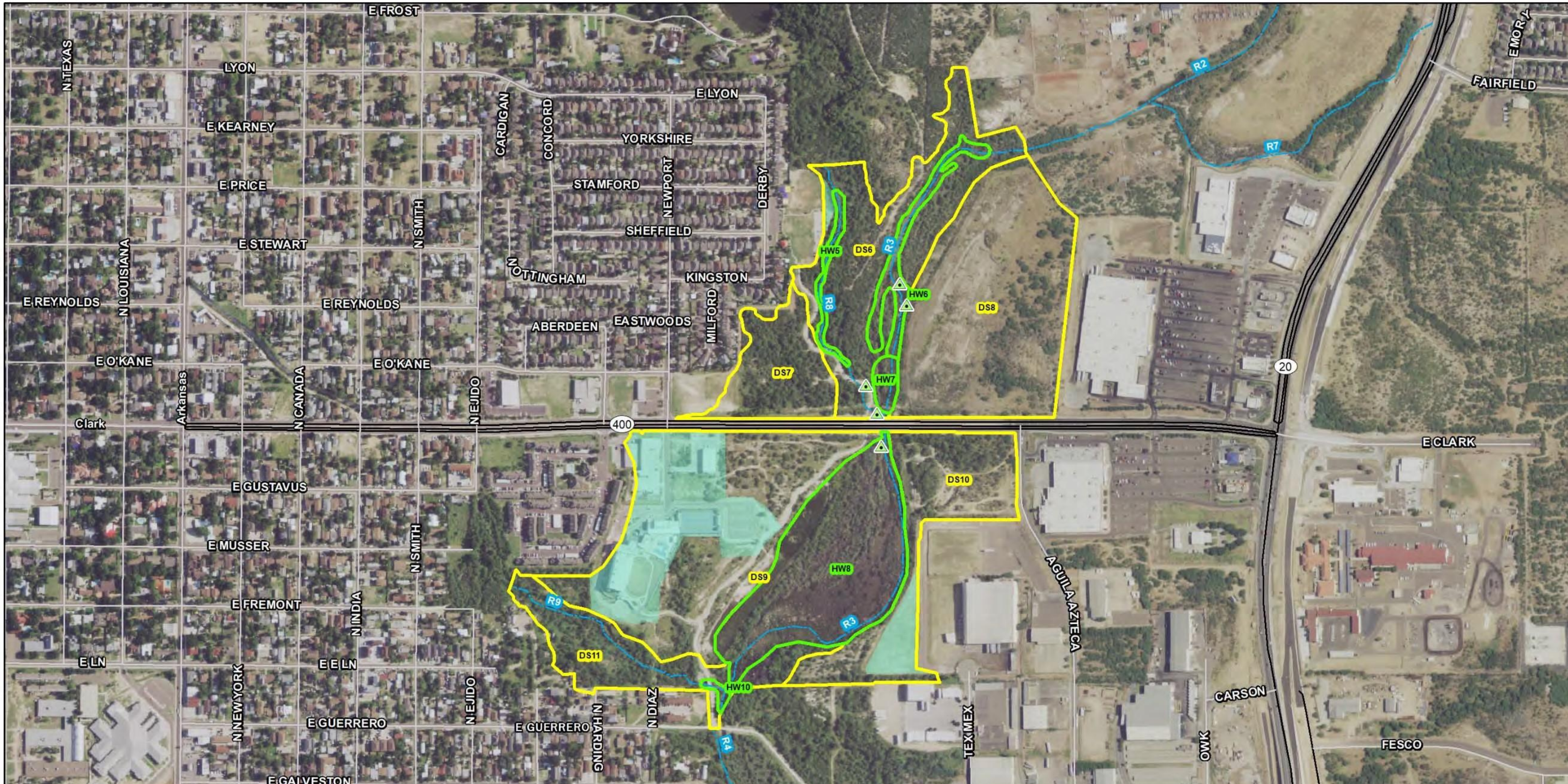


Figure 4.2
Observed Invasive Species
Reach 2
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Salt Cedar: *Tamarix spp.*
- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine

Note: Buffelgrass *(Pennisetum ciliare)* was observed in most open areas. Not all areas were accessible.

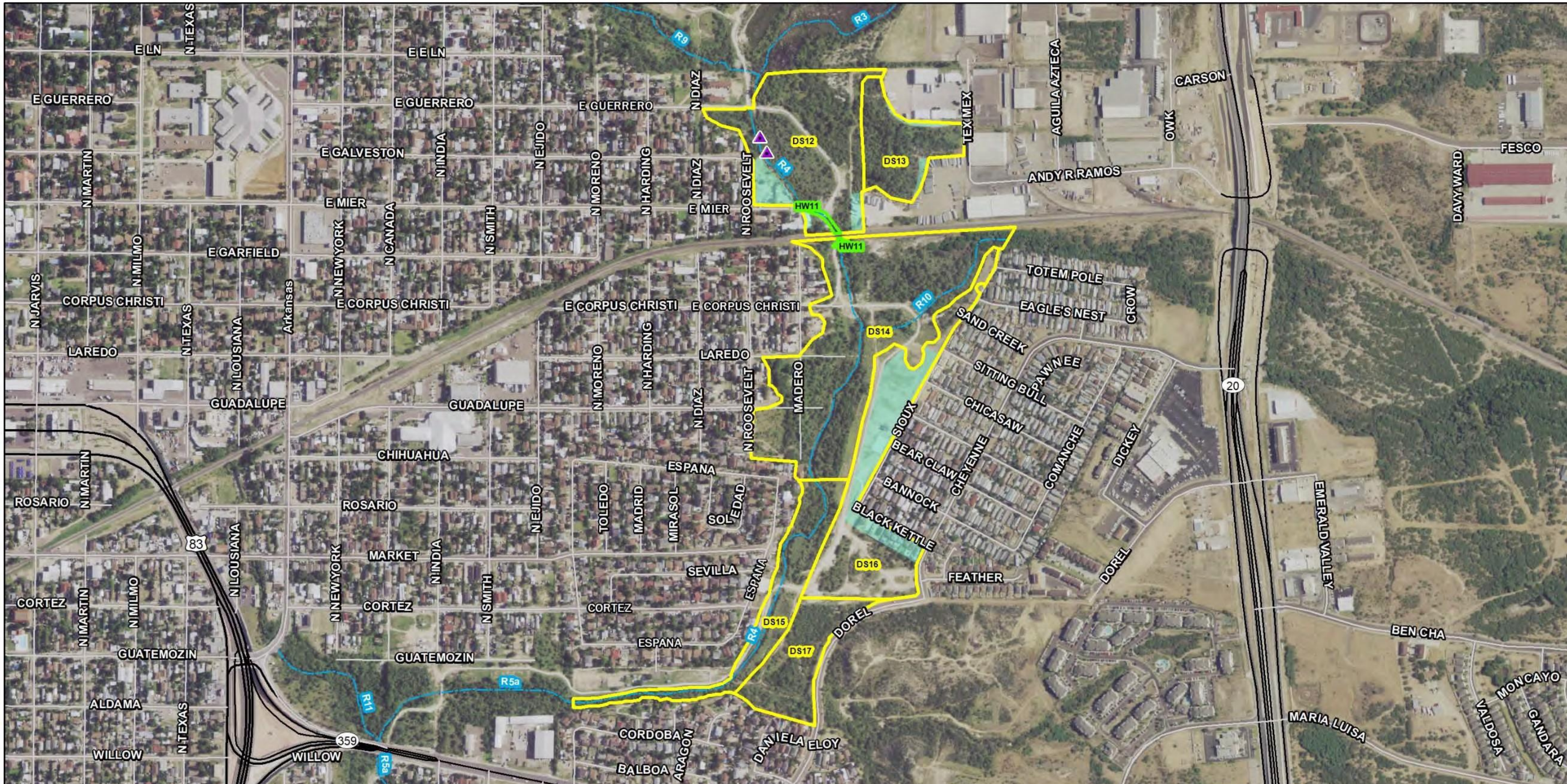
N W E S

1:7,200

0 250 500 1,000 1,500 2,000

Feet

Figure 4.3
Observed Invasive Species
Reach 3
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Castorbean: *Ricinus communis*
- Herbaceous Wetland (HW#-Stand Number)
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine

Note: Buffelgrass (*Pennisetum ciliare*) was observed in most open areas. Not all areas were accessible.

1:8,400

0 250 500 1,000 1,500 2,000
Feet

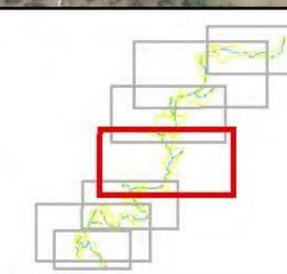


Figure 4.4
Observed Invasive Species
Reach 4
Chacon Creek
City of Laredo
Webb County, Texas

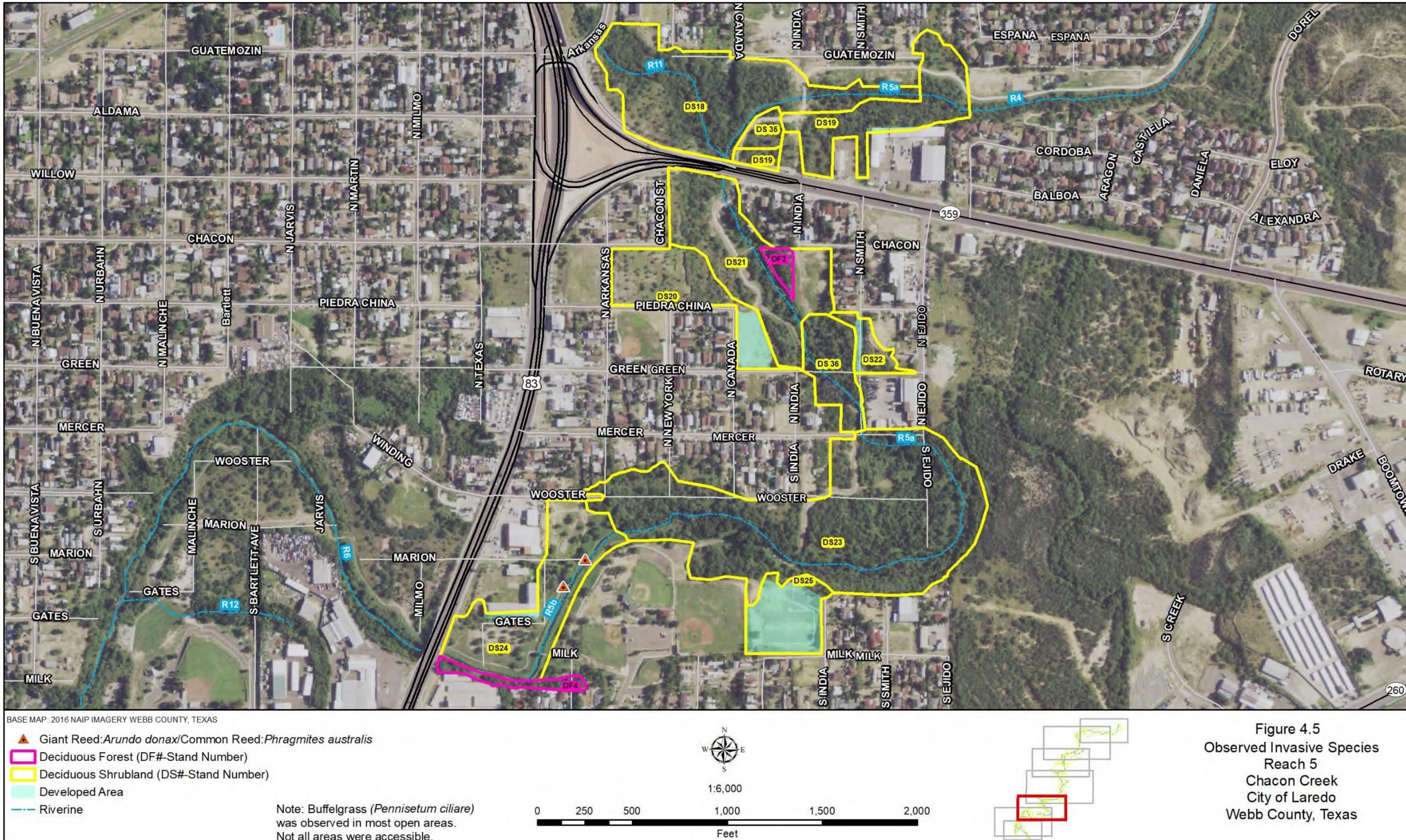
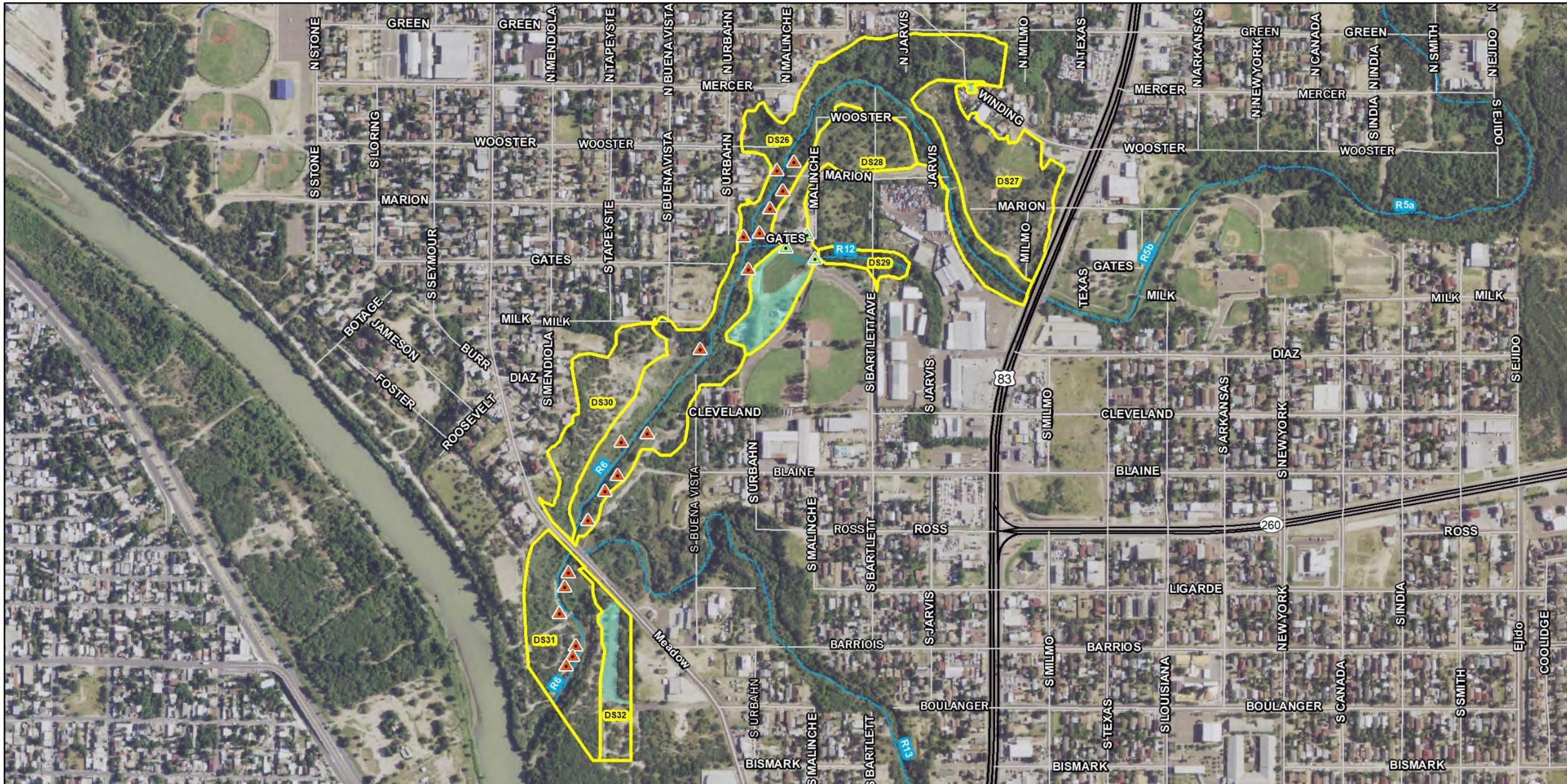


Figure 4.5
Observed Invasive Species
Reach 5
Chacon Creek
City of Laredo
Webb County, Texas



BASE MAP: 2016 NAIP IMAGERY WEBB COUNTY, TEXAS

- Giant Reed:*Arundo donax*/Common Reed:*Phragmites australis*
- Salt Cedar:*Tamarix spp.*
- Deciduous Shrubland (DS#-Stand Number)
- Developed Area
- Riverine

Note: Buffelgrass *(Pennisetum ciliare)* was observed in most open areas. Not all areas were accessible.

N W E S

1:7,200

0 250 500 1,000 1,500 2,000

Feet

Figure 4.6
Observed Invasive Species
Reach 6
Chacon Creek
City of Laredo
Webb County, Texas

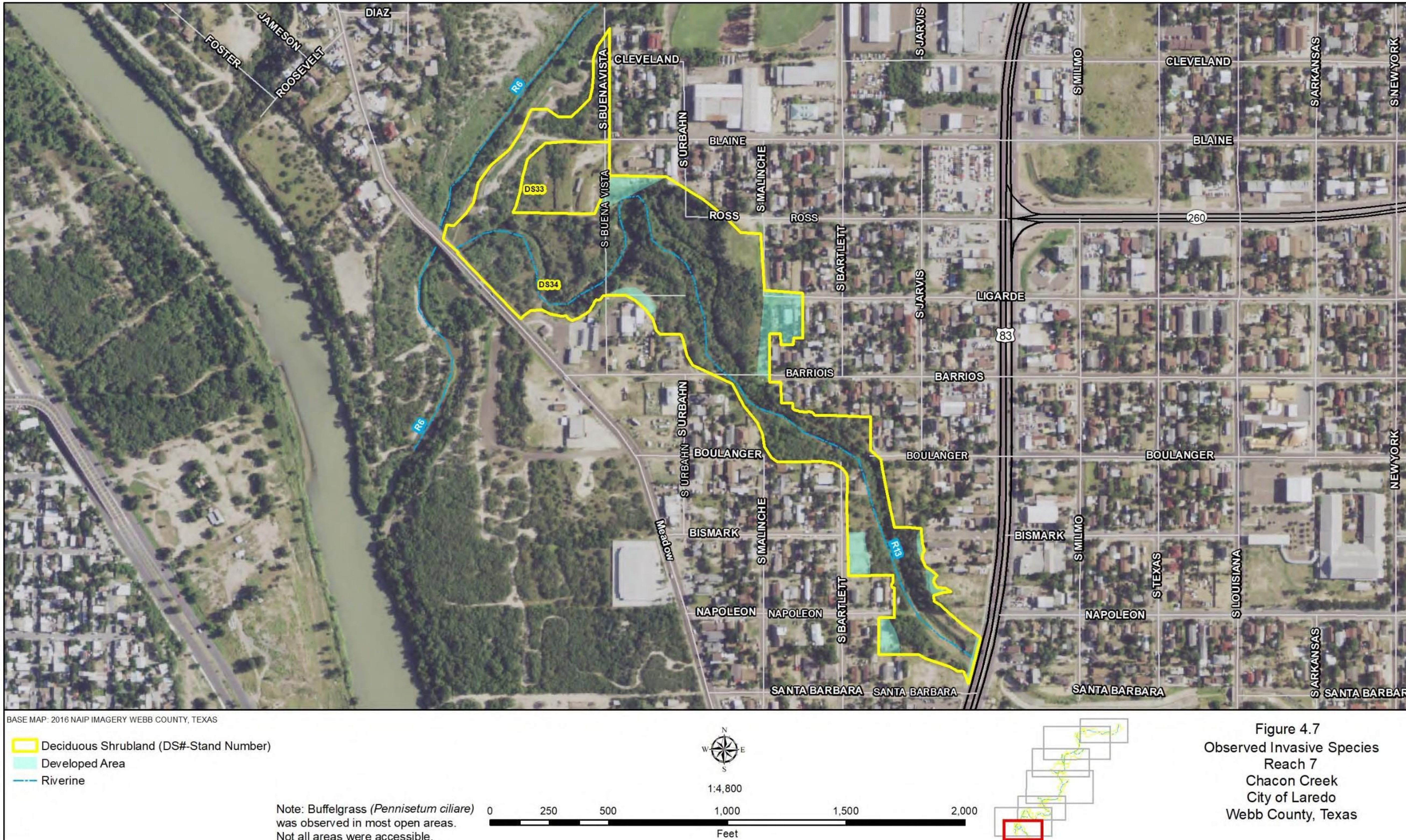


Figure 4.7
Observed Invasive Species
Reach 7
Chacon Creek
City of Laredo
Webb County, Texas

Photo 1. ***Ponded area of Chacon Creek, Riverine Section R1***

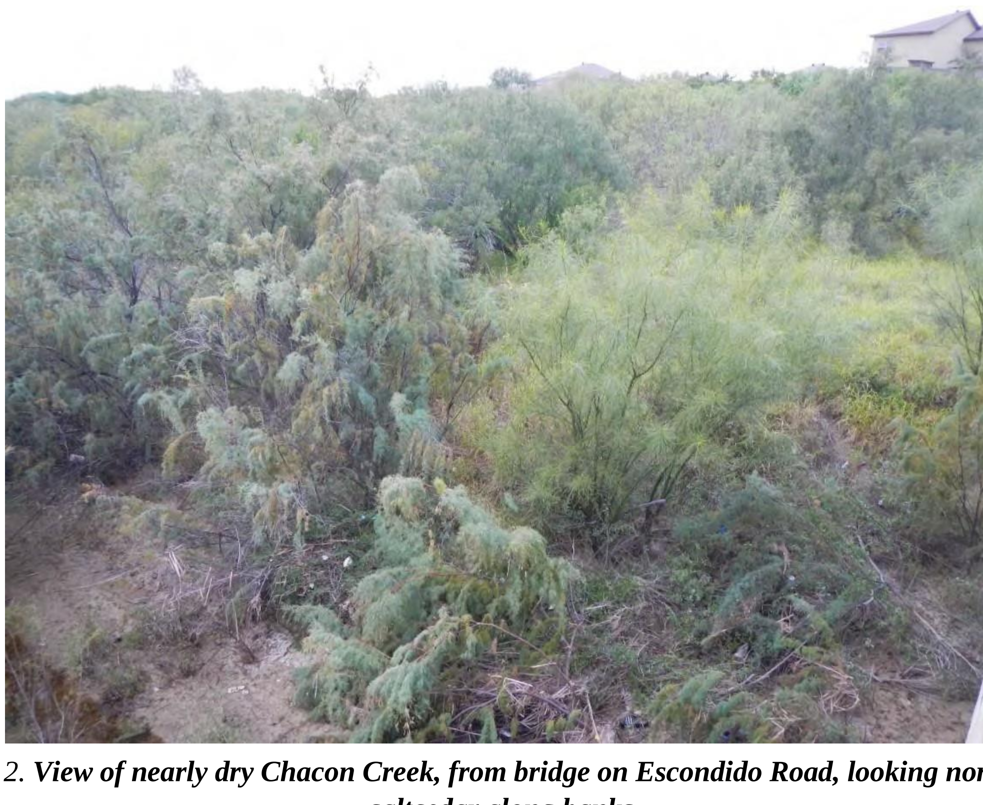


Photo 2. ***View of nearly dry Chacon Creek, from bridge on Escondido Road, looking north. Note saltcedar along banks.***

Photo 3. ***Observations of Herbaceous Wetland 2.***
Note saltcedar on banks of Chacon Creek.

Photo 4. ***View of Herbaceous Wetland 3, from bridge on Business U.S. Highway 59Z.***
Note presence of saltcedar and baccharis on banks.

Photo 5. ***Point 911, looking south. Note hike and bike trail in background. Shrubs dominated by honey mesquite.***

Photo 6. ***Plot 910, looking east. Note diversity of shrubs.***

Photo 7. ***Plot 909, looking north. Note shorter stature shrubs and more open spaces.***

Photo 8. ***Herbaceous Wetland 7, Point 808, looking west. Note saltcedar and big sacaton on banks.***

Photo 9. ***Clark Road wetland restoration. Note extensive stands of cattail in the background and water in foreground. Water in foreground is not typically present. American coots were observed swimming in this area.***

Photo 10. ***Plot 518, looking west. Note big sacaton on left, and buffelgrass in foreground. Shrubs are primarily honey mesquite.***

Photo 11. ***Plot 367, looking west. Area reclassified as DS35. Note absence of large overstory trees. Foreground is buffelgrass.***

Photo 12. ***Plot 52, looking east. Classified as deciduous forest. Note absence of herbaceous layer.***

Photo 13. ***Plot 25, looking west, in Chacon Bat Park. Note terraces in foreground. Opposite bank is dense stand of giant reed.***

Photo 14. ***Herbaceous wetland, plot 289, looking north into Clark Road restoration area, showing wetland in background.***

Photo 15. ***Castorbean mixed with big sacaton.***

Addendum B. Plant List

Common Name[1]	Scientific Name[2]
Berlandier's trumpets	*Acleisanthes obtusa*
whitebrush	*Aloysia gratissima*
ragweed	*Ambrosia sp.*
coral vine	*Antigonon leptopus*
giant reed	*Arundo donax*
zizotes milkweed	*Asclepias oenotheroides*
tubercled saltbush	*Atriplex acanthocarpa*
fourwing saltbush	*Atriplex canescens*
baccharis	*Baccharis sp.*
herb of grace	*Bacopa monnieri*
bushy seaside tansy	*Borrichia frutescens*
goatbush	*Castela erecta*
sspiny hackberry	*Celtis ehrenbergiana*
sugarberry	*Celtis laevigata*
sorrelvine	*Cissus trifoliata*
Drummond's clematis	*Clematis drummondii*
Texan hogplum	*Colubrina texensis*
Brazilian bluewood	*Condalia hookeri*
Texas bindweed	*Convolvulus equitans*
anacahuita	*Cordia boissieri*
Christmas cactus	*Cylindropuntia leptocaulis*
Bermudagrass	*Cynodon dactylon*
Kleberg's bluestem	*Dichanthium annulatum*
Texas persimmon	*Diospyros texana*
Texas ebony	*Ebenopsis ebano*
knockaway	*Ehretia anacua*
Texas swampprivet	*Forestiera angustifolia*
Mexican ash	*Fraxinus berlandieriana*
ash	*Fraxinus sp.*
fringed twinevine	*Funastrum cynanchoides*
Texas lignum-vitae	*Guaiacum angustifolium*
common goldenbush	*Isocoma coronopifolia*
leatherstem	*Jatropha dioica*
hairy caltrop	*Kallstroemia hirsutissima*
coyotillo	*Karwinskia humboldtiana*
West Indian shrubverbena	*Lantana urticoides*
creosote bush	*Larrea tridentata*
white leadtree	*Leucaena leucocephala*
Texas barometer bush	*Leucophyllum frutescens*
Berlandier's wolfberry	*Lycium berlandieri*

Common Name[1]	Scientific Name[2]
Chinaberrytree	*Melia azedarach*
cactus apple	*Opuntia engelmannii*
pricklypear	*Opuntia sp.*
blue panicum	*Panicum antidotale*
kleingrass	*Panicum coloratum*
panicgrass	*Panicum sp.*
pink pappusgrass	*Pappophorum bicolor*
Jerusalem thorn	*Parkinsonia aculeata*
crowngrass	*Paspalum sp.*
buffelgrass	*Pennisetum ciliare*
devilqueen	*Phaulothamnus spinescens*
Christmas mistletoe	*Phoradendron tomentosum*
common reed	*Phragmites australis*
redwhisker clammyweed	*Polanisia dodecandra*
honey mesquite	*Prosopis glandulosa*
littleleaf sumac	*Rhus microphylla*
castorbean	*Ricinus communis*
rougeplant	*Rivina humilis*
Rio Grande palmetto	*Sabal mexicana*
willow	*Salix sp.*
limewater brookweed	*Samolus ebracteatus*
desert yaupon	*Schaefferia cuneifolia*
common threesquare	*Schoenoplectus pungens*
bully	*Sideroxylon sp.*
Texas nightshade	*Solanum triquetrum*
copper globemallow	*Sphaeralcea angustifolia*
big sacaton	*Sporobolus wrightii*
saltcedar	*Tamarix sp.*
germander	*Teucrium sp.*
fiveneedle pricklyleaf	*Thymophylla pentachaeta*
woody crinklemat	*Tiquilia canescens*
false Rhodes grass	*Trichloris crinita*
southern cattail	*Typha domingensis*
sweet acacia	*Vachellia farnesiana*
blackbrush acacia	*Vachellia rigidula*
Texas varilla	*Varilla texana*
Don Quixote's lace	*Yucca treculeana*
lime pricklyash	*Zanthoxylum fagara*
lotebush	*Ziziphus obtusifolia*

[1, 2] Source for common and scientific names is USDA Plants database; primary sources for identification are Vines (2004) and Richardson and King (2011)

Addendum C. IBI Report

**BASELINE FISHERIES SURVEY OF CHACON CREEK
WITHIN THE LAREDO CITY LIMITS
WEBB COUNTY, TEXAS
OCTOBER 2006**

Introduction

A fisheries survey was conducted on Chacon Creek in Laredo, Webb County, Texas, on October 18, 2006, by U.S. Fish and Wildlife Service and City of Laredo Environmental Services Department personnel. The purpose of this survey was to determine baseline fish-community structure within the area of Chacon Creek that could be potentially impacted by stream modifications, development, and/or construction activities associated with possible future flood control projects.

Methods and Materials

Three sites were selected on Chacon Creek to sample fish (Table 1). These three sites were all

Table 1. Chacon Creek baseline fisheries survey sample sites.

Sample Site	General Description
Site 1	Chacon Creek, downstream of Meadow Avenue. Riffle area. Channel center dominated by bedrock substrate intermixed with cobble, gravel, and silt. Substrate in margins dominated by fine silt . Stream width averaged approximately 10 meters. Water depth averaged approximately 0.5 meters.
Site 2	Chacon Creek, within Dryden Memorial Park. Run area dominated by fine silt substrate and steep banks. Stream width averaged approximately 4.0 meters. Water depth averaged approximately 1.0 meter.
Site 3	Chacon Creek, upstream of Clark Blvd.. Pool area dominated by fine silt substrate. Inundated dead woody vegetation present. Pool width averaged approximately 20 meters. Water depth averaged approximately 0.3 meters.

downstream of Casa Blanca Reservoir and were chosen based on in-stream habitat characteristics. Site 1 was considered riffle habitat. Site 2 was characterized as stream run habitat, while Site 3 was designated as pool habitat. The drainage basin for these sites encompasses approximately 402 square kilometers (km^2) [155 square miles (mi^2)].

Fish were collected from all three sites using a fine mesh seine. In addition, fine mesh dip nets were used at Site 1 as a supplement to the seine to collect fish from areas where the substrate was dominated by large cobble. A total of seven seine-hauls were performed at each site. After collection, fish were identified to species, counted, and any observed anomalies were recorded. All fish were then released back into the creek, with the exception of those fish preserved for voucher specimens. The data resulting from this sampling were used to calculate aquatic life use values for each site and the overall area sampled employing a regional index of biotic integrity.

An index of biotic integrity (IBI) provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these metrics to define species richness, trophic composition, and abundance. Each one of these metrics is scored with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric score for a total

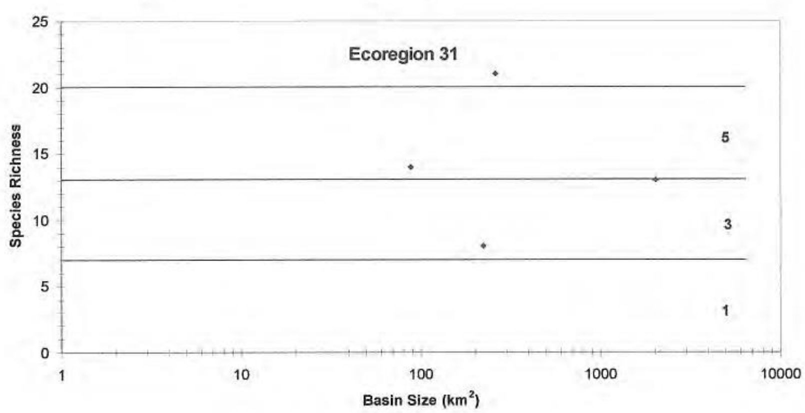
score. Accounting for the high variability in fish assemblages in aquatic systems between various ecological regions (ecoregions) in Texas, Linam *et al.* (2002) developed regionalized IBIs. Chacon Creek is located in the region designated by Linam *et al.* (2002) as the Southern Texas Plains (Ecoregion 31). The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages (Table 2 and Figure 1).

Table 2. Index of biotic integrity (IBI) scoring criteria for fish assemblages within the Southern Texas Plains (Ecoregion 31). Note - ≥42 Exceptional; 37-41 High; 25-36 Intermediate; <25 Limited (Linam *et al.*, 2002).

Metric	Scoring Criteria		
	5	3	1
1. Total number of fish species	★	★	★
2. Number of native cyprinid species	>5	3-5	<3
3. Number of benthic species (catfish, suckers, darters)	>2	2	<2
4. Number of sunfish species	>4	3-4	<3
5. % of individuals as tolerant species (excluding western mosquitofish)	<26%	26-50%	>50%
6. % of individuals as omnivores	<9%	9-16%	>16%
7. % of individuals as invertivores	>65%	33-65%	<33%
8. % of individuals as piscivores	>9%	5-9%	<5%
9a. Number of individuals/seine haul	>39.5	19.7-39.5	<19.7
9b. Number of individuals/minute electrofishing	>8.9	4.4-8.9	<4.4
10. % of individuals as non-native species	<1.4%	1.4-2.7%	>2.7%
11. % of individuals with disease or other anomalies	<0.6%	0.6-1.0%	>1.0%

★Refer to Figure 1 to obtain scoring criteria for Metric No.1.

Figure 1. Species richness compared to basin size for the Southern Texas Plains, from Linam *et al.* (2002).



Results

A total of 422 fish, comprising 10 species from 7 families, were collected from Chacon Creek (Table 3). One hundred ninety-nine individual fish were collected from Site 1 (Table 4), while 71 fish were

Table 3. Total number of fish collected from Chacon Creek, October 18, 2006.		
	Species	**Number**
Atherinidae	Inland Silverside (*Menidia beryllina*)	113
Centrarchidae	Bluegill Sunfish (*Lepomis macrochirus*)	9
Characidae	Mexican Tetra (*Astyanax mexicanus*)	19
Cichlidae	Rio Grade Cichlid (*Cichlasoma cyanoguttatum*)	1
	Blue Tilapia (*Tilapia aureus*)	9
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	33
Cyprinidae	Blacktail Shiner (*Cyprinella venusta*)	68
	Sand Shiner (*Notropis stramineus*)	3
Poeciliidae	Western Mosquitofish (*Gambusia affinis*)	102
	Sailfin Molly (*Poecilia latipinna*)	65
	Total	**422**

Table 4. Site 1 - Chacon Creek - riffle area below Meadow Avenue.		
Family	**Species**	**Number**
Atherinidae	Inland Silverside (*Menidia beryllina*)	24
Centrarchidae	Bluegill Sunfish (*Lepomis macrochirus*)	9
Characidae	Mexican Tetra (*Astyanax mexicanus*)	2
Cichlidae	Rio Grade Cichlid (*Cichlasoma cyanoguttatum*)	1
	Blue Tilapia (*Tilapia aureus*)	8
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	28
Cyprinidae	Blacktail Shiner (*Cyprinella venusta*)	68
	Sand Shiner (*Notropis stramineus*)	3
Poeciliidae	Western Mosquitofish (*Gambusia affinis*)	54
	Sailfin Molly (*Poecilia latipinna*)	2
	Total	**199**

taken from Site 2 (Table 5) and 152 fish were collected at Site 3 (Table 6). Ten different species were collected at Site 1, five species were collected from Site 2, and six separate species were collected at Site 3 (Table). Five species (inland silverside, Mexican tetra, gizzard shad, western mosquitofish, and sailfin molly) were collected at all three sites. Cyprinids (blacktail and sand shiners), centrarchids (bluegill sunfish), and one cichlid species (Rio Grande cichlid) were collected

Table 5. Site 2 - Chacon Creek - run area at Dryden Memorial Park.		
Family	**Species**	**Number**
Atherinidae	Inland Silverside (*Menidia beryllina*)	1
Characidae	Mexican Tetra (*Astyanax mexicanus*)	14
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	3
Poeciliidae	Western Mosquitofish (*Gambusia affinis*)	20
	Sailfin Molly (*Poecilia latipinna*)	33
	Total	**71**

Table 6. Site 3 - Chacon Creek - pool area upstream of Clark Blvd.		
Family	**Species**	**Number**
Atherinidae	Inland Silverside (*Menidia beryllina*)	88
Characidae	Mexican Tetra (*Astyanax mexicanus*)	3
Cichlidae	Blue Tilapia (*Tilapia aureus*)	1
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	2
Poeciliidae	Western Mosquitofish (*Gambusia affinis*)	28
	Sailfin Molly (*Poecilia latipinna*)	30
	Total	**152**

from only one site (Site 1). Only one of the 422 fish collected, a sailfin molly from Site 1, exhibited lesions. Overall, inland silverside represented 27% of the total number of fish collected, followed by western mosquitofish (24%), blacktail shiner (16%), sailfin molly (15%), gizzard shad (8%), Mexican tetra (5%), bluegill sunfish (2%), and blue tilapia (2%). The number of Rio Grande cichlids and sand shiners collected represented less than 1% of the total number of fish collected.

Designated tolerance levels and associated trophic guilds for the fish species collected from all three sites were obtained from Linam *et al.* (2002) and are presented in Table 7. All three sites were dominated by insectivorous fish species. No piscivorus fish were collected at any of the sites. Blue tilapia was the only non-native species collected. No species considered intolerant to limited water conditions (i.e., poor water quality, fluctuating water levels, reduced flow, etc.) were collected at any of the sites.

Results of the IBIs for the three sites and the overall area sampled are included in Tables 8A through 8D. The results demonstrated intermediate aquatic life use values for Sites 1 and 3 (scores of 25 and 27, respectively), and a limited aquatic life use value for Site 2 (score of 21). The fish community within the overall study area was classified as intermediate with a score of 27.

Table 7. Fish species and their associated trophic guilds and tolerance class collected from three sites on Chacon Creek, Webb County, Texas, October 18, 2006				
Family	**Scientific Name**	**Common Name**	**Trophic Guild**	**Tolerance Class**
Atherinidae	*Menidia beryllina*	Inland Silverside	insectivore	Intermediate
Centrarchidae	*Lepomis macrochirus*	Bluegill Sunfish	insectivore	Tolerant
Characidae	*Astyanax mexicanus*	Mexican Tetra	insectivore	Intermediate
Cichlidae	*Cichlasoma cyanoguttatum*	Rio Grande Cichlid	insectivore	Intermediate
	Tilapia aureus	Blue Tilapia	omnivore	Tolerant
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad	omnivore	Tolerant
Cyprinidae	*Cyprinella venusta*	Blacktail Shiner	insectivore	Intermediate
	Notropis stramineus	Sand Shiner	insectivore	Intermediate
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	insectivore	Tolerant
	Poecilia latipinna	Sailfin Molly	omnivore	Tolerant

Table 8A. IBI Metric Calculations (IBI Score) for Site 1.			
Metric	**Score**	**Metric**	**Score**
1. Total number of fish species	(10) 3	7. % of individuals as invertivores	(81) 5
2. Number of native cyprinid species	(2) 1	8. % of individuals as piscivores	(0) 1
3. Number of benthic species	(0) 1	9a. Number of individuals/seine haul	(28) 3
4. Number of sunfish species	(1) 1	9b. Number of individuals/minute electrofishing	n/a
5. % of individuals as tolerant species	(32) 3	10. % of individuals as non-native species	(4) 1
6. % of individuals as omnivores	(19) 1	11. % of individuals with disease or other anomalies	(0.5) 5
IBI Total Score: 25 (Intermediate)			

n/a - is not applicable because fish were not collected using an electrofishing device.

Table 8B. IBI Metric Calculations (IBI Score) for Site 2.			
Metric	**Score**	**Metric**	**Score**
1. Total number of fish species	(5) 1	7. % of individuals as invertivores	(49) 3
2. Number of native cyprinid species	(0) 1	8. % of individuals as piscivores	(0) 1
3. Number of benthic species	(0) 1	9a. Number of individuals/seine haul	(10) 1
4. Number of sunfish species	(0) 1	9b. Number of individuals/minute electrofishing	n/a
5. % of individuals as tolerant species	(71) 1	10. % of individuals as non-native species	(0) 5
6. % of individuals as omnivores	(51) 1	11. % of individuals with disease or other anomalies	(0) 5
IBI Total Score: 21 (Limited)			

n/a - is not applicable because fish were not collected using an electrofishing device.

Table 8C. IBI Metric Calculations (IBI Score) for Site 3.			
Metric	**Score**	**Metric**	**Score**
1. Total number of fish species	(6) 1	7. % of individuals as invertivores	(78) 5
2. Number of native cyprinid species	(0) 1	8. % of individuals as piscivores	(0) 1
3. Number of benthic species	(0) 1	9a. Number of individuals/seine haul	(22) 3
4. Number of sunfish species	(0) 1	9b. Number of individuals/minute electrofishing	n/a
5. % of individuals as tolerant species	(27) 3	10. % of individuals as non-native species	(0.7) 5
6. % of individuals as omnivores	(22) 1	11. % of individuals with disease or other anomalies	(0) 5
IBI Total Score: 27 (Intermediate)			

n/a - is not applicable because fish were not collected using an electrofishing device.

Table 8D. IBI Metric Calculations (IBI Score) for Overall Study Area.			
Metric	**Score**	**Metric**	**Score**
1. Total number of fish species	(10) 3	7. % of individuals as invertivores	(75) 5
2. Number of native cyprinid species	(2) 1	8. % of individuals as piscivores	(0) 1
3. Number of benthic species	(0) 1	9a. Number of individuals/seine haul	(20) 3
4. Number of sunfish species	(1) 1	9b. Number of individuals/minute electrofishing	n/a
5. % of individuals as tolerant species	(36) 3	10. % of individuals as non-native species	(2.1) 3
6. % of individuals as omnivores	(25) 1	11. % of individuals with disease or other anomalies	(0.2) 5
IBI Total Score: 27 (Intermediate)			

n/a - is not applicable because fish were not collected using an electrofishing device.

Conclusions and Recommendations

Results of the baseline fisheries survey conducted on October 18, 2006, utilizing the IBI developed by Linam *et al.* (2002), characterized the fish assemblages inhabiting Chacon Creek as limited to intermediate. Over 50% of the total number of fish collected were considered tolerant to limited in-stream water conditions. Twenty-five percent of the total number of fish collected were omnivorous however, fish communities at all three sites were dominated by insectivorous fish. No piscivorus fish species were collected from any of the sites during this survey. Anomalies such as lesions or tumors were observed on less than 1% of the fish collected.

The limited to intermediate characterization of the fish community in Chacon Creek could possibly be attributed to nominal in-stream habitat, marginal water quality and/or limited in-stream flow. Consequently, it is recommended that future projects consider methods to enhance in-stream structure and/or in-stream flow to provide suitable conditions for the improvement of the fish habitat within Chacon Creek.

References

Linam, G.W., L.J. Kleinsasser, and K.B. Mayes. 2002. Regionalization of the Index of Biotic Integrity for Texas Streams. Texas Parks and Wildlife Department. Austin, Texas.

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APPENDIX C

CULTURAL RESOURCES ANALYSIS

CULTURAL RESOURCES ANALYSIS

INTRODUCTION

Any proposed undertaking under the responsibility of the U.S. Army Corps of Engineers must follow and account for the responsibilities under Federal and State Cultural Resources laws and regulations, Executive Orders, and U.S. Army Corps of Engineers Regulations. All applicable legislative and regulatory mandates are to be considered in the event that any study provides a basis for a Federal undertaking. Any projects will need to consider the legal responsibilities and obligations of the U.S. Army Corps of Engineers with respect to the following guidance.

- National Historic Preservation Act (NHPA) of 1966 (PL 89-665 et seq.)
- National Environmental Policy Act (NEPA) of 1969 (PL 90-190)
- Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (PL 101-601)
- Executive Order 13007 (Accommodation of Sacred Sites, 24 May 1996)
- Government-to-Government Relations with Native American Indian Tribal Governments (Presidential Memorandum of 29 April 1994)
- Engineer Regulation (ER) 1105-2-100 (Guidance for Conducting Civil Works Planning Studies)

The large scale of the relevant study area and the level of effort to collect and prepare this information restricted the data collection to that of currently known and recorded cultural resources in the feasibility phases of the study. Now that project planning has progressed to the identification of a preferred alternative plan, impact areas and the nature of those impacts to cultural resources can be fully assessed in the next phase of work. The potential for unknown, intact, subsurface cultural resources exists within the study area. However, a large portion of the property has been previously surveyed for various private, state, and Federal undertakings, such as sewer lines, roads, and industrial construction, and has since been disturbed by these undertakings. Therefore only limited survey is expected to be necessary for the preferred alternative plan. The Area of Potential Effect (APE) for the selected plan will be determined in consultation with the State Historic Preservation Office (SHPO) so that impacts to cultural resources can be accurately assessed and mitigated if necessary.

The potential impacts to cultural resources to be considered include structural and non-structural flood control and relief systems, easements, pipelines, borrow and disposal areas, mitigation areas, creation of wetland areas, reforestation, and revegetation, among other possibilities. Any of these undertakings would generate a requirement to consider possible impacts to Historic Properties identified to be in the APE of the undertaking. To fully determine the presence of Historic Properties within the project APE, USACE will conduct archaeological surveys and an architectural reconnaissance survey of relevant parcels along the project corridor. Survey boundaries and methods will be developed in consultation with the SHPO. Additional consultations with other interested parties and Native American Indian tribal groups will also be carried out in accordance with 36 CFR Part 800.

Despite best efforts to locate and evaluate all the cultural resources within the project area, unanticipated subsurface deposits are possible at any ground-breaking undertaking. If previously unknown cultural materials are exposed by construction activities related to the undertaking, work will stop in the immediate vicinity, the resource will be protected, and the SHPO will be notified within 24 hours of discovery. If, in consultation with the SHPO, it is determined that the resource is significant, and cannot be avoided by construction, then a mitigation plan will be prepared in consultation with the SHPO and implemented before construction is allowed to continue in that vicinity.

If unmarked human burials are discovered during construction, work will stop in the immediate vicinity, the remains will be protected, and the local law enforcement agency and SHPO will be notified within 24 hours. The location of the unmarked human burial or burials will be documented and the provisions of the Native American Graves Protection and Repatriation Act will be implemented where applicable. Discovery of human remains will be mitigated, in consultation with SHPO and Federally recognized Native American Tribes if appropriate, before construction will be allowed to continue in the vicinity of the discovery.

ARCHAEOLOGICAL RESOURCES

A check of state archaeological site records, at the Texas Archeological Sites Atlas (TASA) online database, indicated numerous previously recorded cultural resources sites within the Chacon Creek vicinity and along nearby tributaries, roads, pipelines, and railroad corridors. So many sites have been recorded in this area as a result of many surveys carried out in association with road work and development in the area over the last 15 years. The project-specific APE will be developed in consultation with the SHPO and from that, the appropriate level of survey will be decided. The majority of the previous surveys have been conducted recently and appear to adequately meet current survey standards. It is not anticipated that the USACE will resurvey areas that have already been sufficiently surveyed by another agency. Areas determined to not have adequate coverage by SHPO will be surveyed.

Because the project area is largely urbanized, and therefore the ground has been previously disturbed along much of the creek corridor, the potential for intact subsurface cultural resources is lower in areas where roads and housing and commercial developments encroach the creek bank. The entire project corridor has been previously surveyed for various undertakings. Reports from those surveys indicate the area is prone to severe erosion in addition to disturbance from development. These surveys have identified 47 archaeological sites within a mile and a half of the study area. Of these, only six are located close enough to Chacon Creek to potentially fall within the APE of the current project. Four sites were determined not eligible for NRHP and are listed as such on the state site files. Given the extreme erosion and rapid development in the area, no further work will be conducted at those sites. Two previously recorded sites are reported to have potential for intact buried deposits and therefore will be further investigated to determine their eligibility if they fall within the project APE. In addition, survey is required for the approximately two-mile section of the project area between Highway 83 and the Rio Grande. The only survey of this area was conducted in 1979 when survey standards were not as rigorous as they are today. Any NRHP-eligible sites discovered along this portion of the project corridor could be impacted by ecosystem restoration activities. Those impacts will be assessed once the methods for restoration have been determined.

Given the high density of sites recorded in the region, it is reasonable to expect archaeological material will be encountered. However, the urbanization of the area suggests few sites will retain enough integrity to be considered eligible for the NRHP.

ARCHITECTURAL RESOURCES

Preliminary indications are that very few, if any, structures in the study area meet age and/or integrity requirements to qualify for the NRHP based upon association with significant people, events, architectural design or information potential. The bridges also initially appear unremarkable for their design and construction values. A more thorough reconnaissance of the structures within the APE will need be conducted in conjunction with the archaeological surveys to determine if any standing building, bridge, or other structure might be eligible for the NRHP. Mitigation for any eligible Historic Properties will be determined in consultation with the SHPO.

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APPENDIX D

REAL ESTATE PLAN

APPENDIX
REAL ESTATE PLAN

CHACON CREEK FLOOD DAMAGE REDUCTION
AND
ECOSYSTEM RESTORATION PROJECT

CITY OF LAREDO, WEBB COUNTY, TEXAS

DATE OF REPORT

NOVEMBER 16, 2009
(REVISED: May 14, 2010)

PREPARED BY

U.S. ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

WITH REVISIONS BY THE CITY OF LAREDO

AUGUST 15, 2018

This Real Estate Plan has been prepared in accordance with ER 405-1-12.

PREPARED BY:

Renee Russell
Realty Specialist
Fort Worth District, Corps of Engineers
Real Estate Division, Realty Services Branch

RECOMMENDED BY:

Randy L. Roberts
Chief, Realty Services Branch
Fort Worth District, Corps of Engineers
Real Estate Division, Realty Services Branch

From the 2010 USACE report PDF:

PREPARED BY:

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Fort Worth District, Corps of Engineers
Real Estate Division, Realty Services Branch

RECOMMENDED BY:

Randy L. Roberts
Chief, Realty Services Branch
Fort Worth District, Corps of Engineers
Real Estate Division, Realty Services Branch

NOTE: The City of Laredo has made minor modifications to the original real estate plan as follows:

- Revisions to Table 2A and 2C by adding updated 2018 numbers.
- Text additions related to the "Relocation Assistance Program, P.L. 91-646" section
- Text additions related to "Lands Containing Hazardous Waste."

PURPOSE

This Real Estate Plan has been prepared in support of the feasibility study that describes the lands, easements, right of way, relocation, and disposal (LERRD) required for the Chacon Creek Flood Damage Reduction and Ecosystem Restoration Project in the City of Laredo, Webb County, Texas. The City of Laredo is the local sponsor and will acquire all LERRD. Authority for the project is contained in a resolution by the Committee on Transportation and Infrastructure, United States House of Representatives, adopted May 21, 2003 as quoted below:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Rio Grande and Tributaries, published as House Document 39, 62nd Congress, 1st Session, and other pertinent reports to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of flood damage reduction, environmental restoration and protection, water conservation and supply, water quality, and related purposes in the Rio Grande Watershed below Falcon Dam."*

The preferred plan identified in the study seeks prevention of flooding and ecosystem degradation due to urban development within the watershed. The ecosystem degradation has resulted in erosion and loss of wetland habitats and vegetation.

LAND, EASEMENT, AND RIGHT-OF-WAY FOR THE RECOMMENDED PLAN

The subject property is located in the City of Laredo, Webb County, Texas. The recommended plan for the Flood Risk Management (FRM) portion of the project is a buyout involving an estimated 64 improved tracts (62 tracts contain site-built single family houses and 2 tracts contain manufactured houses). The Ecosystem Restoration (ER) portion includes the buyout of an estimated 238 vacant tracts.

It should be noted that the local sponsor (City of Laredo) has already acquired 8 improved tracts (4 contain site-built single family houses and 4 contain manufactured houses) in the FRM portion. In the ER portion, the local sponsor has already acquired 140 vacant tracts.

In the ER portion, 20.608 acres will be needed for easements that will be used for electrical and waterlines.

The cost-share for the project is estimated at 65% Federal and 35% local. (The local sponsor is responsible for all LERRD costs which will be credited against their share.)

Table 1A identifies the estates, acreages, and estimated value of the lands to be acquired for Chacon Creek, as well as, lands owned by the City of Laredo for the Flood Risk Management portion of the project. The prices have been escalated based on real estate pricing index values developed by the Federal Reserve Bank of St. Louis.

TABLE 1A

LANDS, EASEMENTS, and RIGHTS OF WAY
CHACON CREEK FLOOD RISK MANAGEMENT PROJECT
LAREDO, TEXAS

ESTATE	ACRES	2010 VALUE	Escalation %	2018 VALUE
PROJECT PURPOSE: Flood Risk Management				
Fee, Excluding Minerals			16.55%	
TBA (SF)	8.997	$4,371,000		$5,094,599
TBA (MF)	0.288	$82,650		$96,332
City owned (SF)	0.576	$282,000		$328,684
City owned (MF)	0.576	$165,300		$192,665
City owned (Vacant)	0.144	$648		$755

Table 1B identifies assumed estates, actual acreages, and values of lands owned acquired by the City of Laredo for Chacon Creek for the Ecosystem Restoration portion of the project. The prices have been escalated based on real estate pricing index values developed by the Federal Reserve Bank of St. Louis.

TABLE 1B

LANDS, EASEMENTS, and RIGHTS OF WAY
CHACON CREEK FLOOD RISK MANAGEMENT and ECOSYSTEM RESTORATION PROJECT
LAREDO, TEXAS

ESTATE	ACRES	2010 VALUE	Escalation %	2018 VALUE
PROJECT PURPOSE Ecosystem Restoration				
Fee, Excluding Minerals				
TBA (Vacant)	187.312	$842,904	16.55%	$982,443
Utility and/or Pipeline Easement				
TBA (Easement)	20.608	$834,362		$972,487
City owned (Vacant)	197.354	$888,093		$1,035,113

Standard estates in accordance with Chapter 5, ER 405-1-12 will be used for this project, as shown below:

Fee, Excluding Minerals (With Restriction on Use of the Surface): The fee simple title to (the land, subject, however, to existing easements for public roads and highways, public utilities, railroads, and pipelines; excepting and excluding all (coal) (oil and gas), in and under said land and all appurtenant rights for the exploration, development, production and removal of said (coal) (oil and gas), but without the right to enter upon or over the surface of said land for the purpose of exploration, development, production and removal therefrom of said (coal) (oil and gas).

Utility and/or Pipeline Easement: A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract Nos. _______, _______, and ______), for the location, construction, operation, maintenance, alteration; repair and patrol of (overhead) (underground) (specifically name type of utility or pipeline); together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

NON-STANDARD ESTATES

There are no non-standard estates associated with this project.

EXISTING FEDERAL PROJECT

There is no existing Federal project that lies fully or partially within the project area.

FEDERALLY OWNED LAND

There is no federally owned land associated with this project.

NAVIGATIONAL SERVITUDE

There is no navigational servitude.

PROJECT AREA

Maps depicting the project area are attached. **Note that all maps are from the original 2010 USACE Real Estate Plan.**

FLOODING OF PROJECT AREA

The recommended plan involves non-structural buyouts of residential properties in the right (north) overbank of Chacon Creek. In accordance with accepted practice for this type of non-structural solution, it is evident that the proposed alternative would have insignificant impacts upon peak flood discharges; therefore, any downstream (hydrologic) inducement would be considered negligible. Similarly, it is also evident that the proposed project would have minimal, but beneficial impacts upon peak flood stages; therefore, it would preclude any upstream (hydraulic) inducement.

BASELINE COST ESTIMATE FOR REAL ESTATE

Property values included in the cost estimate are based on a Gross Appraisal, dated October 13, 2009, prepared by Thurman Schweitzer, Appraiser, for Fort Worth District, U.S. Army Corps of Engineers. The Fort Worth District, Realty Services Branch, staff estimated administrative cost. Contingencies have been added to the estimates as follows:

- 01.23.03.01 Real Estate Planning Documents, 25% based on reasonable cost estimates
- 01.23.03.02 Real Estate Acquisition Documents, 25% based on reasonable cost estimates
- 01.23.03.03 Real Estate Condemnation Documents, 20% based on the normal risks of court actions
- 01.23.03.05 Real Estate Appraisal Documents, 20% based on reasonable contract costs
- 01.23.03.06 Real Estate PL 91-646 Asst. Documents, 10% based on reasonable cost estimates
- 01.23.03.15 Real Estate Payment Documents, based on contingencies (20%) assigned by the Appraiser in the Gross Appraisal
- 01.23.03.17 Real Estate LERRD Accounting Documents, 20% based on reasonable cost estimates relative to accounting requirements

Cost estimates for Chacon Creek are presented in the following three tables. Each of the tables present the 2010 values that were completed, plus the escalated 2018 values. The values have been escalated using real estate pricing index values developed by the Federal Reserve Bank of St. Louis for the Laredo area.

TABLE 2A REAL ESTATE COST ESTIMATES - PROJECT IMPLEMENTATION CHACON CREEK FLOOD DAMAGE REDUCTION & ECOSYSTEM RESTORATION LAREDO, TEXAS (FLOOD RISK MANAGEMENT)				
DESCRIPTION	**2010 ESTIMATE**	**2010 CONTINGENCY**	**2018 ESTIMATE**	**2018 CONTINGENCY**
Lands & Damages				
Construction Contract Documents				
Real Estate Analysis Documents				
Real Estate Planning Documents				
Planning by Non Federal Sponsor	$6,400	$1,600	$7,459	$1,865
Real Estate Acquisition Documents				
Acquisitions by Sponsor	$512,000	$128,000	$596,759	$149,190
Review of Sponsor	$16,000	$4,000	$18,649	$4,662
Real Estate Condemnation Documents				
Condemnations by Sponsor	$210,000	$42,000	$244,765	$48,953
Review of Sponsor	$3,500	$700	$4,079	$816
Real Estate Appraisal Documents				
Appraisals by Sponsor	$160,000	$32,000	$186,487	$37,297
Review of Sponsor	$16,000	$3,200	$18,649	$3,730
Real Estate PL 91-646 Asst. Documents				
PL 91-646 Asst. by Sponsor	$128,000	$12,800	$149,190	$14,919
Review of Sponsor	$16,000	$1,600	$18,649	$1,865
Real Estate Payment Documents				
Payments by Local Sponsor (Fee)	$4,901,598	$980,320	$5,713,035	$1,142,607
Payments by Sponsor (PL 91-646)	$1,600,000	$320,000	$2,368,000	$473,600
Review of Sponsor	$16,000	$3,200	$18,649	$3,730
Real Estate LERRD Credit Documents	$6,400	$1,280	$7,459	$1,492
Total Admin & Payments	**$7,591,898**		**$9,351,800**	
Total Contingencies		**$1,530,700**		**$1,884,800**
GRAND TOTAL	**$9,122,598**		**$11,236,600**	

TABLE 2B REAL ESTATE COST ESTIMATES - PROJECT IMPLEMENTATION CHACON CREEK FLOOD DAMAGE REDUCTION & ECOSYSTEM RESTORATION LAREDO, TEXAS (ECOSYSTEM RESTORATION)				
DESCRIPTION	**2010 ESTIMATE**	**2010 CONTINGENCY**	**2018 ESTIMATE**	**2018 CONTINGENCY**
Lands & Damages				
Construction Contract Documents				
Real Estate Analysis Documents				
Real Estate Planning Documents				
Planning by Non Federal Sponsor	$37,800	$9,450	$44,058	$11,014
Real Estate Acquisition Documents				
Acquisitions by Sponsor	$3,024,000	$756,000	$3,524,609	$881,152
Review of Sponsor	$94,500	$23,625	$110,144	$27,536
Real Estate Condemnation Documents				
Condemnations by Sponsor	$0	$0	$-	$-
Review of Sponsor	$0	$0	$-	$-
Real Estate Appraisal Documents				
Appraisals by Sponsor	$945,000	$189,000	$1,101,440	$220,288
Review of Sponsor	$94,500	$18,900	$110,144	$22,029
Real Estate PL 91-646 Asst. Documents				
PL 91-646 Asst. by Sponsor	$0	$0	$-	$-
Review of Sponsor	$0	$0	$-	$-
Real Estate Payment Documents				
Payments by Local Sponsor (Fee)	$1,814,459	$362,892	$2,114,834	$422,967
Payments by Sponsor (PL 91-646)	$0	$0	$-	$-
Review of Sponsor	$0	$0	$-	$-
Real Estate LERRD Credit Documents	$37,800	$7,560	$44,058	$8,812
Total Admin & Payments	**$6,048,059**		**$7,049,287**	
Total Contingencies		**$1,367,427**		**$1,593,798**
GRAND TOTAL	**$7,415,486**		**$8,643,085**	

TABLE 2C REAL ESTATE COST ESTIMATES - PROJECT IMPLEMENTATION CHACON CREEK FLOOD DAMAGE REDUCTION & ECOSYSTEM RESTORATION LAREDO, TEXAS (2A & 2B GRAND TOTALS)			
YEAR	**ITEM DESCRIPTION**	**VALUE**	**CONTINGENCY**
2010	**Total Admin & Payments**	$13,639,957	
	Total Contingencies		$2,898,127
	GRAND TOTAL	$16,538,084	
2018	**Total Admin & Payments**	$16,401,000	
	Total Contingencies		$3,478,600
	GRAND TOTAL	**$19,879,600**	

RELOCATION ASSISTANCE PROGRAM P.L. 91-646

Current plans indicate that Chacon Creek will have an estimated 60 residential relocations. For the purposes of this report, the maximum cap of $37,000 ($34,000 relocation + $3,000 moving) is estimated for each household for relocation and moving (relocation assistance values are based on 2018 adjusted rates in accordance with Federal Housing Administration guidelines). This will allow some flexibility to address Housing of Last Resort.

MINERAL AND TIMBER ACTIVITY

There is no known mineral exploration currently existing in the Laredo area. Because of the suburban location, the mineral estate is deemed to have a very nominal value. It is most likely that mineral rights have long ago been severed from surface ownership and are highly fractionalized. For those reasons, no minerals will be acquired for this project. The ecosystem restoration will need to protect the surface. An assessment of need for restriction on third party minerals to be addressed later.

In addition, no merchantable timber is present on the lands to be acquired.

NON-FEDERAL SPONSOR'S CAPABILITY TO ACQUIRE LERRD

The local sponsor, City of Laredo is responsible for acquiring LERRD. A checklist prepared in accordance with Chapter 12 of ER 405-1-12 is attached. The local sponsor is aware of the requirements of PL 91-646, as amended, and the requirements for documenting expenses for credit purposes, and will keep an accurate accounting of all fees incurred

The local sponsor has also been advised of the risks associated with acquiring LERRD before execution of the PPA. The Corps will work with the sponsor throughout the project, to the extent appropriate and allowable; to ensure that there is understanding of the Federal real estate principles. Action will also be taken to address any policy issues that could significantly impact the project.

Further, in fulfilling its responsibility for acquiring LERRD, the City of Laredo has full eminent domain power for all of the land required for the project, and is prepared to attain the property through exercise of condemnation proceedings. The City has prepared a memo related to its legal ability and willingness to clear title in this manner in the event an agreement is not reached through property negotiations (see the Memorandum of the City Attorney's Legal Opinion, dated August 9, 2018, following page 11 herein.

DISCUSSION OF EXECUTIVE ORDER

On June 23, 2006, the President issued an Executive Order (EO) titled: Protecting the Property Rights of the American People. The EO is aimed at restricting use of eminent domain for "advancing the economic interests of private parties." It is specific to actions of the Federal Government, and allows takings for public use with just compensation for purposes benefiting the general public. But, it is noted that while many specific purposes are exempted from the restrictions of the EO, flood damage reduction is not. The applicability of the EO to cost-shared projects wherein LERRD is acquired by the non-Federal Sponsor with non-Federal funds is also not clear. Condemnation actions for purposes of clearing title are allowed under the order. The EO states that the Department of Justice is to issue further guidance, but such has not yet been forthcoming. This REP is written under the premise that the non-Federal Sponsor may exercise eminent domain for the flood damage reduction purposes of this project due to failure to reach a reasonable agreement on a negotiated purchase under the normal, long-standing procedures established by the Department of the Army and other Federal agencies.

ZONING ORDINANCES

There are no special Zoning Ordinances proposed for enactment with the project.

MILESTONES FOR REAL ESTATE ACQUISITION

The schedule reflects a realistic implementation timeframe beginning with the anticipated date of FY 2011 for execution of the PPA between the Fort Worth District and the City of Laredo. The schedule assumes the availability of funds and the availability of Federal funding throughout project implementation. The anticipated schedule is as follows:

TABLE 3
REAL ESTATE MILESTONE SCHEDULE
FOR
CHACON CREEK
FLOOD DAMAGE REDUCTION AND ECOSYSTEM RESTORATION PROJECT

ACTIVITY	COE INITIATE	COE COMPLETE	LS INITIATE	LS COMPLETE
Transmittal of ROW drawings to LS with instruction to acquire LERRD	--	1 Oct 2019	--	--
Conduct landowner meeting	--	--	--	15 Nov 2019
Prepare mapping and legal descriptions	--	--	1 Oct 2019	31 Dec 2019
Review mapping and legal descriptions	5 Jan 2020	15 Jan 2020	--	--
Obtain title evidence	--	--	5 Jan 2020	1 Mar 2020
Review title evidence	--	--	5 Jan 2020	15 Mar 2020
Obtain tract appraisals	--	--	5 Jan 2020	15 Mar 2020
Review tract appraisals	30 Mar 2020	30 Oct 2020	--	--
Conduct negotiations	--	--	30 Oct 2020	28 Feb 2020
Perform closings	--	--	15 Nov 2020	30 Apr 202021

Perform condemnations	--	--	7 Jan 2021	15 Jun 2021
Certify availability of LERRD	1 Jul 2021	20 Jul 2021	15 Jul 2021	31 Oct 2021
Complete PL 91-646 benefit assistance	--	--	15 Jul 2021	1 Jan 2022
Review PL 91-646 payments	1 Jan 2022	1 Mar 2022	--	--
Prepare and submit credit requests	--	--	1 Nov 2022	30 Nov 2022
Review credit requests	1 Dec 2022	30 Dec 2022	--	--
Approve or deny credit requests	5 Jan 2023	1 Feb 2023	--	--
Establish value of LERRD credit in accounting records	1 Feb 2023	15 Feb 2023	--	--

RELOCATIONS OF UTILITIES OR FACILITIES

No road or utility relocations are known at this time.

LANDS CONTAINING HAZARDOUS WASTE

None of the project LERRD's are known to contain hazardous, toxic or radiological waste (HTRW). However, the TSP may result in hazardous materials impacts during the demolition and disposal of residential structures and excavation of potentially contaminated soil. Protection of the environment, nearby populations, and project construction workers will be required during these actions. These impacts would be temporary, however, and removal of hazardous materials from the area would be beneficial for existing and proposed projects in the region.

OPPOSITION BY LANDOWNERS IN PROJECT AREA

There have been no public meetings held on this project, therefore landowners concerns are not known.

OTHER REAL ESTATE ISSUES

No other issues relevant to the planning, design, or implementation of this project are known.

Reviewed and approved by:

____

Hyla J. Head
Chief, Real Estate Division

CITY OF LAREDO
Office of the City Attorney

August 9,2018

OPINION

SUBJECT: Legal Authority to Acquire Land for the Chacon Creek Flood Damage Reduction

REQUESTED BY: John Porter,
Director, Environmental Services Department

PREPARED BY: Kristina K. Laurel Hale dW
City Attorney

Question Presented

You have asked this office to provide a response as to whether the City of Laredo is able and willing to acquire the lands, easements, right of way, relocating, and disposal (LERRD) required for the Chacon Creek Flood Drainage Reduction and Ecosystem Restoration Project ("Project").

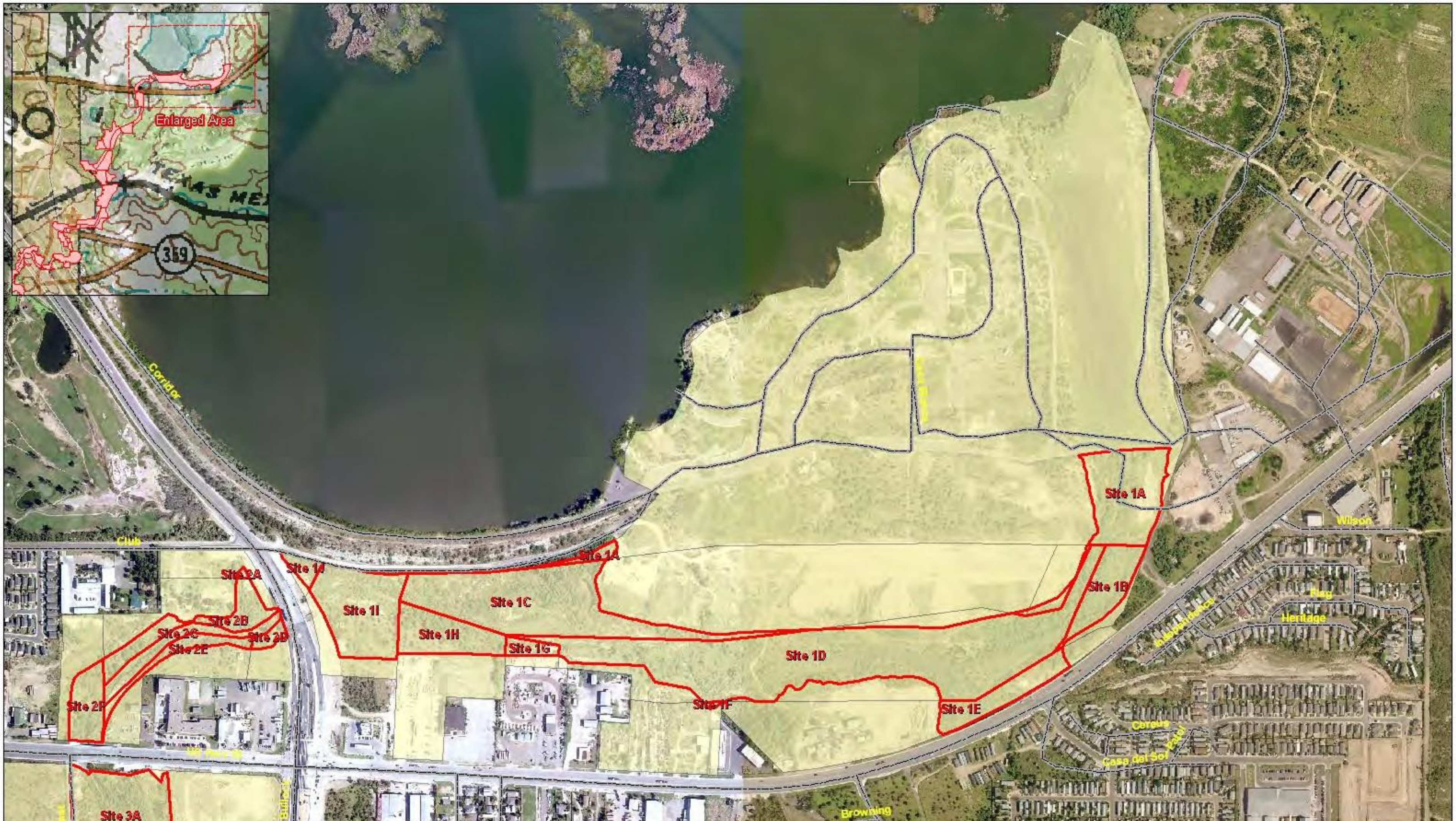
Background

The City of Laredo, as local sponsor, is responsible for acquiring the land needed for this Project located in the Rio Grande Watershed above Falcon Dam that seeks to prevent flooding and ecosystem degradation. As such, the City of Laredo must demonstrate that it is prepared to attain the property through condemnation in order to clear title in the event an agreement is not reached under the procedures established by the Department of the Army and other federal agencies.

Answer

As a public entity, the non-federal sponsor, City of Laredo, has full eminent domain power for all of the land required for the Project that is not limited to the authority of Chapter 2206 of the Texas Government Code and Section(s) 251.001 and 552.103 of the Texas Local Government Code. The City of Laredo further possesses the adequate fmancial capability and experience to handle the real estate acquisitions. When a buyout plan is implemented, the City of Laredo will proceed to provide tract appraisals for all lands required for the Project to be made available to the federal government for a review of the compliance with appraisal standards and for crediting purposes. The City of Laredo has an experienced real estate and legal staff who will handle all aspects of the condemnation proceedings for the acquisition of land that was not obtained through negotiations. The City of Laredo shall further keep an accurate accounting of all fees incurred and will at all times fully cooperate with the federal government as it monitors all real estate activities associated with the project.

Please do not hesitate to contact me with any additional questions or concerns.



US Army Corps of Engineers
Fort Worth District

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 1

Study Area Parcels
Complete Parcels

Feet
0 250 500 1,000 1,500 2,000 2,500

N
S

US Army Corps of Engineers
Fort Worth District

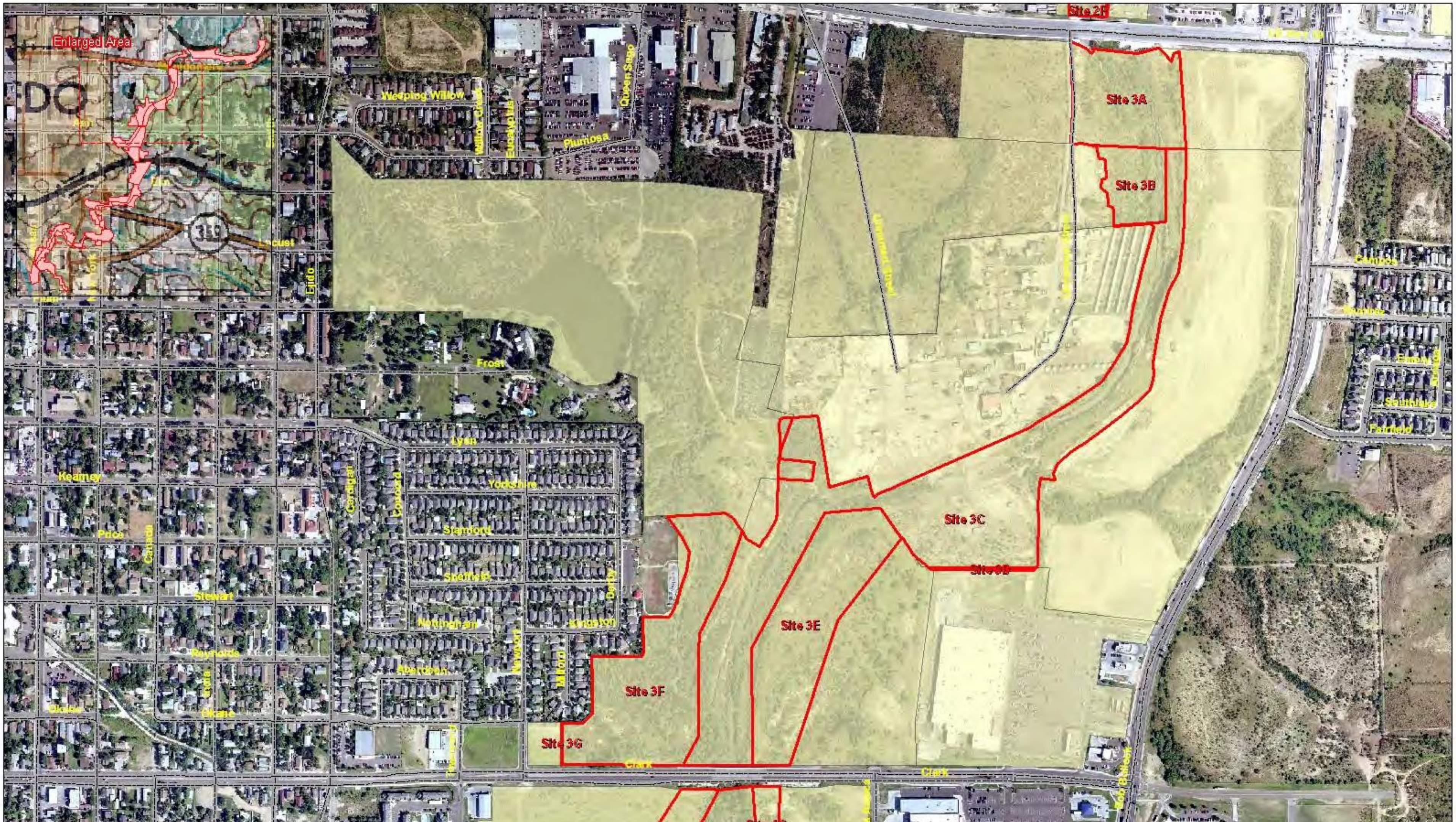
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 2

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S



US Army Corps of Engineers
Fort Worth District

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Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 3

Study Area Parcels   Complete Parcels

Feet
0 250 500 1,000 1,500 2,000

N
S

US Army Corps of Engineers
Fort Worth District

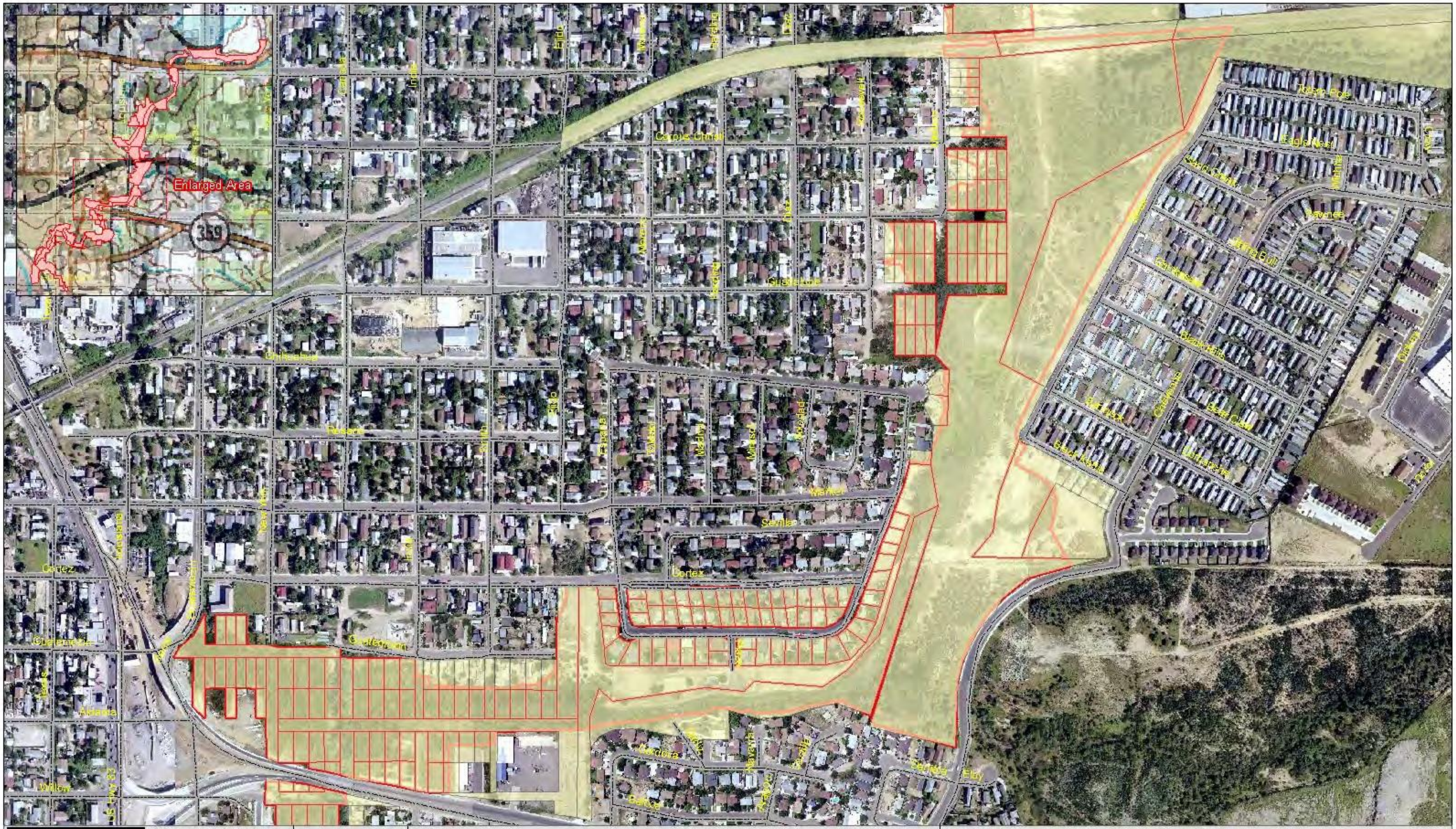
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 4

Study Area Parcels
Complete Parcels

Feet
0 250 500 1,000

N
S



US Army Corps of Engineers
Fort Worth District

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For more information contact the Fort Worth District Planning Office.

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept. Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Complete View

Study Area Parcels
Complete Parcels

Feet
0 250 500 1,000 1,500

N
S

US Army Corps of Engineers
Fort Worth District

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Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Top View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S

US Army Corps of Engineers
Fort Worth District

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Top Middle View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S

US Army Corps of Engineers
Fort Worth District

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Middle View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S

US Army Corps of Engineers
Fort Worth District

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept. Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Bottom Middle View of Site

Study Area Parcels | Complete Parcels

Feet
0 50 100 200 300 400 500

N
S

US Army Corps of Engineers
Fort Worth District

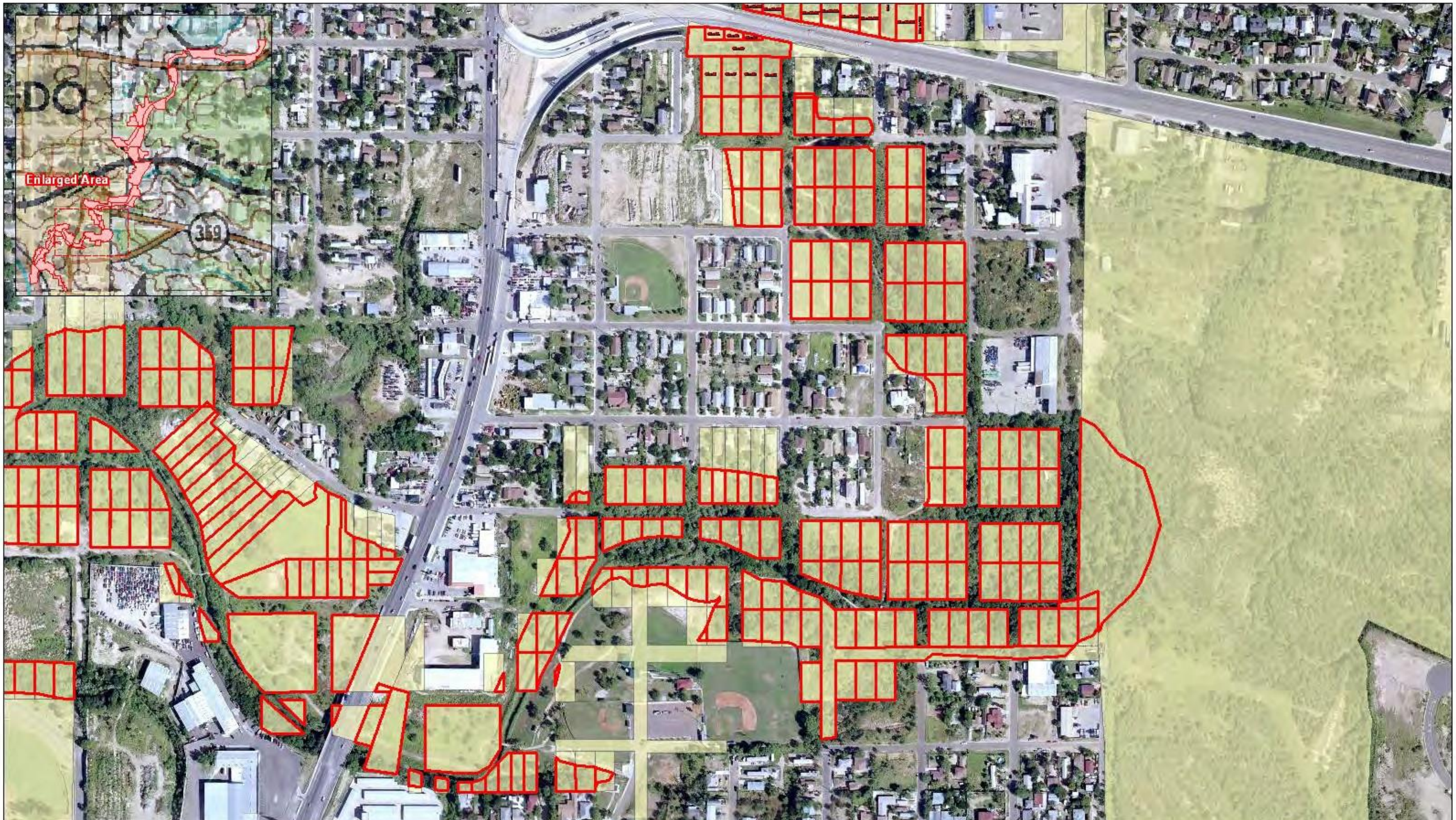
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 5 - Bottom View of site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S



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Fort Worth District

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Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 6

Study Area Parcels
Complete Parcels

Feet
0 250 500 1,000 1,500

N
S

US Army Corps of Engineers
Fort Worth District

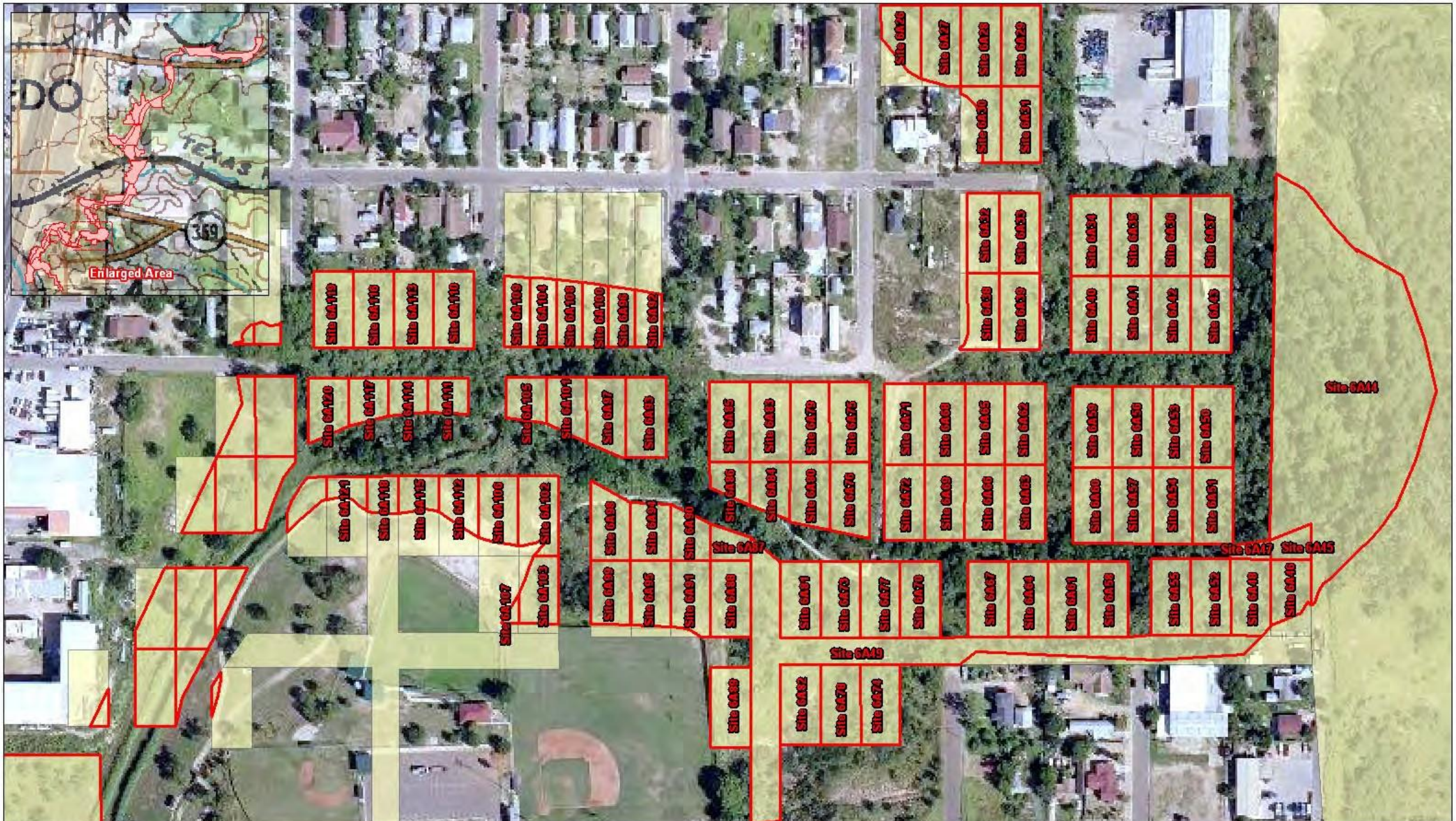
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 6 - Top View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S



US Army Corps of Engineers
Fort Worth District

Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 6 - Middle View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S

US Army Corps of Engineers
Fort Worth District

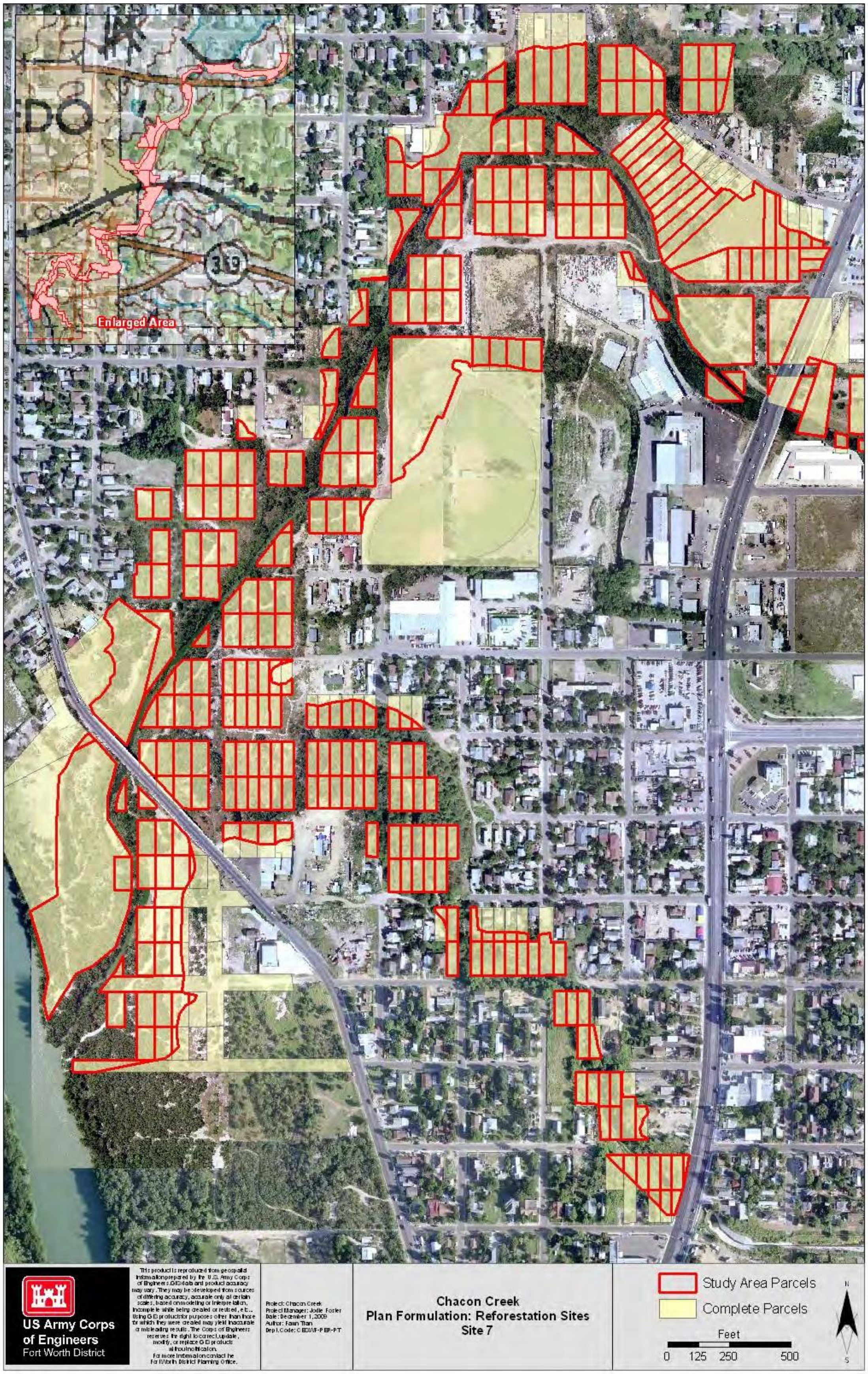
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 6 - Bottom View of Site

Study Area Parcels
Complete Parcels

Feet
0 50 100 200 300 400 500

N
S


Enlarged Area
359
US Army Corps
of Engineers
Fort Worth District
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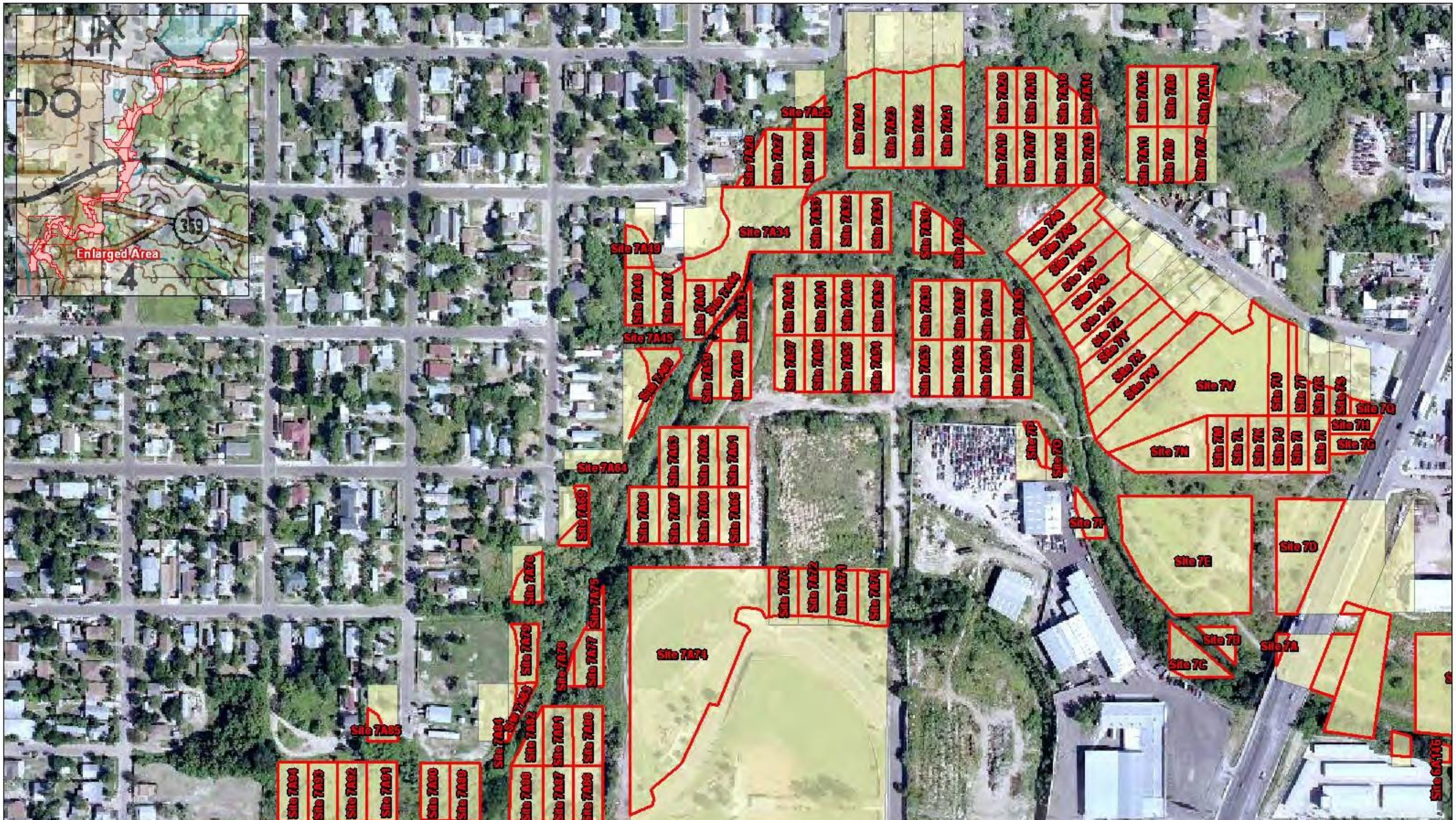
For more information contact the Fort Worth District Planning Office.
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept. Code: CESWF-PER-PT
Chacon Creek
Plan Formulation: Reforestation Sites
Site 7
Study Area Parcels
Complete Parcels
Feet
0 125 250 500
N
S



US Army Corps of Engineers
Fort Worth District

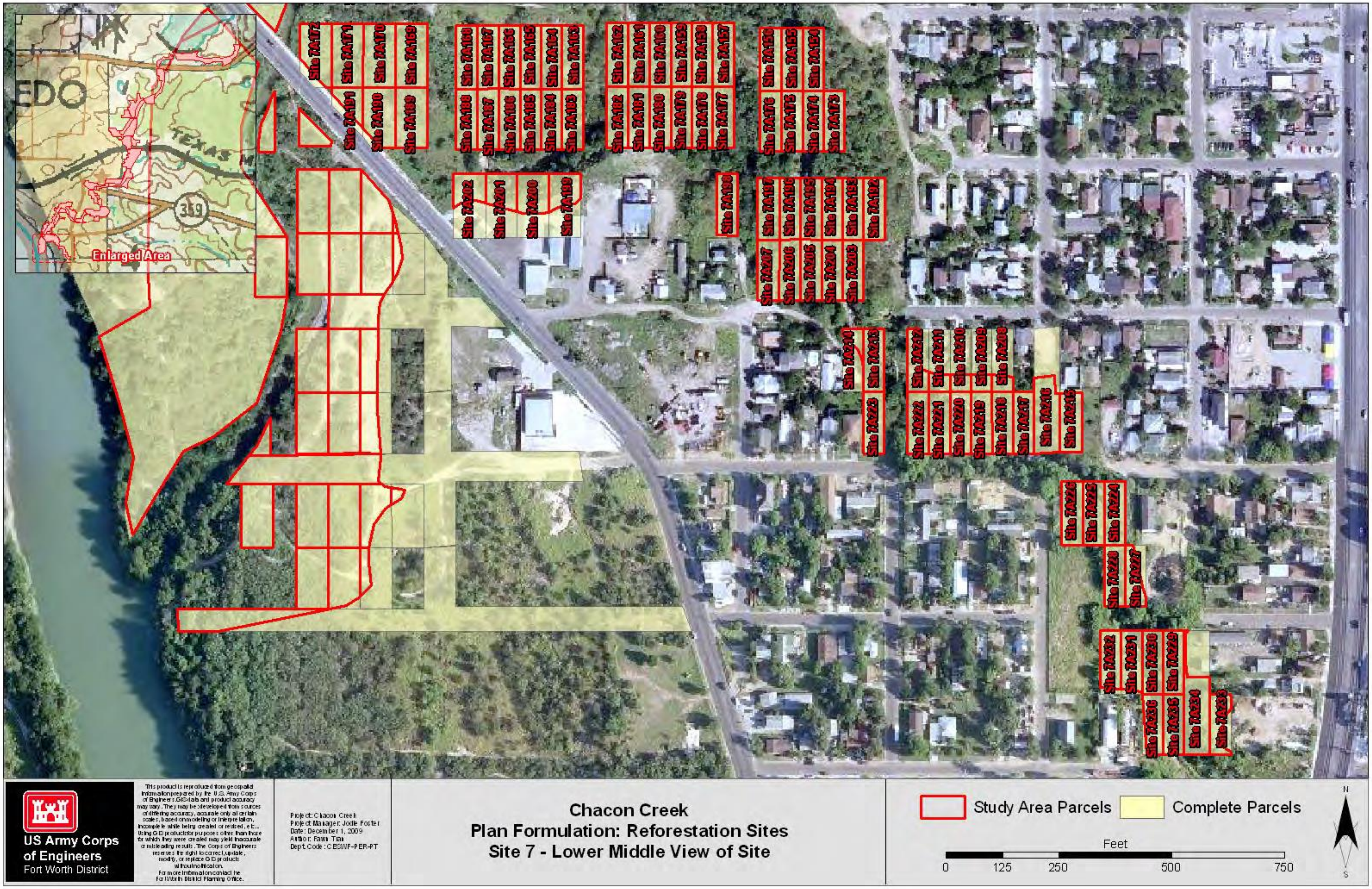
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept Code: CESWF-PER-PT

Chacon Creek
Plan Formulation: Reforestation Sites
Site 7 - Top View of Site

Study Area Parcels
Complete Parcels

Feet
0 125 250 500 750 1,000

N
S


Enlarged Area
US Army Corps of Engineers
Fort Worth District
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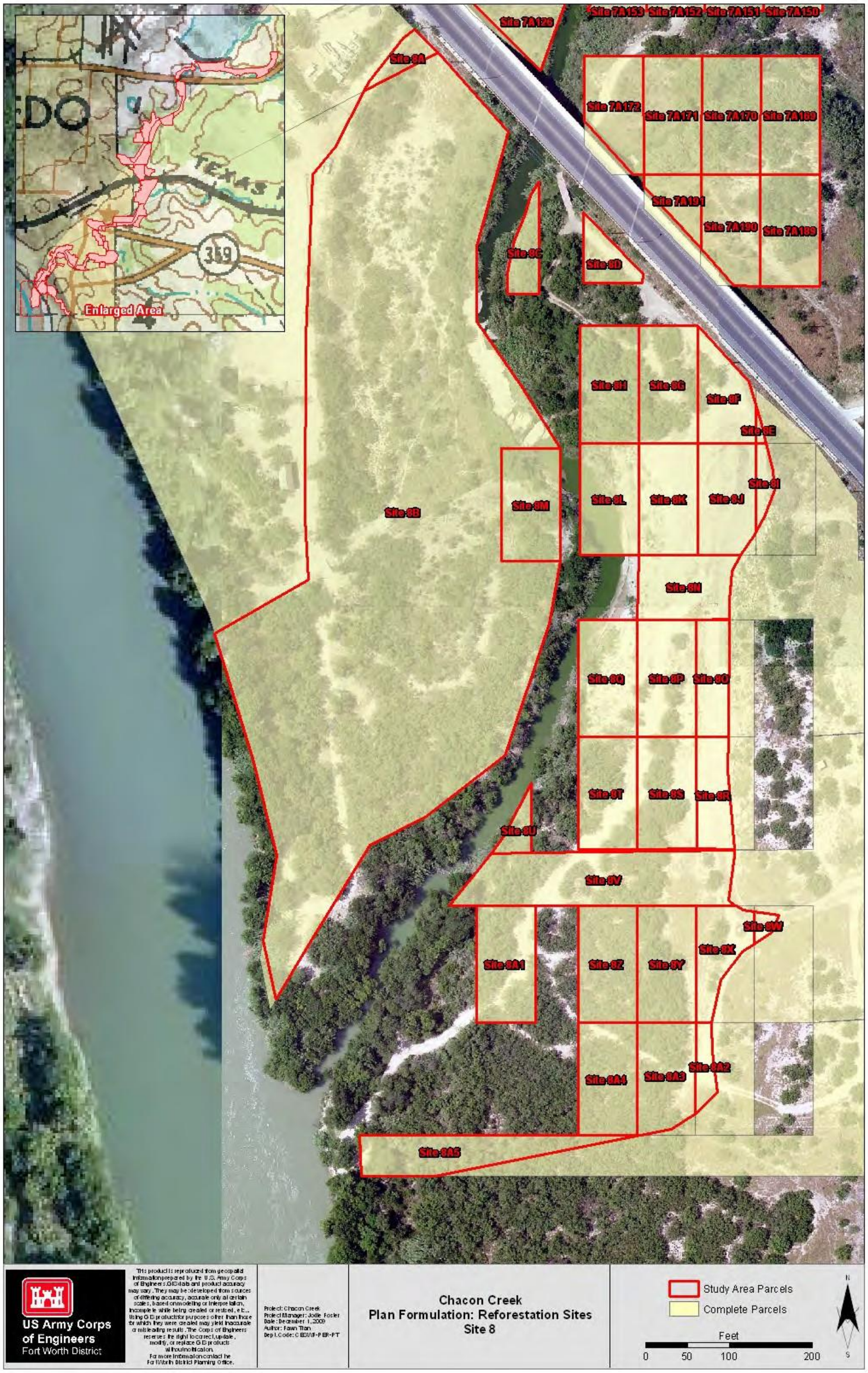
For more information contact the Fort Worth District Planning Office.
Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tian
Dept Code: CESWF-PER-PT
Chacon Creek
Plan Formulation: Reforestation Sites
Site 7 - Lower Middle View of Site
Study Area Parcels
Complete Parcels
Feet
0
125
250
500
750
N
S


Site 7A126
Site 7A153
Site 7A152
Site 7A151
Site 7A150
Site 8A
Site 7A172
Site 7A171
Site 7A170
Site 7A169
Site 7A191
Site 7A190
Site 7A189
Site 8C
Site 8D
Enlarged Area
Site 8H
Site 8G
Site 8F
Site 8E
Site 8I
Site 8B
Site 8M
Site 8L
Site 8K
Site 8J
Site 8N
Site 8Q
Site 8P
Site 8O
Site 8T
Site 8S
Site 8R
Site 8U
Site 8V
Site 8W
Site 8X
Site 8A1
Site 8Z
Site 8Y
Site 8A2
Site 8A4
Site 8A3
Site 8A5
US Army Corps of Engineers
Fort Worth District
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Project: Chacon Creek
Project Manager: Jodie Foster
Date: December 1, 2009
Author: Fawn Tran
Dept. Code: CESWF-PER-PT
Chacon Creek
Plan Formulation: Reforestation Sites
Site 8
Study Area Parcels
Complete Parcels
Feet
0 50 100 200
N
S

APPENDIX E

USFWS COORDINATION

E.1 Planning Aid Letter

E.2 Biological Assessment

APPENDIX E

USFWS COORDINATION

INTRODUCTION

In accordance with the Fish and Wildlife Coordination Act, 1958, the Corps of Engineers is required to consult with the U.S. Fish and Wildlife Service to develop measures to mitigate project-related losses of fish and wildlife resources. To initiate coordination with USFWS, in 2008 the Corps requested a review of the “Existing Conditions Report for Chacon Creek Floodway,” dated February 2007.

This appendix contains a copy of the Planning Aid Letter subsequently received from the U.S. Department of the Interior, Fish and Wildlife Service Ecological Services, dated May 2010.

The appendix also includes a current Biological Assessment dated April 2018.

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APPENDIX E.1

PLANNING AID LETTER AND CORRESPONDENCE

United S ates Department of the Interior

FISH AND WILDLIFESERVlCE
Ecological Services
do TAMU-CC. Campus Box 338
6300 Oce;J.1D1 rive
Corpus Christi, Texas 78112

May I0, 2008

Jodie Foster
Project Manager
U.S. Army Corps of Engineers
Fort W011h District
819 Taylor Street
Fott Worth, TX 76102

Consultation No. 21410-2010-1-0283

Dear Mr. Foster:

Enclosed is the U.S. Fish and Wildlife Service's (Service) Planning Aid Report in accordance with the Fish and Wjldlife Coordination Act guidelines. We have incorporated all the U.S. Arm Corps of Engineers (USACE) comments on the draft repo1t submitted in April, 2010. Based on the review of proposed project materials and documents, we recommend thrt the USACE prepare a Biological Assessment in accordance with section 7 oftj1e Endangered Species Act of I973. as amended (16 U.S.C. §1531 et seq.) to address temPiorary adverse impacts to the endangered ocelot *(Leopardus pardalis)* and endangered Gulf Coast jaguanmdj *(Fe/is yagouaroundi cacomitli)* that may use the project area as a travel corridor, and may be affected during construction and maintenance phases of the project. The Service acknowledges, as addressed in the Planning Aid Repo11, that pro osed project components will also have the capacity to create benefits to ocelot and jaguanmcli habitat by increasing access to water, increasing plant diversity, and increasing prey base species availability.

Please address any comments or questions on the final document to Dr. Larisa Ford. The Service is available to assist Ms. Hope Pollman with the development of the Biological Assesment and can provide some basic information for her use. Dr. Larisa Ford can be contacted at 361-994-9005 (office), 36l-533-2797 (cell) or by email at larisa_ford@.fws.gov.

Sincerely,

llan M. Strand
Field Supervisor

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PLANNING
AID REPORT

Flood Risk Management and Restoration Project for Chacon Creek, Laredo, Webb County, Texas

Consultation Number: 21410-2010-I-0283

Submitted by:

Larisa Ford, PhD, MPA
Senior Fish and Wildlife Biologist

U.S. Fish and Wildlife Service
Corpus Christi Ecological Field Services Field Office
Corpus Christi, Texas

Submitted to:

U.S. Army Corps of Engineers-Fort Worth District
Forth Worth, Texas

April, 2010, Revised May 2010

EXECUTIVE SUMMARY

The purpose of the proposed project is to provide environmental restoration and flood control within the Chacon Creek watershed. The removal of vegetation, rapid urban development, alteration of flows, and invasion of exotic species affect both terrestrial and aquatic habitats in the lower Chacon Creek floodway. This proposed project is located in the City of Laredo, Webb County, Texas in the Lower Chacon Creek watershed.

A Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1980, 1981) analysis was used to evaluate the suitability of existing riparian and wetland habitats for wildlife within the proposed project area, and to quantify the amount of habitat currently available. In general, habitat suitability was less than optimal as assessed by each of the selected models. The absence of measurable surface water flows during portions of the year, lack of emergent vegetation, low water clarity, lack of riffles, and sparse cover in all vegetation strata in portions of the upland areas contribute to low habitat suitability for species evaluated.

The project goal for ecosystem restoration is to provide a diverse and viable ecosystem for Chacon Creek while improving the suitability and quality of the habitat in the proposed project area in a manner that is sustainable and enhances the natural systems within the Chacon Creek corridor. The restoration plan, proposed by the U.S. Army Corps of Engineers (USACE) includes measures to: (1) remove urban waste, (2) reduce flood damages, (3) create natural vegetative buffers for storm water filtration, (4) create, modify, and enhance wetlands, (5) revegetate areas with native plant species, and (6) construct riffle areas within the stream in riparian zones. A component of this project also provides for demolishing existing recreational facilities (soccer field, playgrounds, etc…) and constructing recreational facilities into already disturbed areas. Unlighted foot trails are also planned for recreational use. As a result, the proposed project would restore and enhance natural areas that serve as travel corridor habitat for the Federally-listed, endangered ocelot (*Leopardus pardalis*) and Gulf coast jaguarundi (*Herpailurus yagouaroundi cacomitli*).

Purpose of Project

The purpose of the proposed project is to alleviate flooding within the City of Laredo and restore aquatic and riparian habitat within the Chacon Creek watershed. In addition, recreational opportunities will also be enhanced by the proposed project.

Historical flooding within the Chacon Creek watershed has resulted in significant property damage within the City of Laredo. The extensive flooding that occurred in 2007 resulted in the damage of 68 homes and also the loss of a human life, the first flooding death in the City of Laredo's history. Continued urban growth has exacerbated flooding along Chacon Creek. This increase in flood waters has exacerbated stream bank erosion resulting in loss of riparian habitats, increase in water turbidity, and the degradation of water quality. Alleviating flooding in the proposed project area will reduce erosion and stabilize hydrological functions in the project area. Alternatively, modifying stream characteristics to allow for increased flow during the normal extended periods of low water flow will help improve water quality and overall health of the aquatic ecosystem downstream to the Rio Grande.

Introduction of invasive plant species has also contributed to the degradation of wildlife habitat in the proposed project area. Establishment of invasive species increases the potential for fires, threatens to alter soil characteristics, and decreases diversity of available vegetation types and associated wildlife species. Control and replacement of invasive species with native vegetation will increase available habitat and improve wildlife diversity (USACE 2010).

The project goal for ecosystem restoration is to provide a diverse and viable ecosystem for Chacon Creek while improving the suitability and quality of the habitat in the study area in a manner that is sustainable and enhances the natural systems within the Chacon Creek corridor. The restoration plan, proposed by the U.S. Army Corps of Engineers (USACE) includes measures to: (1) remove urban waste, (2) reduce flood damages, (3) create natural vegetative buffers for storm water filtration, (4) create, modify, and enhance wetlands, (5) revegetate areas with native plant species, and (6) construct riffle areas within the stream in riparian zones. A component of this project also provides for retaining existing recreational facilities and expanding some recreational components into already disturbed areas. Unlighted foot trails are also planned for recreational use. Vehicle access to the trails will be limited for maintenance of the associated restoration sites, and access for emergency responders. Routine vehicle access will be provided on the trails (USACE 2010). Although not considered in standard habitat assessment methods, recovery goals for federally-listed species will be advanced by the proposed project. This project would restore and enhance natural areas that serve as travel corridor habitat for the Federally-listed, endangered ocelot (*Leopardus pardalis*) and Gulf coast jaguarundi (*Herpailurus yagouaroundi cacomitli*).

General Description of the Project Area

The project area is located in south-central Texas, approximately 120 miles south of San Antonio, in Laredo, Webb County, Texas. Laredo is located on the northern border of the Rio Grande River. Located in the eastern half of the city, Chacon Creek, originates north of Lake Casa Blanca and flows about six miles to the south and west emptying into the Rio Grande (Figure 1).

Chacon Creek provides some flood control for the city, but it is also a local natural resource with recreational, educational, and economic potential (USACE 2010). The stream has been adversely impacted by illegal dumping, urban expansion, invasive species introduction, extended droughts and periodic flooding. The project area is located on Chacon Creek downstream of Lake Casa Blanca in the portion of the stream that falls within the 500 year floodplain (~1310 acres). The stream exhibits low surface water flows (<5 cubic feet per second (cfs)) through much of the project area.

Development east of Chacon Creek and along the stream's eastern tributaries has impacted the watershed. A majority of the proposed project area is bordered by residential and commercial development, as well as the Laredo International Airport, much of which are within the 100 year floodplain. Lake Casa Blanca was created by the impoundment of Chacon Creek in 1951 for the purposes of water retention

Figure 1: Proposed Project Area for Laredo Flood Control Project (USACE 2010)

and to provide recreational opportunities. The dam is a large, earthen structure (impoundment capacity of 77,838 acre-feet). A spillway is located northeast of the dam's left abutment and a second, emergency spillway is located near the right abutment of the dam. A large portion of the upper watershed east of the stream and lake remains relatively undeveloped. However, the proposed project corridor is predominated by riparian vegetation adjacent to a narrow stream, with small open-water wetlands, but is highly disturbed (USACE 2010).

Within the proposed project area, there are four major bridges that cross Chacon Creek: Highways 359, 83, 59 and the Texas-Mexico Railroad. There are also three detention ponds within the stream's basin which were constructed to mitigate flooding. One of these ponds is located in the Los Presidentes area, the second pond is located just south of Chacota Street, adjacent to the Zachery Elementary School, and the third pond is located east of Ejido Street and includes a concrete channel between Louisiana Street and Pine Street to improve hydraulic functions (USACE 2010).

There are two main soil types found within the Chacon Creek watershed: Tela Sandy Clay Loam and the Rio Grande Very Fine Sandy Loam. Both of these soil types are well drained and moderately permeable. Five other subsidiary soil types are found throughout the proposed project area, includingCopita Fine Sandy Loam, Jimenex-Quemado Complex, Lagloria Silt Loam, Maverick-Catarina Complex, Verrick fine sandy loam (USACE 2010, Carter Burgess 2001).

The main sources of water for the project area and the City of Laredo are the Rio Grande and Lake Casa Blanca. Groundwater resources are limited throughout Webb County. Direct water quality measurements are not available for Chacon Creek, however; there is substantial illegal dumping, urban development, and storm water runoff that generally contributes to degradation of water quality. Non-point source (NPS) pollution is known to affect Rio Grande water quality. The Texas Commission on Environmental Quality (TCEQ) assessed the water quality of the Rio Grande downstream from International Bridge #2, near the confluence of Chacon Creek, and reported that recreational use or fish consumption are not supported due to elevated levels of fecal coliform bacteria (USACE 2010).

The proposed project area is located in the Tamualipan Biotic Province. This province represents a mixture of neotropical, Austroriparian and southwestern species and is generally considered to have greater species diversity than any other province in Texas (Blair 1950).

Aquatic organisms that commonly occur in the creek include inland silversides (*Menidia beryllina*), western mosquitofish (*Gambusia affinis*), salfin mollies (*Poecilia latipinna*), blacktail shiners (*Cyprinella venusta*), and gizzard shad (*Dorosoma cepedianum*). During a 2006 study, all sites investigated along

Chacon Cree were dominated by insectivorous fish species. Species considered intolerant to limited water conditions were not collected at any sites (FWS 2006).

Although specific records in and adjacent to Chacon Creek are not available, common snakes in the South Texas Plains include the checkered garter snake (*Thamnophis marcianus*), diamondback water snake (*Nerodia rhombifera*), Mexican racer (*Coluber constrictor oaxaca*), Texas glossy snake (*Arizona elegans*), western diamondback rattlesnake (*Crotalus atrox*), and the Texas indigo snake (*Drymarchon corais*). Common lizards of the South Texas Plains include the blue spiny lizard (*Sceloporus cyanogenys*), southern prairie lizard (*Sceloporus undulatus consobrinus*), Texas banded gecko (*Coleonyx brevis*), Texas spiny lizard (*Sceloporus olivaceus*), Texas spotted whiptail (*Cnemidophorus gularis*) and a closely related whiptail lizard (*Cnemidophorus laredoensis*). Slider turtles (*Trachemys scripta*) are also known to be common in the area (Walker 1986, USACE 2010, Carter Burgess 2001).

A variety of birds have been documented, by several sources, within the proposed project area and in the vicinity of the City of Laredo. Several species of doves, sparrows, herons, egrets, grackles and waterfowl have been observed in the area. Common birds in and near Chacon Creek include: ltimira oriole (*Icterus gularis*), Chachalaca (*Ortalis vetula*), green jay (*Cyanocroax yncas*), blue jay (*Cyanocitta cristata*), olive sparrow (*Arremonops rufivirgatus*), road runner (*Geococcyx californianus*), scaled quail (*Callipepla squamata*), and white-tipped dove (*Leptotila verreauxi)* (USACE 2010). In addition, the great kiskadee (*Pitangus sulphuratus)*, the red-winged blackbird (*Agelaius phoeniceus*), the golden fronted woodpecker (*Melanerpes aurifrons*), the white-collared seedeater (*Sporophila torqueola*), and the scissor-tailed flycatcher (*Tryannus forticatus*) have been observed in the vicinity (Pulich and Dellinger 1980, Woodin et al. 1998; Carter Burgess 2001).

Several mammals have been observed in the project vicinity including the eastern fox squirrel (*Sciurus niger*), the nine-banded armadillo (*Dasypus novemcinctus*), various dogs and coyotes (*Canis* sp.) and a variety of rodents (Cater Burgess 2001).

Special status species affects such as federally listed species, refers to the proposed project’s ability to provide a significant contribution to some key life requisite of a special status species. There are several federal and state listed threatened and endangered species in Webb County. Several species listed as threatened or endangered, including Ashy dogweed, Johnston’s frankenia, and the interior least tern, utilize similar habitats found within the proposed project area, but none of these species are known to still occur in the project area. However, two federally listed cats, the ocelot (*Leopardus pardalis*) and the Gulf Coast jaguarundi (*Herpailurus yagouaroundi cacomitli*), could exist in the Chacon Creek corridor.

Listed in 1972, historical records indicate that the ocelot once occurred throughout south Texas, the southern Edwards Plateau, and along the Coastal Plain. Today, its range is the south Texas brush country and lower Rio Grande valley, although unconfirmed sightings have been reported west of Chacon Creek in Maverick County, Texas. Ocelots are endangered because their habitat (including riparian shrubland) has been cleared for farming and urban expansion. Only about 30 to 35 Ocelots live in the shrublands remaining at or near the Laguna Atascosa National Wildlife Refuge near Brownsville, Texas (located approximately 160 miles southeast of Laredo). Recently, it was estimated that a total of approximately 50 individuals lived in Texas (FWS 2010).

Listed in 1976, the jaguarundi is so elusive that researches have not been able to estimate how many are left in the wild. Like the ocelot, the jaguarundi is found in dense, thorny shrublands. Jaguarundis are endangered because the dense brush that provides habitat has been cleared for farming or for the growth of cities. Jaguarundis still exist in Mexico, but they are now very rare in Texas. It is found in the south Texas brush country and lower Rio Grande valley, although unconfirmed sightings have been reported near San Antonio (located approximately 140 miles northeast of Laredo) and west of Chacon Creek in Maverick County, Texas (FWS 2009).

The 2007 Existing Conditions Report for Chacon Creek Floodway identified the proposed project area as low quality habitat for the ocelot and jaguarundi, but also stated the potential for these cats to migrate through the project area near the Rio Grande. The Fish and Wildlife Service (Service), in the 2008 site visit report, referred to the project area as a potential travel corridor habitat for the federally-listed ocelot and jaguarundi. Habitat suitability for the ocelot and jaguarundi could be improved with the restoration of riparian shrubland and by reconnecting the riparian corridor of the Chacon Creek watershed with the Rio Grande.

Specific Habitat Types within Project Area

Riverine: Six miles of relatively narrow stream and a few wider open water areas make up the specific project area. The water depth ranges from approximately 0.1 to 4 feet. Water quality parameters have not been measured in the project area. The emergent vegetation associated with the creek varies considerably among stretches. Some stretches have little to no emergent vegetation along their shorelines, and others have 100 % cover of emergent vegetation.

Riparian: Five riparian areas were delineated in the project area. These areas are characterized as being suitable for the American coot (*Fulica americana*), belted kingfisher (*Megaceryle alcyon*), eastern cottontail (*Sylvilagus floridanus*), and slider turtle. Riparian areas have standing or flowing water during most of the year. In some area, cattails are predominant.

Wetland: Three areas considered palustrine wetlands also occur in the project area. They are characterized by some herbaceous emergent vegetation along the channel edges and persistent stems of inundated woody vegetation within areas of open water. Although these high value aquatic habitats persist in the project area, apparent poor water quality, anthropogenic disturbance, scouring during high flows, sedimentation and infestation of invasive species have contributed to their degradation.

Mesquite (Prosopis gladulosa)-Mixed Shrub-Buffelgrass (Pennisetum ciliare) Shrubland: Almost the entire project area is characterized as this type of habitat type. Approximately 151 acres of buffelgrass occurs along Chacon Creek project area within the floodplain. Buffelgrass is still being cultivated as "superior" forage for cattle. These plants can alter fire regimes and out-compete native plant species.

Sugarberry (Celtis laevigata) –Mexican Ash (Fraxinus berlandieriana) Temporarily Flooded Forest: Sugarberry temporarily flooded forest typically occurs on alluvial sites of rivers or on low ridges of sloughs. The dominant overstay of this habitat consists of sugarberry (also known as hackberry) and Mexican ash. The project area supports only remnants stands of this habitat type, primarily in the middle of the project area.

Other Invasive species: The persistence of invasive plant species such as salt cedar (*Tamarix ramosissima*) and giant cane (*Arundo donax*) has significantly degraded the ecological function and habitat value for wildlife, as well as prevented the reestablishment of desirable native species. These invasive plants escaped from cultivated settings and proliferated. These plants will typically colonize newly disturbed areas and often form dense monotypic stands over wide areas and have little value to native wildlife. Salt cedar excretes salts collected from surrounding soils and deposits the salts under the tree and thereby creating a soil condition intolerable to other plant species.

Proposed Restoration Plan:

The following are planning objectives for the Laredo Flood Control Project for the period of analysis 2012-2062:

1. Proposed actions must use a multi-objective approach balancing the needs among flood damage reduction and ecosystem restoration.
2. Reduce flood damages to structures and their contents as well as vehicles.
3. Reduce the public and private costs associated with flood fighting and recovery.
4. Protect and restore aquatic and riparian habitat and open space for public use consistent with reduction of flood damages.
5. Improve the overall health, safety, and quality of life of the citizens of the City of Laredo, the State of Texas, and the United States of America.

6. Provide a diverse and sustainable ecosystem for Chacon Creek by restoring quality and/or increasing the quantity of aquatic, wetland, and riparian habitats, as well as, the federally-listed cats.
7. Provide for compatible recreational features and other quality-of-life enhancements.

The proposed plan includes elements for improving water quality, increasing cover of native herbaceous species, reducing erosion and turbidity, controlling invasive species, and enhancing riverine, riparian, and wetland habitats.

Riverine and Wetland Measures:
Three wetland areas will be created and/or enhanced totaling approximately 16.75 acres, representing an addition of 13.09 acres of wetlands. A weir would be constructed in the most upstream wetland area to raise surface water levels by two feet. A riffle will be constructed within the stream channel immediately downstream of the weir to prevent scouring and support the weir structure. This riffle structure will also enhance riverine habitat by adding oxygen to the water and provide positive changes to the habitat suitability in the area. An animal containment facility is located upstream from the proposed weir. Run-off from this facility adds excessive nutrients to the system. As part of the riparian measure, this facility will be removed from the project area. A second weir would be constructed downstream of the first weir at the second wetland area that would add approximately three feet of permanent water to the second wetland site. A supporting riffle structure would be constructed downstream from this weir as well. For the third wetland area, an off channel weir would be constructed that seasonally would add up to three feet of surface water to the site. As with the previous two wetland areas, a supporting riffle structure would also be constructed downstream from this weir. Extensive debris removal will also be conducted in this area. However, there are several desirable woody plant species in the area and impacts to these plants will be avoided and minimized.

Riparian Measure
The remaining portions of the project area were considered for riparian restoration, and include removal and control of invasive species, as well as riparian reforestation. Created and restored riparian areas will total approximately 401.12 acres.

Flood Risk Management
Flood risk management will be accomplished by purchasing structures within the more frequent flooding events and utilizing this already disturbed land for recreational amenities.

<u>Proposed Habitat Diversity and Value</u>

The USACE conducted habitat assessments and Habitat Evaluation Procedure (HEP) analyses to quantitatively assess the value of existing habitat and the potential of restored habitats under the proposed restoration plan. The HEP analyses specifically evaluated the impacts of the restoration project for the American coot, belted kingfisher, eastern cottontail, slider turtle (riparian), and red-winged blackbird (wetland). The results are summarized in Table 1 and indicate that each species would have an increase in the average annual habitat units (AAHUs) available if the restoration plan was completed. Currently, only 163.18 AAHUs are available to the riparian species within the project site. With the addition of the restored habitat, an additional 241.35 AAHUs would be available. The wetland habitat for the red-winged blackbird would be increased by a range of 0.82 to 3.24 AAHU's primarily due to weir construction. The baseline habitat conditions at the project site for riverine species is extremely low due to the number of tolerant fish species present, high water turbidity, extremely low flows, limited water quality, and very little in stream structure. Controlling erosion into the waterbodies, removing debris and constructing riffles as proposed in the restoration plan, will reduce turbid conditions, increase in stream structure, improve water quality and has the potential of increasing the AAHU's by 1.10 units.

The HEP analysis is not an appropriate method to assess the habitat values for the federally-listed species that could be potentially benefited by completion of the restoration efforts proposed at Laredo Flood Control project site. Consequently, due to the restoration project's potential for increasing habitat available for ocelots and jaguarundi, the impacts of the project to the habitats important to federally-listed cats and migratory birds were assessed separately.

The restoration plan addresses each of these habitat components. If successful, the increase in habitat quality can be related directly to increased habitat availability for migratory birds because more plant diversity and density will increase available foraging, sheltering, and nesting opportunities.
For example, the white-collared seedeater is a popular species among birders and has been observed in the Laredo area. The white-collared seedeater uses giant cane for shelter and foraging for insects. Although the proposed restoration project would remove much of the giant cane from the area, some cane would remain along the Rio Grande near the project site. Sugarberry forests are also documented as suitable habitat for the white-collared seedeater, and the bird feeds on a variety of grass seeds. The sugarberry and native grasses are proposed to be used in revegetation of approximately 410 acres of the restoration site. The increased diversity of woody plant species and native grasses will greatly increase habitat that can be used for foraging, shelter and nesting by the white–collared seedeater and other similar migratory bird species.

The increase in habitat quality can also be directly related to increased habitat value for the federally-listed cats by providing travel corridors of suitable cover, access to water, and providing more habitat that could increase the availability and abundance of prey species.

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Project Components that Correspond to Recovery Plan Tasks and Management Plans

HEP analyses and habitat assessments, in general do not take into consideration specific recovery plan goals that may be met or advanced due to proposed restoration efforts. The Laredo Flood Control project addresses specific recovery goals for the ocelot and jaguarundi and thus potential advancements to the recovery of these species should be included in assessment of the overall benefits the project would provide. If the restoration project is completed, five recovery goals for the federally-listed cats will be advanced (FWS 1990). For the federally listed cats, encouraging private sector habitat protection and increasing habitat through restoration and restoration research can be directly facilitated by the restoration areas within the project site. All recovery goals that will be advanced by the restoration project are summarized in Table 2.

The restoration project also advances several tasks identified by the The Lower Rio Grande/Rio Bravo Binational Ecosystem Group Management Plan (2004). Although the plan targets the southern portion of the Lower Rio Grande Valley in order to reduce the geographic scope of the specific plan, the conservation and management tasks apply to the entire Lower Rio Grande River Ecosystem. Six tasks that will be advanced by the Laredo Flood Control Project are summarized in Table 3. Most importantly, the restoration project will contribute to protecting and restoring biodiversity of important aquatic, terrestrial and wetland habitats within the Lower Rio Grande Ecosystem for listed proposed, candidate and rare species, as well as protecting and restoring riparian habitats to help improve surface water quality.

The habitat quality for threatened and endangered species in the restoration area will potentially increase four to 10-fold, depending on habitat community type. In addition, the importance in the increase habitat quality should be further weighted and emphasized by the restoration project’s potential to advance five recovery goals for federally listed species and six goals identified by the Lower Rio Grande/Rio Bravo Binational Ecosystem Group that apply to the entire Lower Rio Grande conservation and management needs.

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Table 1: Estimated Impacts to Aquatic and Terrestrial Habitats (provided by the USACE)

Habitat Type		**Average Annual Habitat Units (AAUUs)**		
	Evaluation Species	**Without Project**	**With Project**	**Net Change**
Riparian/Forest	**American Coot** **Belted Kingfisher** **Eastern Cottontail** **Slider Turtle**	63.18	304.53	+241.35
Wetland	**Red-winged Blackbird**			
A		0.20	2.40	+2.20
B		0.24	3.48	+3.24
C		0.01	0.83	+0.82
Riverine	**Variety of fish (based on FWS 2006 Index of biotic integrity)**	0.14	1.24	+1.10

Table 2: Recovery tasks for federally-listed species that will be advanced by the proposed project.

Species Effected	Task name	Task number	Priority for recovery effort	Proposed Project Contribution	Duration of Effect	Reference
Ocelot	Encourage private sector habitat protection	142	2	Increases public awareness of habitat needs and provides enhanced corridor of potential habitat	Project Completion	Harwell and Siminski, 1990
Ocelot	Increase habitat through restoration and restoration research	143	2	Restoration project can be used as samples sites and /or a control restoration site in a variety of research efforts concerning federally-listed cats as well as migratory birds.	Project Completion	Harwell and Siminski, 1990
Jaguarundi	Encourage private sector habitat protection	432	2	Increases public awareness of habitat needs and provides enhanced corridor of potential habitat	Project Completion	Harwell and Siminski, 1990
Jaguarundi	Increase habitat through restoration and restoration research	433	2	Restoration project can be used as samples sites and /or a control restoration site in a variety of research efforts concerning federally-listed cats as well as migratory birds.	Project Completeion	Harwell and Siminski, 1990
Ocelot/Jaguraundi	Develop an education and information program	6	3	Recreationists, local birding organizations, eco-tourists, local public schools and civic groups could be contacted about resources available at the restoration site and the potential to develop site-specific programs exists.	Ongoing	Harwell and Siminski, 1990

Table 5: Management Plan tasks for Lower Rio Grande/Rio Bravo Binational Ecosystem that will be advanced by the proposed project.

Strategy	Task name	Proposed Project Contribution	Duration of Effect
Maintain and improve the quality of subsurface water for the conservation of natural resources for fish and wildlife	Protect and restore riparian habitats to help improve the quality of water	Restores approximately 410 acres of riparian habitat by removing invasive species, and revegetating with native species, and provides for preservation of the project area	Upon project completion and ongoing
	Establish vegetation to provide a buffer zone around important wetlands, lakes and rivers to reduce contamination/eutrophication.	Provides erosion control on the high banks of the gravel pits. The gravel pits would be expected to reduce turbidity and better water quality.	Upon project completion and ongoing
Identify groups of local species including migratory birds, federally-listed, proposed, candidate and rare species.	Develop projects to protect essential areas for threatened and endangered species.	Corps proposes specific construction methodologies to minimize impacts to travel cooridorst and the methods are being incorporated into other, similar Corps projects, and stabilizing erosive banks will increase water quality for a variety of species.	Construction Period (2 years) and ongoing
	Protect and restore biodiversity of important integrates aquatic, terrestrial and wetland habitats within the Lower Rio Grande Ecosystem for listed proposed, candidate and rare species.	Entire project purpose would advance this task and provide more diverse habitats for the white-collared seedeater, other migratory birds, and enhance the travel habitat for the ocelot and jaguarundi.	Upon project completion and ongoing
Promote outdoor recreation opportunities to increase public awareness and involvement in wildlife conservation	Emphasize positive relationship of natural resources and outdoor activities	Provides nature trails and observation points to view the diversity habitats within the project area.	Project Initiation and Ongoing
	Identify partners involved with promoting outdoor recreation programs in the area.	Establishes formal cooperation between City of Laredo with the Corps and the Service. Local birding organizations, school groups and eco-tourism groups can be informed of the resources available for recreation, ecotourism and education at the restoration site.	Project Initiation and Ongoing

APPENDIX E.2

BIOLOGICAL ASSESSMENT

Chacon Creek, Laredo, Texas

Biological Assessment

April 2018

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TETRA TECH

Table of Contents

List of Figures

List of Tables

1 - Introduction

The U.S. Army Corps of Engineers (USACE), Fort Worth District in partnership with the City of Laredo (City) as the non-federal sponsor completed the Chacon Creek, Laredo, Texas, Draft Feasibility Study and Environmental Assessment (Study) in 2007 and updated the Study in 2018, which evaluated ecosystem restoration needs and opportunities for Chacon Creek. The purpose of the Study was to identify potential measures that could reduce the risk of flooding, restore degraded aquatic ecosystems, and provide increased recreational opportunities. These measures include, but are not limited to, three primary objectives:

- Flood risk management measures that would reduce the risk of future damages along Chacon Creek
- Ecosystem restoration measures that would restore degraded aquatic and riparian habitat and increase ecosystem function to a more natural condition
- Increased recreational amenities that would integrate and compliment ecosystem restoration

Federal Action and Authority

Section 7(a) (2) of the Endangered Species Act (ESA) of 1973 assures that, through consultation with USFWS, federal actions "…are not likely to jeopardize the continued existence of any federally proposed or listed endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species…". The purpose of this Biological Assessment (BA) is to comply with this requirement and assess potential actions outlined in the Study on proposed or listed ESA species within the project action area.

There are an estimated 503 structures located in the Chacon Creek 500-year floodplain that are at risk of flooding in Laredo, Webb County, Texas. Urban growth and other watershed perturbations, such as increased imperviousness, have altered flow regimes leading to exacerbated flooding along Chacon Creek during high rainfall events. Flood events in 2002 prompted the city to permanently evacuate three houses along Chacon Creek. Flooding in 2007 impacted the City and resulted in extensive property damage and the first flooding death in Laredo's history. Laredo received five to eight inches of rain in a four-hour period during 2007 flooding events, whereas average annual precipitation is 20 inches. Eighteen homes were reported to have received major damage, and an additional 50 homes received varied damages. Rapid urbanization within the watershed and associated changes in storm runoff timing and volumes into Chacon Creek have also caused hydrogeomorphological effects including erosion and loss of wetland habitats and vegetation. The stream provides flood conveyance, but it also serves as a local natural resource with considerable recreational, educational, and economic potential. The city also has a sizable deficiency in terms of the number and size of its park facilities, particularly passive recreation amenities such as trails, pavilions and shelters, picnic tables, and playgrounds.

Storm water runoff pollution, associated with the various land uses in the watershed, has contributed to water quality impairments in the form of increased turbidity in aquatic habitats, potentially elevated nutrients, and overall degradation of ecosystem integrity. Additionally, the introduction and spread of invasive plant species has increased the potential for fires, altered soil productivity, and diminished the value of terrestrial, wetland, and aquatic habitats for wildlife in the Study area. Due to the above factors, there is a need to identify flood risk management and ecosystem restoration measures that would address water resource problems in the Chacon Creek watershed.

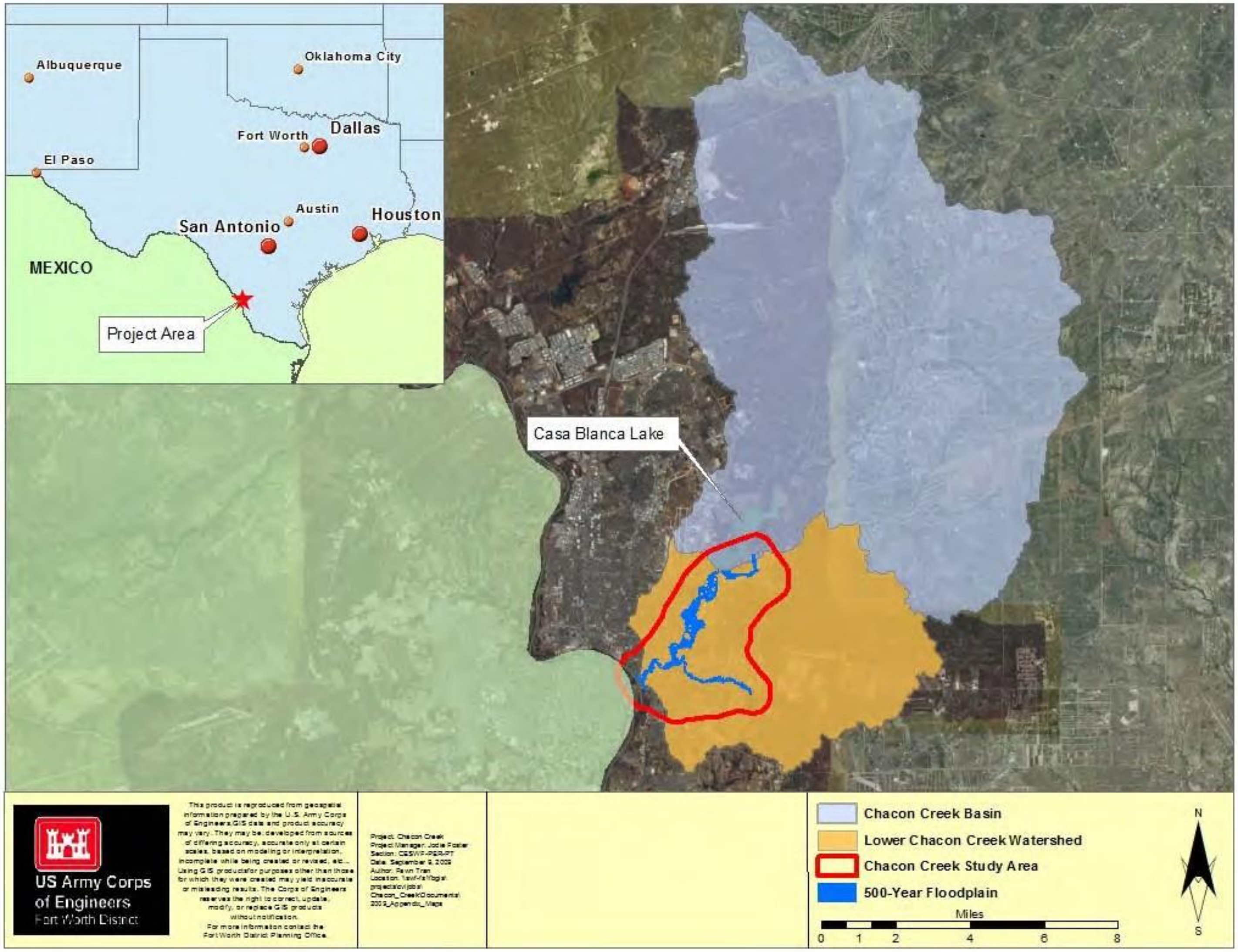
Project History

In 2007, USACE initiated the Study for Chacon Creek, which included a detailed field investigation, the development of feasibility designs for stream restoration, identification of real estate needs (buy out, etc.), modeling of hydraulic impacts, preparation of a project cost estimate, and an analysis of ecological benefits. Chacon Creek was identified as an area for ecosystem restoration due to degraded watershed and ecosystem conditions leading to habitat loss, high nutrient loads, impaired water quality, and flooding. In 2010, USACE produced a BA for the 2007 Study, which included an analysis of the proposed actions that “May Affect” listed species within the Study area. The BA presented here updates information presented in 2010 and analyzes effects to species federally-listed as threatened, endangered, proposed, or sensitive within the area potentially affected by the proposed actions in the Study.

2 - Location and Site Description

Description of the Action Area and Project Sites

The Study area is spatially defined as beginning at the Casa Blanca Lake outfall, west of the reservoir, and continuing downstream along the Chacon Creek channel corridor, including associated riparian and upland transitional areas, to the confluence with the Rio Grande (hereafter referred to as the Lower Chacon Creek watershed) (Figure 1). The Study area is further delineated by the area adjacent to Chacon Creek within the 500-year floodplain, which contains approximately 1,006 acres. The action area for the proposed actions considered in this BA contains aquatic riverine, wetland, riparian, and transitional terrestrial ecosystems associated with Chacon Creek. The action area is defined as the scope of the surfaces consisting of the Chacon Creek channel and related streamside and upland vegetation communities.

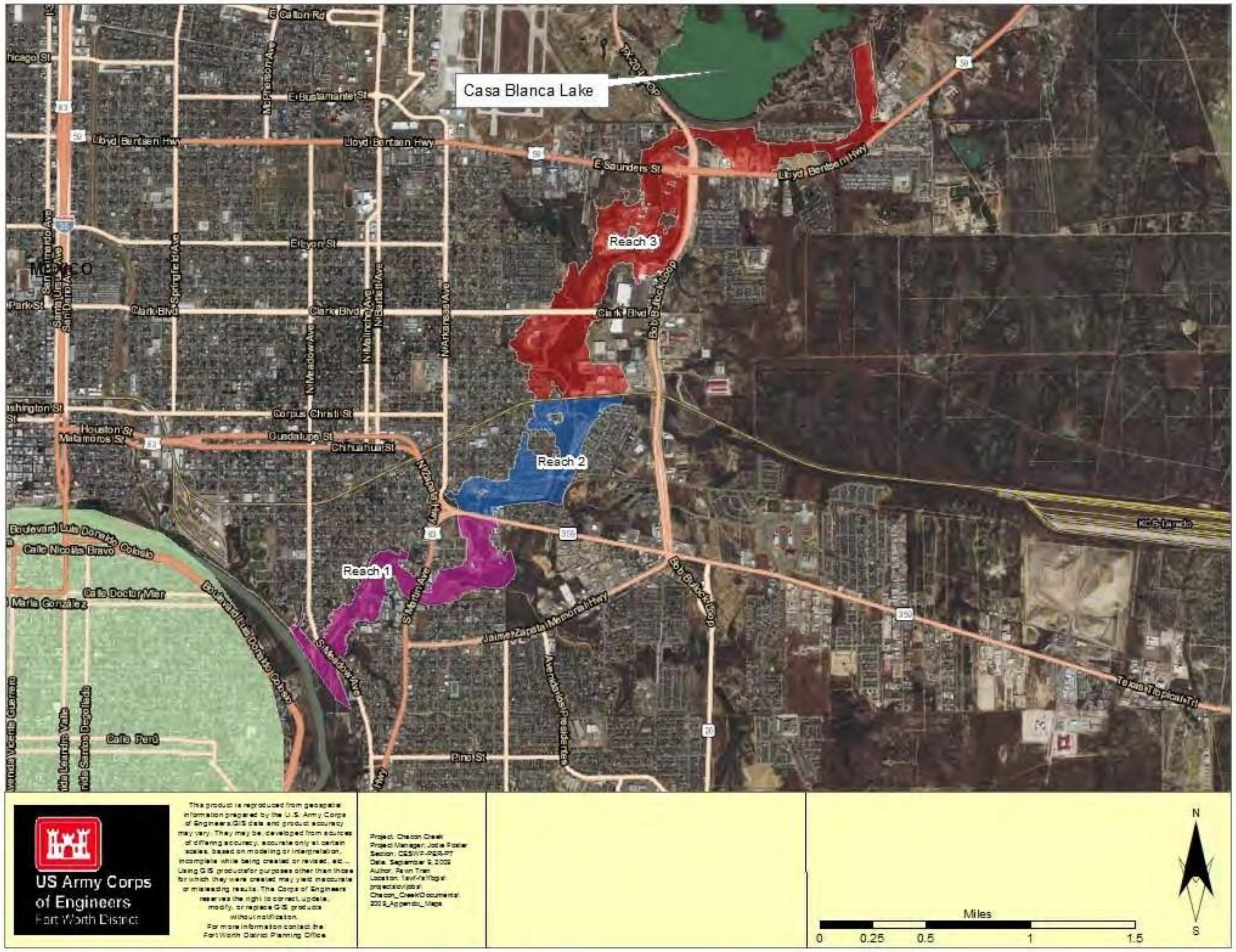


(Image Source: USACE, 2010)

Figure 1. Study Location

For the purposes of analysis, the Creek was divided into three reaches (Figure 2), defined as follows:

- Reach 1 is the area of Chacon Creek between the confluence with the Rio Grande and State Highway 359
- Reach 2 is between State Highway 359 and the Tex Mex Railway
- Reach 3 is between Tex Mex Railway and Lake Casa Blanca outfall



(Image Source: USACE, 2010)

Figure 2. Study Location Reaches

Study Setting

The Study setting lies entirely within the City, in Webb County, Texas. The City is north and adjacent to the Rio Grande, which forms the international border between the United States and Mexico. The City is approximately 120 miles south of San Antonio, Texas and is a major trucking route for international trade between the United States and Mexico. The City and Webb County are currently experiencing rapid growth and increased development in the Chacon Creek watershed. The projected growth rate in Laredo is expected to be among the highest in the US (US Conference of Mayors, 2017). In recent years, urban development east of Chacon Creek and along the eastern drainages has filled in much of the watershed. The Laredo International Airport is located immediately west of Lake Casa Blanca in the northern part of the lower Chacon Creek watershed.

The hydrologic setting of the Study is within the Lower Chacon Creek watershed, which is situated in the larger San Ambrosia-Santa Isabel watershed (8-digit Hydrologic Unit Code (HUC) 13080002) within the Lower Rio Grande Valley (LRGV). The entire Chacon Creek watershed is approximately 155 square miles. Lake Casa Blanca is a reservoir and forms an impoundment on Chacon Creek north of the Study area. The Lower Chacon Creek watershed is approximately 38 square miles and is defined as the sub-basin downstream from Casa Blanca Lake and the associated spillway (Figure 1). The lower reach of Chacon Creek is characterized by deeper and wider pools as groundwater and backwater influences from the Rio Grande are realized. Vegetation removal, urban development, flow alteration, and exotic species invasion have all impacted the aquatic habitat of Chacon Creek. Chacon Creek is an intermittent stream with flows generated by dam seepage and supplemental flows form precipitation events and storm water inputs. The low flow channel generally conveys less than five cubic feet per second (cfs) during normal conditions. Average elevation in the Study area is approximately 430 feet above mean sea level. Tributaries to Chacon Creek below Casa Blanca Lake include two unnamed urban drainages.

Chacon Creek has been adversely impacted by illegal dumping and other detrimental activities within the watershed including a concentrated animal feeding operation (CAFO). Although no direct water quality measurements are available for Chacon Creek, there is considerable illegal dumping within the floodplain. Additionally, there is substantial urban development encroaching on the floodplain immediately adjacent to Chacon Creek and in an undeveloped area east of the Study area. Increased impervious surfaces and limited storm water management activities have resulted in water quality problems in Chacon Creek. The lack of storm water management activities has resulted in a loss of soils and vegetation, as well as increased turbidity in aquatic habitats.

2.1.1.1 Land Ownership

Within the Chacon Creek Study area, low- and medium-density residential land use makes up almost 56 percent of the Study area. High-density residential makes up less than one percent. Light and heavy industrial land use makes up six percent of Study area land use. Retail and office land use is 16.5 percent, and parks and recreational open space makes up another 16.5 percent. It is projected that land use for the Study area will change substantially in the coming years. Over 50 percent of the Study area is expected to be used for parks and recreational open space compared to the current 20.5 percent. Significant drops in residential uses are expected for the Study area as well as a reduction in retail and office use. The City, the local sponsor, has been actively acquiring property in the Chacon Creek floodplain. In addition to land already owned by the City, roughly an additional 200 acres would be acquired, changing from private ownership to public ownership. The proposed action would involve buying out 66 residential parcels, about 16 acres, for the flood damage reduction component. This area would then be used for recreation component of the project. For the ecosystem restoration component, an estimate of 238 vacant tracts would be acquired, totaling approximately 186 acres.

2.1.1.2 Exotic and Invasive Species

Several invasive plants are presently well established in the riparian and adjoining upland settings throughout the Study area. Documented invasive grasses with significant coverage include buffelgrass (*Pennisetum ciliare*), Kleberg bluestem (*Dichanthium annulatum*), guineagrass (*Urochloa maxima*), and Arundo cane (*Arundo donax*). Other invasive species with a substantial presence in the Study area include salt cedar (*Tamarix* spp.), castorbean (*Ricinus communis*), and Russian thistle (*Salsola tragus*). Additional invasive species documented in the Study area in smaller quantities include bermudagrass (*Cynodon dactylon*), chinaberry (*Melia azedarach*), and kleingrass (*Panicum coloratum*). Buffelgrass and Arundo cane are the most predominant invasive grass species in the Study area, whereas castor bean and salt cedar are the principal invasive woody species.

3 - Biology and Distribution of Listed Species

Federally-Listed Species and Critical Habitat

A list of threatened, endangered, and candidate species known to occur in the Study area was generated from the U.S. Fish and Wildlife Service (USFWS) Information, Planning and Conservation System (IPaC) system to analyze potential effects under the proposed actions discussed in this report and in the Study. The IPaC database identified seven federally-threatened, endangered, or candidate species which are known to occur in the Study area (Appendix A). The status, habitat type, and determination of federally proposed or listed endangered species or threatened species are presented below (Table 1). No other species and no designated or proposed critical habitat was identified within the Study area.

Table 1. Threatened, Endangered and Candidate Species in Study Area

Taxon	Common Name	Scientific Name	Status	Habitat Type	Determination
			USFWS		
Birds	Least Tern	*Sterna antillarum*	Endangered	Riparian/Coastline	No Effect
Birds	Piping Plover	*Charadrius melodus*	Threatened	Shoreline/Wetlands	No Effect
Birds	Red Knot	*Calidris canutus rufa*	Threatened	Coastline	No Effect
Mammals	Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Forested/Riparian	Likely to adversely affect
Mammals	Gulf Coast Jaguarundi	*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*	Endangered	Desert Scrub/Forest	Likely to adversely affect
Mollusks	Texas hornshell	*Popenaias popeii*	Endangered	Aquatic	May Affect
Plants	Ashy dogweed	*Thymophylla tephroleuca*	Endangered	Grasslands	No Effect

Determinations of potential effects were made based upon habitat suitability of species presented in Table 1. The following species were evaluated and determined that they would not be likely to be present in the Study area for the reasons described below: least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*) and, ashy dogweed (*Thymophylla tephroleuca*).

The least tern nests on sparsely vegetated open flats of beaches, river channels, sandbars, and coastlines in the southern U.S. Habitat requirements for the least tern are not present in the Study area. The piping plover and red knot are only subject to consideration for wind related projects within migratory routes. No such components are discussed or considered in the Study.

Ashy dogweed is a narrow endemic (i.e. is only found in a restricted geographic range) that occurs in open grassland and scattered shrub-dominated vegetation (Tamaulipan thornscrub habitat) with deep sandy loam soils of the Hebbronville series in south Texas (USFWS 2011). Soil is considered the most important attribute for characterizing habitat for rare plant species (Elith and Leathwick 2009) and potential habitat, based on soils and associated plant communities, occurs in the Study area. A USDA Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS) custom soil resource report was generated for the Lower Chacon Creek watershed to review available habitat on appropriate soils (Appendix B). The Study area contains approximately 5.8-acres of Hebbronville loamy fine sand (HeB), however the singular occurrence of this soil type is within an urban setting that has been developed and previously disturbed, therefore ashy dogweed was removed from consideration.

Status of the Species within the Action Area

The riparian areas and surrounding undeveloped area within the Study area may serve as a travel corridor for the ocelot (*Leopardus* (=*Felis*) *pardalis*) and Gulf Coast Jaguarundi (*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*; jaguarundi). Additionally, the Texas hornshell (*Popenaias popeii*) also has potential to occur within the project area. This BA will assess potential effects to the ocelot, jaguarundi, and Texas hornshell.

The ocelot and jaguarundi are treated together in this assessment, as in many publications (e.g. USFWS 1990), because, although very little is known about the ocelot, and even less about the jaguarundi, the two are thought to exhibit similar habitat preferences in south Texas. They suffer from similar causes of population decline, and benefit from similar recovery efforts. The actual number of ocelots in Texas is unknown. In 1998 there was an estimated 80-120 individuals thought to reside in Texas (Shindle and Tewes 1998), however the population of ocelots may be as low as 12 individuals (The Nature Conservancy 2016a). The actual number of jaguarundi is unknown, but certainly less than that of ocelots. Due to their elusive nature, the actual number that may occur within the action area is unknown. Critical habitat has not been designated for either species.

The most common plants occurring in habitats in LRGV where the ocelot and jaguarundi is known to occur are huisache (*Acacia farnesiana*), blackbrush acacia (*Acacia rigidula*), prairie baccharis (*Baccharis texana*), chilipiquin (*Capsicum annuum*), lotebush, allthorn goatbush (*Castela texana*), Texas persimmon (*Diospyros texana*), coyotillo (*Karwinskia humboldtiana*), common lantana (*Lantana horrida*), berlandier wolfberry (*Lycium berlandier*), javelinabrush (*Microrhammus ericoides*), Texas pricklypear (*Opuntia lindheimeri*), retama (*Parkinsonia aculeata*), honey mesquite (*Prosopis glandulosa*), cedar elm (*Ulmus crassifolia*), and lime pricklyash (*Zanthoxylum fagara*) (Goodwyn 1970).

As mentioned, the number of jaguarundi in south Texas is unknown. For Webb County, there have been no surveys or confirmed sightings in recent years. The last unconfirmed sightings of jaguarundi in Webb County occurred in the mid 1980's and in 1993. The last unconfirmed sighting of an ocelot has been reported in Webb County occurred in 1980.

<u>Ocelot</u>

In 1982, the ocelot was designated as an endangered species under the ESA, a status that extended U.S. protections to the species throughout its range in 22 countries, including Texas, Mexico, and Central and South America (USFWS 1990). Critical habitat has not been designated for the ocelot. Ocelot populations gained greater protections in 1989, when the species was upgraded to Appendix I of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES); a protection that prohibits CITES signatories from permitting any trade in the species or its parts. Two subspecies occur in the United States: the Texas ocelot (*L.p. albescens*) and the Sonoran ocelot (*L.p. sonoriensis*). The Texas ocelot is isolated from the Sonoran ocelot by the Sierra Madre highlands (Tewes and Schmidly 1987; USFWS 1990). No critical habitat has been designated for this species.

3.1.1.1 Species Description

The ocelot is a medium-sized cat, measuring up to three feet in body length and weighing as much as 35 pounds. It is slender and covered with attractive, irregular-shaped rosettes and spots that run the length of its body. The ocelot's background coloration can range from light yellow, to reddish gray, to gold, to a grayish gold color with a white underside. The head has spots, two black stripes on the cheeks, four to five longitudinal black stripes on the neck and their black has large white spots. The tail has dark bars or incomplete rings. Though it resembles the margay (*Leopardus wiedii*), the ocelot is approximately twice the size of a margay with a slightly shorter tail (Murray and Gardner 1997; de Oliveira 1998).

3.1.1.2 Distribution and Abundance

Historically, the ocelot occurred in Arkansas, Arizona, southern California, Texas, Mexico and southward through Central and South America to Peru, Uruguay, and northern Argentina (Navarro-Lopez 1985). Today it ranges from southern Texas and northern Sonora, Mexico to Central America, Ecuador and northern Argentina, but in reduced numbers (Tewes and Everett 1986; Emmons 1990; Murray and Gardner 1997).

Two U.S. populations of ocelot occur in southern Texas (Tewes and Everett 1986). One population occurs in Willacy and Kennedy counties primarily on private lands (Navarro-Lopez 1985) and the other in Cameron County primarily on the Laguna Atascosa National Wildlife Refuge and another population on a conservation easement within the privately-owned Yturria Ranch (Laack 1991; The Nature Conservancy 2016a). Approximately 50 ocelots are estimated to inhabit portions of Willacy county (The Nature Conservancy 2016b).

In Texas, over the past 20 years, individual ocelots have only been documented in Cameron, Hidalgo, Willacy, Kennedy and Jim Wells counties (Tewes and Hughes 2001). Laack and Rappole (1986) documented ocelot sightings in Cameron County. Shinn (2002) used camera traps and hair snares on 25 widely scattered tracts managed by the south Texas Refuges Complex, and did not find evidence of ocelot west of Brownsville on the Rio Grande River. His studies did confirm the presence of the species in extreme southern Cameron County and in extreme western Willacy County.

In Hidalgo County, at the Santa Ana National Wildlife Refuge, at least one ocelot was radio-tracked in the 1990's and it is believed that they may still occur in the area (Mays 2009). Fischer (1998) trapped, radio-tracked and tagged an adult female from 1992 through 1996 along the Rio Grande River in southeastern Hidalgo County. Out of 8,304 trap-nights he caught 21 bobcats, 300 non-target animals, and no other ocelots.

In 1982, Tewes (1986) trapped two ocelots on a private ranch in Willacy County. Five ocelots (3 females, 1 male and 1 of unknown sex) were identified in Willacy County near Raymondville, Texas in December 2002. Based on two photographs on October 11, 2003, one of the females was pregnant; therefore, a sixth resident ocelot may have been born (Sternberg and Chapa 2004). Between October 18 and December 2003 camera traps photographed three cats on another private ranch in Willacy.

Tewes and Everett (1986) based a “crude estimate” of the total ocelot population size in south Texas from 80 to 120 individuals upon an aerial survey of brush habitat and knowledge gained from following the movements of radio-collared ocelots trapped in or near Laguna Atascosa National Wildlife Refuge. Haines et al. (2005a) estimated the number of breeding individuals in the Laguna Atascosa National Wildlife Refuge population was 19 ocelots with sufficient habitat to support 38 ocelots in Cameron County. He estimated the population by averaging ocelot home range sizes reported by Navarro-Lopez (1985), Tewes (1986), and Laack (1991) and extrapolating this estimate to the amount of available dense thorn scrub habitat and assumed adults equaled half of the total population. Today, as few as 50 individuals may remain in south Texas and the U.S. The Cameron County ocelot population is estimated at 25 to 35 individuals (Mays 2009)

A much larger population of the Texas ocelot occurs in Tamaulipas, Mexico near San Fernando, approximately 100 mi south of the U.S.-Mexico border (Caso 1994). In forested South America, alone Emmons (1988) noted that even at the lowest density estimates (one animal per 5 km^2) there will be approximately 800,000 ocelots, and suggested that true numbers are probably 1.5 to 3 million. Using an extrapolated estimate technique, Stasey (2012) estimated 874 ocelots may inhabit the Sierra de Tamaulipas in northeastern Mexico.

3.1.1.3 Habitat

Tamaulipan brushland is a unique ecosystem, consisting of dense and thorny shrubs, which is found only in south Texas and northeastern Mexico. It is estimated approximately 95 percent has been has been cleared for agriculture, urban development, road developments and expansions, and recreation (USFWS 1990, Jahrsdoerfer and Leslie 1988). Tewes and Everett (1986) found less than 1 percent of southern Texas supported the extremely dense thorn scrub used by ocelots.

Tewes and Everett (1986) classified ocelot habitat in Texas according to the amount of foliar canopy. Class A or optimal habitat was 95 percent canopy cover, Class B or suboptimal habitat was 75 percent to 95 percent canopy cover, and Class C, with 75 percent or less canopy cover, was considered inadequate. The most critical habitat component is probably dense cover near the ground [<3 ft. in height] and that core areas of ocelot home ranges on Laguna Atascosa National Wildlife Refuge contained more thorn scrub than peripheral areas of their home ranges. Jackson et al (2005) suggest that the ocelot in Texas prefers closed canopy habitats, but that areas used by this species tend to consist of more patches with greater edge. The cat is reported to occur along watercourses, and will readily enter the water (Goodwyn 1970 as cited by USFWS 1990), but it is unclear if this proximity to water is a habitat requisite or simply an indication of where dense cover is most likely to occur.

Species composition of shrubs used by ocelots was quantified in three plant communities, two in Texas and one in Mexico (Shindle and Tewes 1998, Caso 1994). In Texas, 45 woody plant species were found at the Laguna Atascosa National Wildlife Refuge in Cameron County, and 28 woody species on a private ranch in Willacy County (Shindle and Tewes 1998). The dominant species were granjeno (*Celtis pallida*), crucita (*Eupatorium odoratum*), Berlandier fiddlewood (*Citharexylum berlandieri*), honey mesquite, and desert olive (*Forestiera angustifolia*) at Laguna Atascosa National Wildlife Refuge, and honey mesquite and snake-eyes (*Phaulothamnus spinescens*) in Willacy County.

In Mexico, ocelot habitat use occurred in areas with 97.6 percent mature forest (heavy rain forest to sparse tropical deciduous forest) and 2.4 percent pasture-grassland (Caso 1994). In Veracruz, Hall and Dalquest (1963) stated ocelots utilized the forests and jungles. Ocelots are known from the tropical forest of Belize, lowland rain forest of Peru, and semideciduous forest and seasonally flooded marshes of Brazil (Ludlow and Sunquist 1987).

3.1.1.4 Life History

The ocelot is primarily nocturnal, although some diurnal activity has been recorded (Navarro-Lopez 1985l; Tewes 1986; Tewes and Schmidly 198; Laack 1991; Caso 1994). Navarro-Lopez (1985) found ocelots in Texas to have two peaks of activity, one at about midnight and the other at daybreak. Ocelots are solitary hunters and eat a wide variety of prey, but mammals, especially rodents, make up the bulk of their diet (Bisbal 1986; Emmons 1987; USFWS 1990). Other items of prey include birds, armadillos, marsupials, monkeys, rabbits, bats, feral hogs, reptiles, fish and crabs (Emmons 1987; Ludlow and Sunquist 1987; USFWS 1990).

The reproductive season is year-round, with spring or autumn breeding peaks noted in Texas and Mexico. The mating season varies from region to region. In the Yucatan, mating occurs in October and October-January mating peaks are also reported from Paraguay and northeastern Argentina. Laack (1991) observed first reproduction in wild females between 30 and 45 months-of-age, but Eaton (1977) and Tewes and Schmidly (1987) estimated they may produce young at 18-30 months of age. Ocelots can produce young year-round and have a gestation period of 70-80 days (Eaton 1977; Laack 1991). Litters contain one, two, and rarely three kittens (Eaton 1977; Laack 1991). Laack et al. (2005) reported an average of 1.2 kittens per litter for 16 litters born to 12 ocelots in Texas. Den sites are usually well hidden and include dense, thorny scrub, caves, hollows in trees or logs, and grass tussocks (Laack 1991; Tewes and Schmidly 1987). The mother provides extended parental care to the young because of the time it takes for them to become proficient at capturing prey. Males are believed to contribute little to direct parental care (Tewes 1986; Laack 1991).

Adults of both sexes tend to have home ranges exclusive of other adult individuals of the same sex, but there is considerable home range overlap between the sexes (Emmons 1988; Laack 1991). Adult males have larger home ranges than adult females. The home ranges of sub adult males and females tend to be similar in size to the home ranges of adult females until dispersal (Laack 1991). A number of studies have looked at the home range size of ocelots in Texas and Mexico, as determined from monitoring radio-collared individuals. Home range size generally varies from 2-18 km^2 (Caso 1994; Ludlow and Sunquist 1987; Konecny 1989; Dillon 2005) with mean home ranges of approximately 12 km^2 (Gonzalez Borrajo et al. 2017). The established adult home ranges of ocelots in Laack’s study (1991) of dispersing ocelots did not include semi-isolated patches, and transient home ranges were at times farther from the natal range than the animal’s eventual home range.

During dispersal the ocelots used narrow (5-100 m) corridors of brush along abandoned river channels, known locally as “resacas” and drainage ditches and small scrub patches within agricultural or pasture land. The ocelots tended to avoid areas occupied by adults. According to Laack (1991), none of the dispersing ocelots successfully joined a population outside of Laguna Atascosa National Wildlife Refuge.

Various studies resulted in the estimation of various survival rates. Tewes (1986) reported a survival rate of 71 percent based on four mortalities while monitoring 12 radio-tagged ocelots and Haines et al. (2005b) estimated an annual survival rate at 87 percent for resident adults and 57 percent for transient ocelots. For newborn ocelots Laack et al. (2005) estimated 68 percent annual survival rate.

3.1.1.5 Reason for Listing/Threats to Survival

Fragmentation of habitat and habitat loss due to brush clearing are primary reasons for ocelot decline. Ocelots rely upon thick vegetation along the Lower Rio Grande and the south Texas Tamaulipan brush community for foraging, resting, and establishing dens. They require corridors, such as rivers, shorelines, and natural drainages to travel between optimal habitat areas. Destruction and fragmentation of optimal habitat and travel corridors increases threats to the ocelot, such as urban expansion and development, new roads and expansion, loss of agricultural lands to development, mortality from vehicles, incidental trapping, construction of border fence and other tactical infrastructure, international bridges and competition from feral dogs and cats. In Mexico, particularly in the northeast, ocelots suffer from habitat loss due to charcoal production, agriculture and livestock ranching. Human population increases and associated urban expansion in the LRGV have resulted in brush clearing and increased pollution (USFWS 1986). Industrialization has degraded water quality (USFWS 1986). Brushland habitats have also been converted to rangeland with herbicides (Bontrager et al. 1979), root plowing and fire (Hanselka 1980).

Pesticides can be incorporated into the food chain and are potentially harmful or fatal to terrestrial and aquatic organisms. Agriculture pesticides are used year-round in LRGV, and drift and overspray from aerial applications occur periodically on National Wildlife Refuge lands. In the LRGV, runoff from cultivated fields may concentrate pesticides and herbicides in permanent bodies of water. The types of pesticide chemical compounds and application rates have been extensive and heavy throughout the LRGV. As a result, pesticide accumulation in the biota remains a major concern in management of Tamaulipan thornscrub.

Although habitat loss in south Texas is mainly attributable to agricultural and urban expansion, other contributing factors include human modifications of the Rio Grande with dams and reservoirs for flood control and hydroelectric power; floodway systems that remove water from the stream channel during peak flows; water diversions for irrigation, municipal, and industrial usage; and channel restriction and canalization (Coastal Impact Monitoring Program 1995).

Due to increasing economic integration between the U.S. and Mexico, there is increasing pressure for highways and bridge infrastructure and recently increasing national security concerns increase pressure for fences and lighting in the Texas/Mexico border region. Local population growth and rapid industrialization on the Mexican side of the border has raised Service concern regarding the placement of road and bridge infrastructure in the LRGV. Increased construction of these bridges may impact certain parcels of the Lower Rio Grande Valley National Wildlife Refuge, the Rio Grande floodplain, and the remaining riparian wildlife habitat and disrupt the continuity of the “wildlife corridor.”

Importing and exporting skins of many spotted cats became illegal in the U.S. between 1967 and 1973 and the ocelot was added to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora during 1989. Recommendations were made by Tewes and Everett (1986) for selective methods of predator control and the education of hunters to avoid accidental shooting of ocelots. In 1997 the Service entered into a Section 7 consultation with the U.S. Department of Agriculture's Animal Damage Control for the use of leg-hold traps, snares, and M-44s explosive predator baits in south Texas and provided provisions for the protection of ocelots during their practices.

Data is limited regarding disease in the ocelot but several diseases and parasites have been documented. Some include Notoedric mange (*Notoedres cati*) (Pence et al. 1995), Hepatozoon in the blood, Cytauxzoon in their red blood cells, fleas (*Pulex sp.)*, dog ticks (*Dermacentor variabilis*) and Amblyomma ticks (Mercer et al. 1988). The tapeworm (*Taenia taeniaeformis*) (USFWS 1990) and helminthes (Pence et al. 2003) were also reported in ocelots.

Ocelot mortality has also been attributed to aggression and predation by other animals. Ocelots can be prey of domestic dogs, coyotes, snakes, alligators and bobcats (USFWS 1990)

Vehicular collisions are the greatest known cause of ocelot mortality in south Texas accounting for 45 percent of deaths of 80 radio-tagged ocelots monitored by Haines et al. (2005b) between 1983 and 2002. In 2016, seven ocelots were killed on roads in south Texas (The Nature Conservancy 2016b). Underpasses and culverts have been or are to be installed for ocelots in critical areas to be used as travel corridors. The construction or modification of two roads that underwent formal section 7 consultation, State Highway 48 and Farm-to-Market Road 106, made provisions for the careful placement, design, and maintenance of such culverts. It is anticipated these culverts and underpasses would allow ocelots to disperse between patches of suitable habitat and reduce genetic isolation of the populations.

<u>Gulf Coast Jaguarundi</u>

The jaguarundi was listed as endangered on June 14, 1976 (USFWS 2013). The jaguarundi is also listed in the CITES Appendix I of the convention which bans international commerce. CITES offers some protection over much of its range. Hunting is prohibited in Argentina, Belize, Bolivia, Columbia, Costa Rica, French Guiana, Guatemala, Honduras, Mexico, Panama, Paraguay, Surinam, Uruguay, United States, and Venezuela. Hunting is regulated in Peru, while no legal protection is offered in Brazil, Nicaragua, Ecuador, El Salvador, and Guyana. No critical habitat has been designated for this species.

3.1.1.6 Species Description

The jaguarundi has a long slender body, short legs, and sleek unpatterned fur, and looks more like a large weasel than a cat. They are roughly twice the size of a domestic cat, weighing about 7-22 lbs, standing 10 to 14 inches at the shoulder, and can be up to four feet long from nose to tail tip, with the tail taking up about a third of its length. It has a long and flat head instead of a round one. The ears are short and rounded, and this is one of the few cat species that does not have a contrasting color on the backs of the ears. Their eyes are small and set closely together.

Jaguarundi have two distinct color phases, red and gray, the latter phase has also been called blue. The phases are so distinct that at one time they were thought to be separate species, the red one being called *Felis eyra*. A third color phase, black, has also been reported, but apparently does not occur in Texas (Goodwyn 1970). These cats are not known to be closely related to the other small South American cats. Instead of having 36 chromosomes, like the South American cats, it has 38 like the cougar and puma (Tewes and Schmidly 1987).

3.1.1.7 Distribution and Abundance

The jaguarundi historically occurred in southeast Arizona, south Texas, Mexico and Central and South America as far south as northern Argentina. Today this cat has a similar distribution, but in reduced numbers, although it probably no longer occurs in Arizona (Tewes and Schmidly 1987). It may also be extinct in Uruguay. They are reported to occur at Masaya National Park in Nicaragua, Soberania National Park in Panama, and El Imposible National Park in El Salvador (Nowell and Jackson 1996). The presence of jaguarundi in Florida is likely the result of human introduction (Nowak and Paradiso 1983).

In Texas, jaguarundi has been known to occur in Cameron and Willacy counties. Tewes and Everett (1986) analyzed the records of a clearinghouse established in 1981 to coordinate reception and filing of reports of jaguarundi (and ocelots) in Texas. Many of the reports were solicited by sending out questionnaires to trappers. Jaguarundi was reported from central Texas and the upper Gulf Coast as well as from south Texas. However, due to lack of any tangible evidence, such as road kills, most of the sightings in the first two areas are believed to have been of black feral house cats. Tewes and Everett (1986) could make no estimate of the jaguarundi population in south Texas, although its population is presumably smaller than that of the ocelot, because confirmed sightings are rare. Goodwyn (1970) reported, based on interviews he conducted in 1969, that jaguarundi were thought to occur in seven specific areas: Santa Ana National Wildlife Refuge; Laguna Atascosa National Wildlife Refuge, “Paso Real” an area along the lower Arroyo Colorado on the border between Cameron and Willacy Counties; the southern part of the El Sauz Ranch in northeast Willacy County; a small area west of Olmito in southern Cameron County; an area east of Villa Nueva; and an area near the Port Isabel airport in Cameron County.

Tewes (1987) and Tewes and Everett (1986) documented several other credible reports of jaguarundi in Cameron, Willacy and Webb counties. One was a road-killed male jaguarundi found near the junction of State Highway 4 and Farm-to-Market Road (FM) 511 (Keller’s Corner) in Cameron County on April 21, 1986 (Tewes 1987; Laack and Rappole 1987). While this was the last confirmed record of a jaguarundi in Texas, unconfirmed jaguarundi sightings in Hidalgo County have been reported from Bentsen Rio Grande State Park, Santa Ana National Wildlife Refuge, Lower Rio Grande, Laguna Atascosa National Wildlife Refuges, Cimarron Country Club, Wimberley Ranch, and the Anacua Unit of the Texas Parks and Wildlife Department’s Las Palomas Wildlife Management Area, and other areas (Prieto 1990; Tewes 1992; Benn 1997). Unconfirmed sightings of a jaguarundi occurred at the Sabal Palm Grove Sanctuary in Cameron County in 1988 (Anonymous 1989) and at the Santa Ana National Wildlife Refuge in March 1998 (Santa Ana National Wildlife Refuge data). Based upon sighting reports, personnel of the Santa Ana National Wildlife Refuge suspect the presence of jaguarundi on the refuge (Benn 1997). A July 2009 editorial in Texas Parks and Wildlife Magazine reported jaguarundi in Bexar County on federal lands owned by the U.S. Air Force (Lackland Annex).

No jaguarundi have been documented during the 96,840 camera trap-nights and at least 36,347 live trapnights at the south Texas Refuge Complex, which includes Laguna Atascosa, Lower Rio Grande, and Santa Ana National Wildlife Refuges, since monitoring efforts began in 1982.

3.1.1.8 Habitat

Habitat requirements in Texas are similar to those for the ocelot: thick, dense thorny brush lands or chaparral. Approximately 1.6 percent of the land area in south Texas is this type of habitat (Tewes and Everett 1986). The thickets do not have to be continuous but may be interspersed with cleared areas. Jaguarundi possibly shows a preference for habitat near streams (Goodwyn 1970; Davis and Schmidly 1994) and may be more tolerant of open areas than the ocelot.

The jaguarundi uses mature forest (i.e., brush) and pasture-grassland (Caso 1994). Jaguarundi use open areas for hunting and sometimes resting, but if threatened with a potential danger they would seek cover in brush areas.

In South America, habitat includes high mountain forests, tropical forests, swamp forests, savannahs, overgrown pastures, and thickets (Aldrich 1980, Tewes and Schmidly 1987). In Venezuela, Jaguarundi have been most frequently found in tropical dry forest relative to other habitat types. They are rarer and thinly distributed in moist forest types, especially deep rain forest. They have been reported to prefer forest edges and secondary brush communities, but this is where they are most frequently seen. In Belize’s Cockscomb Basin Wildlife Sanctuary, jaguarundi are most frequently associated with water and old-field habitats. It appears to be the most flexible cat in its ability to occupy different habitats and having access to dense ground vegetation appears to determine habitat suitability (Nowell and Jackson 1996).

3.1.1.9 Life History

Most information gathered on the jaguarundi comes from historical writings and information gained from studying the ocelot in south Texas and in Mexico.

In Belize, jaguarundi are seen quite often and Konecny (1989) found that two males had home ranges of 100 and 88 km^2, and one female had a home range of 20 $km^{2.}$ Caso (1994) captured and radio collared jaguarundi in Tamaulipas, Mexico from 1991 to 2005. He found home range sizes averaged 9.83 km^2 and 8.36 km^2 for males and females, respectively. Both studies captured jaguarundi in undisturbed brush and grasslands with scattered second growth woodlands (Caso 1994). Historical accounts from Mexico suggest that jaguarundi are good swimmers and enter the water freely.

Little is known of jaguarundi reproduction in the wild. Den sites include dense thickets, hollow trees, spaces under fallen logs overgrown with vegetation, and ditches overgrown with shrubs (Tewes and Schmidly 1987; Davis and Schmidly 1994). In Mexico, they are observed as being solitary, except during November and December when they mate. Young have been born in March and August with possibly two litters per year. Usually two to four young comprise a litter, with litters being either all of one color phase or containing both the red and gray phases. Jaguarundi kittens are spotted at birth, and lose their markings as they mature. Gestation (for captive jaguarundi) varies from 63 to 75 days (Goodwyn 1970; Tewes and Schmidly 1987; Davis and Schmidly 1994). Jaguarundi communicates by calls, of which 13 have been identified in captive animals. The largest repertoire occurs during the mating season (Hulley 1976).

The jaguarundi is primarily diurnal, although some nocturnal activity has been recorded (Konecny 1989, Caso 1994). However, it appears to be less nocturnal than the ocelot. They are excellent climbers although they spend most of the time on the ground. They hunt primarily in the morning and evenings. Prey is largely birds, but bird eggs, rats, mice, rabbits, reptiles and fish are also taken (Goodwyn 1970; Tewes and Schmidly 1987; Davis and Schmidly 1994). In Venezuela, Bisbal (1986) found the diet of jaguarundi to be 46-percent mammals, 26-percent birds, and 29-percent reptiles.

3.1.1.10 Reasons for Listing and Threats to Survival

Loss of habitat is one of the main threats to the jaguarundi. Historically, dense mixed brush occurred along dry washes, arroyos, resacas, and the flood plains of the Rio Grande. A majority of shrub land has been converted to agriculture and urban development. Unfortunately for the jaguarundi the best soil types used for agricultural crops also grow the thickest brush and thus produce the best habitat for the jaguarundi. Less than 5 percent of the original vegetation remains in the Rio Grande Valley.

Texas Hornshell

The Texas hornshell was listed as a federally endangered species on March 12, 2018 (USFWS 2018). The species was previously under a candidate review for listing since November 15, 1994 (USFWS 2016b). Conservation of candidate species is encouraged; however, such species do not receive statutory protection under the ESA or designated critical habitat. The Texas hornshell is a native freshwater mussel found in undercut banks, under large boulders, and among travertine shelves in medium to large rivers (USFWS 2016b). Since the Texas hornshell occurs in Texas waters and has been documented in the Rio Grande near Laredo (Randklev et al 2016) effects of the proposed action to the hornshell are analyzed here.

3.1.1.11 Species Description

The Texas Hornshell is a medium sized freshwater mussel species approximately 3 inches in length with a laterally compressed shell. Shell color ranges from dark brown to green and individuals can be differentiated by distinct lines of color on the shell. Juvenile Texas hornshell mussels have distinct green rays on the shell (Carman 2007).

3.1.1.12 Distribution and Abundance

The Texas hornshell is an endemic freshwater mussel found in medium to large waterways in the Rio Grande drainage in Texas and New Mexico. The species historically ranged from the Pecos River near Roswell, New Mexico to the confluence with the Rio Grande and southeast to the Gulf of Mexico (USFWS 2016b). Based on a limited understanding of pre-development distribution, the species was historically known to occur in the Rio Grande and three tributaries: the Pecos River, Devils River, and Las Moras Creek. More information is needed regarding population distribution and species abundance of the Texas hornshell. The species presently occupies approximately 15-percent of its historic range in the U.S., however current understanding of species distribution is limited due to lack of scientific surveys regarding the status of populations, limited sampling efforts, and small spatial scale of studies (Randklev et al. 2016). Surveys in Texas have reported live mussels or recently dead individuals from the Rio Grande in Terrel, Del Rio, and Webb Counties as well as in the Devils River in Val Verde County. It is thought that the species has been extirpated from the Rio Grande downstream of Laredo, however the exact upstream and downstream limits of the species are not known. Abundance of the species is greater on the Rio Grande near Laredo compared to sampled sites upstream of Laredo (Randklev et al 2016).

3.1.1.13 Habitat

The Texas hornshell primarily occurs in shallow, slow-running, perennially flowing water, tucked under travertine shelves, and among large diameter channel bed materials, such as boulders, where soft sediment accumulates. Flows vary in occupied habitat; however, populations of the species have been documented in portions of the Black River (a tributary to the Pecos River south of Carlsbad, New Mexico) where flows range from 2.6- 912 cfs and have a mean daily discharge of 10.1 cfs (Carman 2007).

3.1.1.14 Life History

The life history of the Texas hornshell is similar to other freshwater mussels. The species is a benthic filter feeder, subsisting on microorganisms, inorganic, and organic materials from the water (Howard and Cuffey 2006). Spawning generally takes place from March to August. Reproduction occurs when males release sperm into the water column, which is drawn into the body of female mussels. Fertilization and the development of larvae takes place in the gill chamber of female Texas hornshell mussels over a 4-6-week period after which glochidia, microscopic mussel larvae, are released. Glochidia are released in a sticky mucous net or string and must attach to the gills, head, or fin of a host fish where they feed on fish body fluids. Glochidia are parasitic and will die if they do not attach to a host fish. The primary host fishes are river carpsucker (*Carpiodes carpio*), grey redhorsem (*Moxostoma congestum*), and red shiner (*Cyprinella lutrensis*). Such species are also the primary factor in the dispersal of the Texas hornshell. Glochidia metamorphose to juveniles in about 30 days at which point the juveniles will release from the host fish a drop into channel substrate. The lifespan of the Texas hornshell is approximately 20 years, however precise longevity is unknown (Carman 2007).

3.1.1.15 Reason for Consideration for Listing

The primary reasons for Texas hornshell population declines include water quality impairments, reduced water flow, and inundations associated with increased sedimentation of river channel bottoms. Drought, groundwater extraction and uncertain future surface flows will likely limit reproduction success of the Texas hornshell. Mussel population and reproductive processes may also be negatively influenced by the decline of specific host fish for their glochidia. Channel alterations such as dams and other fish barriers limit the movement and distribution of native fish species that the Texas hornshell is dependent on for reproduction. Additionally, predators such as muskrats, racoons, birds, turtles, and fish may deplete mussel beds and cause population declines (Carman 2007).

Freshwater mussels such as the Texas hornshell are considered the most rapidly declining group of aquatic organisms in North America (Winemiller et al 2010). The primary threats to species viability are related to accumulations in fine sediment, reduction in surface water flows, and water quality impairments (USFWS 2016b). The entire range of the Texas hornshell has been fragmented by large dams and reservoirs, effectively precluding recolonization of the species in channel segments where it has been extirpated, leading to reduced dispersal and fragmented populations. Additionally, the presence of dams has diminished or removed periodic flood pulses from river ecosystems. Dams may also reduce habitat due to excessive silt deposition upstream of dam features. Conservation of mussel species also requires the conservation of their host fish species.

Elevated salinity is believed to limit Texas hornshell distribution. Salinity exceeding 7.0 parts per thousand (ppt) has been demonstrated to induce signs of physiological stress followed by death in laboratory studies (Lang 2001). High salinity may occur due to natural sources, however elevated salinity is also caused by the use and reuse of waters in the Rio Grande basin for agriculture, discharge of salty groundwater during irrigation and drainage operations, and the effects of evapotranspiration (Hendrickx et al. 1999) The resulting increase in salinity in the known range of the species has affected the Texas hornshell mussel.

The species has also experienced habitat loss from decreased water flows, impaired water quality, such as ammonia from wastewater treatment plants which discharge treated wastewater into the Rio Grande, increased accumulation of fine sediment, and periods of low flow leading to increased predation (USFWSb).

4 - Description of the Proposed Action

Proposed Action

The purpose of the proposed action is to address three planning components: flood risk management, ecosystem restoration, and recreation in the Study area. Specific actions related to planning components are discussed in the subsection below. Construction and maintenance activities under the proposed action would be minor, localized, and temporary. The approximate duration of the disturbance associated with the proposed action is expected to be 12 months.

4.1.1 Flood Risk Management

The flood-risk management component of the proposed action includes the permanent evacuation of 73 residential structures, and using the vacated lands for a local recreation facility. Currently this is an urban, residential area. The evacuation would include demolishing 73 residential structures and debris removal. This area would then be used for recreation and serve as an urban park. The proposed action would help alleviate the risk of flooding in an area known to have had significant events in recent years and provide additional recreational amenities where such facilities currently lacking.

4.1.2 Ecosystem Restoration

The proposed ecosystem restoration components under the Tentatively Selected Plan (TSP) would restore three wetland sites totaling 16.75 acres producing a total increase of 12.29 Average Annual Habitat Units (AAHUs). Proposed wetland measures would also include instream ecosystem restoration components consisting of weir-riffle structures to increase the amount of habitat for fish diversity in the Study area and contribute to more abiotic structural diversity, and increased dissolved oxygen levels. Weirs would be installed perpendicular to the channel to obstruct flow and allow the pooling of water above weir structures. No permanent impacts to wetlands are anticipated under the TSP.

The TSP also includes riparian measures that would restore 401 acres of riparian habitat providing 151.62 AAHUs, by removing buffelgrass, salt cedar, and Arundo cane and planting native species with irrigation until plants are established. These measures would further protect high-quality vegetation communities. The proposed action would also include the removal of debris as well as a concrete barrier from the streambed.

4.1.3 Recreation

The recreation component in Reach 2 consists of a proposed park that would comprise approximately 18.7 acres. A city-owned park already exists in part of the area behind residential structures on the south side of Espana Street. The proposed action would relocate existing park features to the area where residential structures are being removed to provide flood damage reduction. The existing park would provide an ecosystem restoration buffer zone. The proposed action includes two multi-use open space fields, a playground, one large, domed group shelter, one small pavilion, 32 picnic tables, 32 trash receptacles, 19 picnic shelters, 23 grills, 19 benches, seven drinking water fountains, two comfort stations, one amphitheater, a horseshoe and rig toss pit, nine-disc golf baskets, 6,850 linear feet of five-foot-wide sidewalks, 89,000 square feet of parking lots and drives, and other associated infrastructure.

A secondary recreation component in Reach 1 consisting of two areas, one of which would serve as a trailhead with minimal picnic facilities, in the form of six single tables with three grills, three trash cans, 7,452 square feet of parking, two water fountains, one bike rack, and security lighting for the parking lot. The second area would contain a playground, six picnic tables, six benches, three grills, four trash cans, one bike rack, 7,452 square feet of parking, and restrooms with associated facilities, including two water fountains, lighting, and water and wastewater linkages. 1,572 linear feet of five-foot-wide walk is planned to link the playground and picnic tables, as well as a connection to the nature trail/boardwalk planned for the ecosystem restoration and wetland site. Connection is also provided to the multiuse trail system.

Best Management Practices (BMPs)

The following BMPs would be implemented as a part of these actions to avoid and/or minimize impacts to the federally-listed species; the ocelot, jaguarundi, and Texas hornshell.

1. Prior to any construction activities, a kick-off meeting would be scheduled. A representative from each contract would attend, along with representatives from the City of Laredo and USACE. One of the primary purposes would be to coordinate efforts, discuss the BMPs, and provide training and education for all on-site workers.

2. All workers who would be entering the project area would be required to attend training focused on potential encounters with endangered species, identifying ocelot and jaguarundi, and procedures to follow should an ocelot or jaguarundi be observed on the project site.

3. Individual federally-listed animals found in the project area would not be harassed and would be allowed to leave on their own volition. An individual, with the authority to stop construction activities, would be on-site during all construction activities, and would halt all activities immediately upon report of an ocelot or jaguarundi sighting. The USFWS would be contacted immediately if a federally-listed animal is seen in the project vicinity. The USFWS Corpus Christi Ecological Services Field Office (CCESFO) can be contacted at 361-994-9005 during normal business hours. A protocol for contacting USFWS after hours would be established.

4. During ecosystem restoration construction activities (or such distance that noise, light, or other effects reach the habitat), a qualified Government-designated environmental monitor, with authority to temporarily suspend construction at any time if the appropriate BMPs are not being properly implemented, would be present on site. Duties of the monitor would include ensuring that activities stay within designated project areas, evaluating the response of individuals that come near the project site and implementing the appropriate BMP.

5. Clearance and disturbance of vegetation beyond the design parameters needed for construction and maintenance and use would be avoided.

6. The perimeter of all areas to be disturbed during construction or maintenance activities would be clearly demarcated using flagging or temporary construction fence, and no disturbance outside that perimeter would be authorized.

7. Materials such as sand would be obtained from existing developed or previously used sources, not from undisturbed areas adjacent to the project area.

8. If new access is needed or existing access requires improvements to be usable for the project, access design and implementation would be coordinated with USFWS.

9. Areas already disturbed by past activities or those that would be used later in the construction period would be used for staging, parking, and equipment storage.

10. Removal of native trees and brush in project area would be limited to the smallest amount needed to meet project objectives. Clearing of and removal of invasive species is likely to diminish over time. Loss of habitat is not likely after initial construction and permanent loss would be compensated, if applicable, through appropriate mitigation measures. Native vegetation would be planted and managed and it is expected that habitat quality would improve over baseline conditions as such vegetation establishes.

11. Nonhazardous waste materials and other discarded materials such as construction waste would be contained until removed from the construction site. This would assist in keeping the project area and surroundings free of litter and reduce the amount of disturbed area needed for waste storage.

12. To eliminate attraction of predators of protected animals, all food related trash items such as wrappers, cans, bottles, and food scraps, would be disposed of in closed containers and removed daily from project sites.

<u>Species Specific BMPs for the ocelot and jaguarundi:</u>

1. During construction a qualified biological monitor with authority to temporarily suspend construction at any time if the appropriate BMPs are not being properly implemented as agreed to would be present on site.

2. Removal of wetland habitat or desirable riparian vegetation would be avoided. Removal of dense thornscrub would be minimized and restricted to the designated right-of-way (ROW). When removing scrub habitat, root systems would be left intact where possible.

3. Documentation of observed ocelots and jaguarundi in project and activity areas would be reported to USFWS.

4. Construction and maintenance activities would be conducted only during daylight hours to avoid nighttime noise and lighting disturbance to minimize potential individual ocelot and jaguarundi impacts.

Ecosystem Restoration Measures

The riparian restoration consists of the removal and management of invasive species, as well as planting of native species in the riparian area.

Invasive species would be removed. Salt cedar would be selectively removed from 251 acres, and buffelgrass would be removed from 150 acres within the Study area. 150 acres of native species of trees, shrubs, and herbaceous vegetation would be planted in the riparian area. This would ultimately result in 401 acres of restored riparian habitat and 16.75 acres of wetlands. This would increase the quantity and diversity of vegetation in the project area,

Maintenance Activities

The Federal Government and the City of Laredo would enter into a project partnership agreement under which the City would accept the project following completion of construction and ensure operation, maintenance, repair, rehabilitation. The major items involved include: regular maintenance of park facilities, restriping access areas, debris cleanup, selective trimming in restoration areas, and invasive species control to reduce the numbers and extent of exotic and invasive plant species.

Flood Risk Management

The flood-risk management component includes the permanent evacuation of 73 residential structures, which would require no maintenance. The vacated land would be used for recreation facilities. Maintenance of recreation facilities is discussed below.

Ecosystem Restoration

The ecosystem restoration component includes restoration of three wetlands, as well as riparian measures that would restore 401 acres of riparian habitat. The proposed action would require regular/annual maintenance, including invasive and exotic vegetation management, and repair/maintenance of wetland weir structures. Vegetation management would consist of exotic and invasive species control consisting of selective removal of salt cedar and treating buffelgrass and Arundo can stands and salt cedar cut stems with herbicides glyphosate and/or imazapyr.

A Monitoring and Adaptive Management Plan which describes existing habitats and monitoring methods pertaining to the Study ecosystem restoration measures is presented in Appendix C. The Chacon Creek Monitoring and Adaptive Management Plan provides monitoring components and success criteria to determine if project goals have been achieved and provides a framework to address future management considerations and actions.

Recreation

The recreation component consists of a proposed park that would comprise approximately 18.7 acres. Maintenance activities would include lighting, debris cleanup, mowing and grounds maintenance, as well as equipment and infrastructure maintenance.

Monitoring during Implementation of the Proposed Action

In order to avoid further impacts on ocelot, jaguarundi, and Texas hornshell habitats, the following monitoring efforts would be implemented:

1. The onsite government-designated individual would be trained and would monitor construction activities to limit unnecessary disturbance or clearance of ocelot and jaguarundi habitat adjacent to the project area.

<u>During Construction</u>

1. All construction and maintenance projects in federally listed species potential habitat would receive training and have a designated biological monitor on site during the work. See Section 4.2 above.

<u>Post-Construction</u>

1. Brush pilings in areas adjacent to thorn scrub and grassland habitat would be chipped to reduce the potential for brush fires. Other brush would be left in place to provide wildlife shelter in disturbed areas. These brush pile locations would be coordinated with USFWS prior to continuation of construction.

2. Reseeding disturbed areas with approved native grasses and forbs would be performed after construction activities have been completed. The seed mix used for reseeding would be approved by USFWS prior to use.

3. Monitoring reports during the implementation period would be provided weekly via email to Dr. Larisa Ford at larisa_ford@fws.gov, indicating if BMPs were employed properly by the contractor. A project completion report would be submitted 30 days after completion of work to Allan Strand, Field Supervisor, CCESFO, Texas A&M University at Corpus Christi, 6300 Ocean Drive, Unit 5837, Corpus Christi, Texas 78412-5837, summarizing all work completed. A monthly email report indicating the duration and date of supplemental watering was completed in the revegetation areas would be sent to Dr. Larisa Ford at the address above. An annual report detailing the revegetation that has occurred would be submitted to Allan Strand at the address above. If 80 percent revegetation has not occurred in the revegetation zone by the end of monitoring year 1, then revegetation methods may be augmented and supplemental reports may be required. Further monitoring standards, adaptive management measures, and project criteria are located in Monitoring and Adaptive Management Plan (Appendix C).

4. Monitoring of the vegetation and associated habitat characteristics would occur at intervals described in the Monitoring and Adaptive Management Plan (Appendix C).

5 - Effects of the Proposed Action

This BA focuses on the effects of the proposed action to the ocelot, jaguarundi, and Texas hornshell habitats since they are not known to occur in the project area, but have the potential to occur in the project area. The Texas hornshell is only considered in the lower reaches of the project area where backwater effects from the Rio Grande provide year-round surface water.

Direct Effects

Vegetation Removal/Mowing

The removal of invasive species would consist of clearing and grubbing areas of buffelgrass, as well as selective removal of salt cedar. Salt cedar removal would consist of cutting, followed by herbicide treatment of cut stumps. The contractor shall take precautions to prevent damage to other native trees. There would be short-term, temporary adverse impacts due to the removal of salt cedar and other invasive vegetation. Federally-listed cats may forage or migrate through the Chacon Creek corridor and the execution of ecosystem restoration measures would be expected to temporarily adversely impact the cats due to human disturbance, noise, implementation of restoration designs, construction of wetland sites, and delay of habitat availability while planted vegetation at restoration sites establishes and matures.

Revegetating these areas with a dense assemblage of dense thornscrub vegetation would reestablish connectivity within the corridor and would provide long-term benefits for the movement of ocelot and jaguarundi. The reestablished connectivity between Lake Casa Blanca and the Rio Grande would provide additional area for foraging and migration and would provide access to traditional water sources. Renewed habitat connectivity would limit genetic erosion, inbreeding, and population vulnerability.

Based on survey results and proposed BMPs, the proposed action is not likely to directly adversely affect individuals or populations of federally-listed species but would temporarily directly affect habitat for these species. However, the long-term benefits to native habitat would improve habitat and potential of use of the area by these two species.

The 2016 ocelot recovery plan identified thornscrub restoration approaches in secondary areas capable of supporting the species, including invasive grass control and the planting of native plant species (USFWS 2016a). An environmental monitor would ensure that any species of ocelot or jaguarundi encountered during construction activities would not be harassed or approached and allowed to move away on its own.

Temporary Noise from Construction Activities

Noise created during construction would have the potential to affect individual ocelot and jaguarundi that occur within the project area. All project-related noise would be temporary and would only be heard within the action area.

The impacts of noise would include subtle, localized impacts from the overall elevation of ambient noise levels during construction. Noise levels after construction are anticipated to return to close to current ambient levels. Elevated noise levels during construction could result in reduced communication ranges, interference with predator/prey detection, or habitat avoidance in the action area. More intense impacts would include behavioral change or disorientation. Predictors of wildlife response to noise include noise type (i.e., continuous or intermittent), prior experience with noise, in proximity to a noise source, stage in the breeding cycle, activity, and age. Prior experience with noise is the most important factor in the response of wildlife to noise, because wildlife can become accustomed (or habituate) to the noise. The proposed action runs along many areas that are developed and it is likely that any ocelot or jaguarundi that inhabit the action area have prior experience with noise. The rate of habituation to short-term construction is not known, but it is anticipated that most ocelot and jaguarundi would only be permanently displaced from the areas where the habitat is cleared and would be temporarily dispersed from areas adjacent to the project areas, within and outside the project footprint, during construction periods.

Indirect Effects

Removal of native vegetation could affect ocelots and jaguarondi indirectly by modifying their migratory patterns, habitat, or prey populations. Because both species require brush or other forms of cover for foraging, eradication would make habitat less suitable. The cats depend on herbaceous species for shelter and movement corridors. Removal of native vegetation would also provide suitable location for invasive grasses. After completion of construction activities, disturbed areas would be treated with herbicides for control of invasive grasses and reseeded with native grasses to minimize colonization of invasive grasses. Native trees and shrubs would also be planted to reestablish the riparian corridor along Chacon Creek, and improve habitat within the project area. The culmination of the proposed action would increase the quality of habitat within the Study area.

Cumulative Effects

Thresholds of significance are used to determine whether a project might have a significant environmental effect on resources. The significance threshold for a given environmental effect is that level at which the Study team finds the effects of the project to be significant, based on a quantitative or qualitative standard or a given set of criteria.

USACE, with the City of Laredo as the non-Federal sponsor, conducted a feasibility study on a proposed 130-acre aquatic ecosystem restoration area adjacent to the Rio Grande, along a 90-degree bend in the southwest portion of the city. This study was initiated about the same time as the Chacon Creek Feasibility Study; however, it was studied under Section 206 (Aquatic Ecosystem Restoration) of the USACE Continuing Authorities Program. The study was completed in 2013, the design was completed in 2015, and construction began in 2016.

The study area contains seven derelict gravel pits and large spoil mounds remaining from sand and gravel operations that ceased around 1954. The pits are supplied lateral subsurface percolating water from the Rio Grande, and the property has problematic non-native invasive plant species. Because it is located in the southwest corner of the City, this project does not have any direct relationship with the Chacon Creek Study, but it should be considered when addressing cumulative effects of any TSP.

<u>Vegetation</u>

The significance threshold for native vegetation includes a substantial reduction in ecological processes, communities, or populations that would threaten the long-term viability of a species or result in the substantial loss of a sensitive community that would not be offset or otherwise compensated. Removal and control of non-native plant species outlined in the Study plan would have a significant and beneficial cumulative impact on vegetation, due to the removal of invasive species from the system, revegetation of native species, and reduced fire potential. The conversion of vegetation types from native riparian species to fire-adapted grasses is possible. Disturbance driven spread of invasive vegetation is possible if proper measures are not established. Eradication of native vegetation would require a sustained effort using chemical and mechanical methods. Thorough cleaning of equipment would be required to prevent the spread of seeds and further colonization of invasive plant species. Aggressive revegetation of restoration areas would be necessary to prevent invasive species from re-establishing in treated areas.

Wildlife

The significance threshold for wildlife includes a substantial reduction in ecological processes or populations that would threaten the long-term viability of a species or result in the substantial loss of a sensitive habitat that would not be offset or otherwise compensated for. Removal of invasive plant species within the Study area as part of the Study as well as control of Arundo cane throughout Webb County for reasonably foreseeable projects, would have a positive cumulative impact on habitat for native wildlife species. Wildlife habitat value would also increase due to revegetation of native species.

Threatened and Endangered Species

Different components of the Study plan would have different levels of impacts on the Federally-listed cats—the ocelot and jaguarondi. The flood-risk management component of the proposed action alone would not likely affect the ocelot and jaguarondi. While there is no Federally designated critical habitat for Federally Listed species potentially occurring in Webb County, the ecosystem restoration component would have temporary adverse effects but long-term benefits for ocelot, jaguarondi, and Texas hornshell habitat. Texas hornshell habitat would benefit from aquatic and wetland restoration. Further benefits to the Texas hornshell would occur from increased vegetated buffers and associated improvements to water quality. The short-term effects would be due to construction activities and removal of stands of buffelgrass and other invasive species but the effects of revegetation with native species would be long-term. The removal of fire-adapted buffelgrass would prevent compositional shifts from native vegetation to this fire adapted grass dominated vegetation type and would promote the establishment of Tamaulipan thornscrub vegetation. This action, when combined with other existing and proposed projects in the region, would not have a significant cumulative impact on endangered, threatened, or rare species, nor jeopardize the continued existence of any species, and could provide overall benefits.

Recreation

The recreation component, particularly the trails portion, could bring additional human activities within habitat that the ocelot and jaguarundi might migrate through. While these cats may forage or migrate through Chacon Creek, the implementation of this component might be expected to adversely impact the cats due to increased human disturbance.

Aquatic

Implementing the Study plan in addition to the Laredo Riverbend Section 206 Aquatic Ecosystem Restoration Project would beneficially impact the habitat, and provide both near and long-term benefits. The use of erosion control measures, such as silt fencing and planting of native grasses to serve as stream buffers, would affect the reproduction and forage base of resident fish, while in-stream structures, such as rock weirs with riffles associated with the TSP would increase habitat diversity for fish in the project area. Species whose habitat requirements include more abiotic structural complexity (different types of sediment, and rock), adequate minimum water flow, or dissolved oxygen would be the most likely to benefit. Improvements to the riparian area, including tree planting, would indirectly benefit fish by decreasing erosion and long-term sedimentation problems. Increasing the quantity of woody vegetation along the river would increase the amount of woody debris in the river in the long term, generally benefiting many species by providing escape cover and a cooling effect in the littoral zone. Other projects in the region would not be within a close enough proximity to have additional cumulative impacts to the project area.

Water Quality

The Study plan is expected to have no adverse impacts to water quality within the Study area due to the establishment of native vegetation which would reduce erosion and turbidity. Additional wetland areas would also contribute to improved water quality. Other existing and reasonably foreseeable projects in the region would not be expected to have any cumulative adverse impacts to water quality in the project area.

Effects Determination

5.1.1.1 Ocelot and Jaguarundi

Different project components have different levels of effect of the federally-listed cats and significant cumulative effects have occurred to reduced habitat and population numbers for the ocelot and jaguarundi. Overall, ***the project may affect, and is likely to adversely affect the ocelot and jaguarundi***.

The flood-risk management component of the proposed action alone would not likely affect the ocelot and jaguarundi.

The ecosystem restoration component would have temporary adverse effects, but would also provide potential long term benefits for ocelot and jaguarundi habitat. This long-term benefit would become more evident as development of the lower Chacon Creek watershed continues.

Due to construction and temporary loss of possible migration and foraging habitat, the ecosystem restoration component is likely to have a temporary adverse effect the ocelot and jaguarundi. This determination is mainly due to construction and removal of stands of buffelgrass. However, the effect of revegetation with native species would confer long-term benefits to these species.

The recreation component of the proposed action would have temporary adverse effects to ocelot and jaguarundi, and the long-term effect of increased human access into some of the restoration areas.

5.1.1.2 Texas hornshell

The ***project components may affect, but are not likely to adversely affect the Texas hornshell***. Potential Texas hornshell habitat may exist in Chacon Creek, particularly at the lower reaches near the confluence with the Rio Grande where water is present throughout the year.

The proposed flood management may affect the Texas hornshell through the introduction of wetland weir structures. Wetland weir structures would impound water and may prevent the dispersal of the species upstream of the confluence of the Rio Grande. However, the upper portions of Chacon Creek often experiences flows insufficient to support the Texas hornshell, therefore this the effects are negligible.

Proposed ecosystem restoration measure would likely result in the reduction of sediment inputs and overall improvements to the water quality of Chacon Creek, which would benefit the species. Proposed recreation improvements would not impact the channel and would therefore have no effect.

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7 - Appendices

Appendix A

Federally threatened, endangered and proposed to be listed species list in proposed project location, 02ETTX00-2018-SLI-0394

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Texas Coastal & Central Plains Esfo
17629 El Camino Real, Suite 211
Houston, TX 77058-3051
Phone: (281) 286-8282 Fax: (281) 488-5882

In Reply Refer To: 04/02/2024 14:29:42 UTC
Project Code: 2024-0071296
Project Name: Chacon Creek

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The U.S. Fish and Wildlife Service (Service) field offices in Clear Lake, Corpus Christi, Fort Worth, and Alamo, Texas, have combined administratively to form the Texas Coastal Ecological Services Field Office. All project related correspondence should be sent to the field office address listed below responsible for the county in which your project occurs:

Project Leader; U.S. Fish and Wildlife Service; 17629 El Camino Real Ste. 211; Houston, Texas 77058
Angelina, *Austin*, *Brazoria*, *Brazos*, *Chambers, Colorado, Fayette, Fort Bend, Freestone, Galveston, Grimes, Hardin, Harris, Houston, Jasper, Jefferson, Leon, Liberty, Limestone, Madison, Matagorda, Montgomery, Newton, Orange, Polk, Robertson, Sabine, San Augustine, San Jacinto, Trinity, Tyler, Walker, Waller, and Wharton.*

Assistant Field Supervisor, U.S. Fish and Wildlife Service; 4444 Corona Drive, Ste 215; Corpus Christi, Texas 78411
Aransas, Atascosa, Bee, Brooks, Calhoun, De Witt, Dimmit, Duval, Frio, Goliad, Gonzales, Hidalgo, Jackson, Jim Hogg, Jim Wells, Karnes, Kenedy, Kleberg, La Salle, Lavaca, Live Oak, Maverick, McMullen, Nueces, Refugio, San Patricio, Victoria, and Wilson.

U.S. Fish and Wildlife Service; Santa Ana National Wildlife Refuge; Attn: Texas Ecological Services Sub-Office; 3325 Green Jay Road, Alamo, Texas 78516
Cameron, Hidalgo, Starr, Webb, Willacy, and Zapata.

For questions or coordination for projects occurring in counties not listed above, please contact arles@fws.gov.

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your

proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/media/endangered-species-consultation-handbook.

Non-Federal entities may consult under Sections 9 and 10 of the Act. Section 9 and Federal regulations prohibit the take of endangered and threatened species, respectively, without special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. “Harass” is defined (50 CFR § 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Should the proposed project have the potential to take listed species, the Service recommends that the applicant develop a Habitat Conservation Plan and obtain a section 10(a)(1)(B) permit. The Habitat Conservation Planning Handbook is available at: https://www.fws.gov/library/collections/habitat-conservation-planning-handbook.

Migratory Birds:
In addition to responsibilities to protect threatened and endangered species under the Act, there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts visit: https://www.fws.gov/program/migratory-birds.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable National Environmental Policy Act (NEPA) documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Texas Coastal & Central Plains Esfo
17629 El Camino Real, Suite 211
Houston, TX 77058-3051
(281) 286-8282

PROJECT SUMMARY

Project Code: 2024-0071296
Project Name: Chacon Creek
Project Type: Flooding
Project Description: This study examined an array of alternatives to address each of the challenges to reduce flood threat along Chacon Creek, restore the aquatic and riparian ecosystems, and provide compatible recreational opportunities.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@27.508271399999998,-99.45710767374105,14z

Counties: Webb County, Texas

ENDANGERED SPECIES ACT SPECIES

There is a total of 9 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 3 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ This species only needs to be considered if the project includes wind turbine operations. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Cactus Ferruginous Pygmy-owl *Glaucidium brasilianum cactorum* There is **final** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1225	Threatened
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Wind related projects within migratory route. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. This species only needs to be considered under the following conditions: ▪ Wind Related Projects Within Migratory Route Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

CLAMS

NAME	STATUS
Mexican Fawnsfoot *Truncilla cognata* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7870	Proposed Endangered
Salina Mucket *Potamilus metnecktayi* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8753	Proposed Endangered
Texas Hornshell *Popenaias popeii* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/919	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
Ashy Dogweed *Thymophylla tephroleuca* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7696	Endangered

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

THERE ARE NO BALD AND GOLDEN EAGLES WITHIN THE VICINITY OF YOUR PROJECT AREA.

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Brownsville Curve-billed Thrasher *Toxostoma curvirostre oberholseri* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11981	Breeds Feb 15 to Aug 15
Chihuahuan Raven *Corvus cryptoleucus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11945	Breeds Apr 1 to Aug 31
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9406	Breeds Mar 15 to Aug 25
Eastern Meadowlark *Sturnella magna* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9455	Breeds Apr 25 to Aug 31
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-billed Curlew *Numenius americanus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5511	Breeds elsewhere
Orchard Oriole *Icterus spurius* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9457	Breeds Jun 10 to Aug 15
Painted Bunting *Passerina ciris* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9511	Breeds Apr 25 to Aug 15

NAME	BREEDING SEASON
Pectoral Sandpiper *Calidris melanotos* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9561	Breeds elsewhere

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)

Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

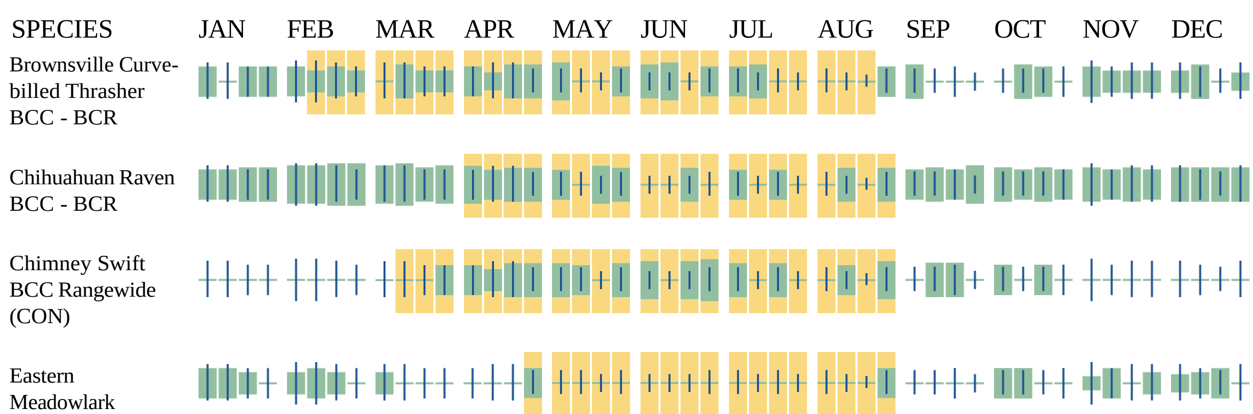
Survey Effort (|)

Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)

A week is marked as having no data if there were no survey events for that week.

■ probability of presence ■ breeding season | survey effort – no data



BCC - BCR

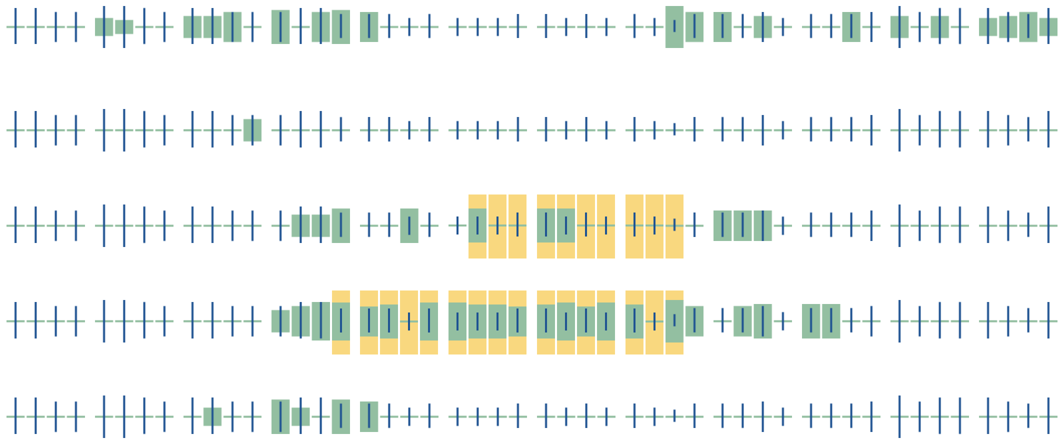
Lesser Yellowlegs
BCC Rangewide
(CON)

Long-billed Curlew
BCC - BCR

Orchard Oriole
BCC - BCR

Painted Bunting
BCC - BCR

Pectoral Sandpiper
BCC Rangewide
(CON)



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

RIVERINE

- R4SBJ
- R4SBC
- R2UBH
- R5UBH

FRESHWATER EMERGENT WETLAND

- PEM1C

FRESHWATER FORESTED/SHRUB WETLAND

- PSS2/EM1A
- PSS3/1A
- PSS1/3A

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers Name:
Brandon Ford Ford Address: 2000
Fort Point Road City: Galveston
State: TX
Zip: 77550
Email christopher.b.ford@usace.army.mil Phone:
4097663079

Appendix B

Custom Soil Resource Report for Webb County, TX

United States Department of Agriculture

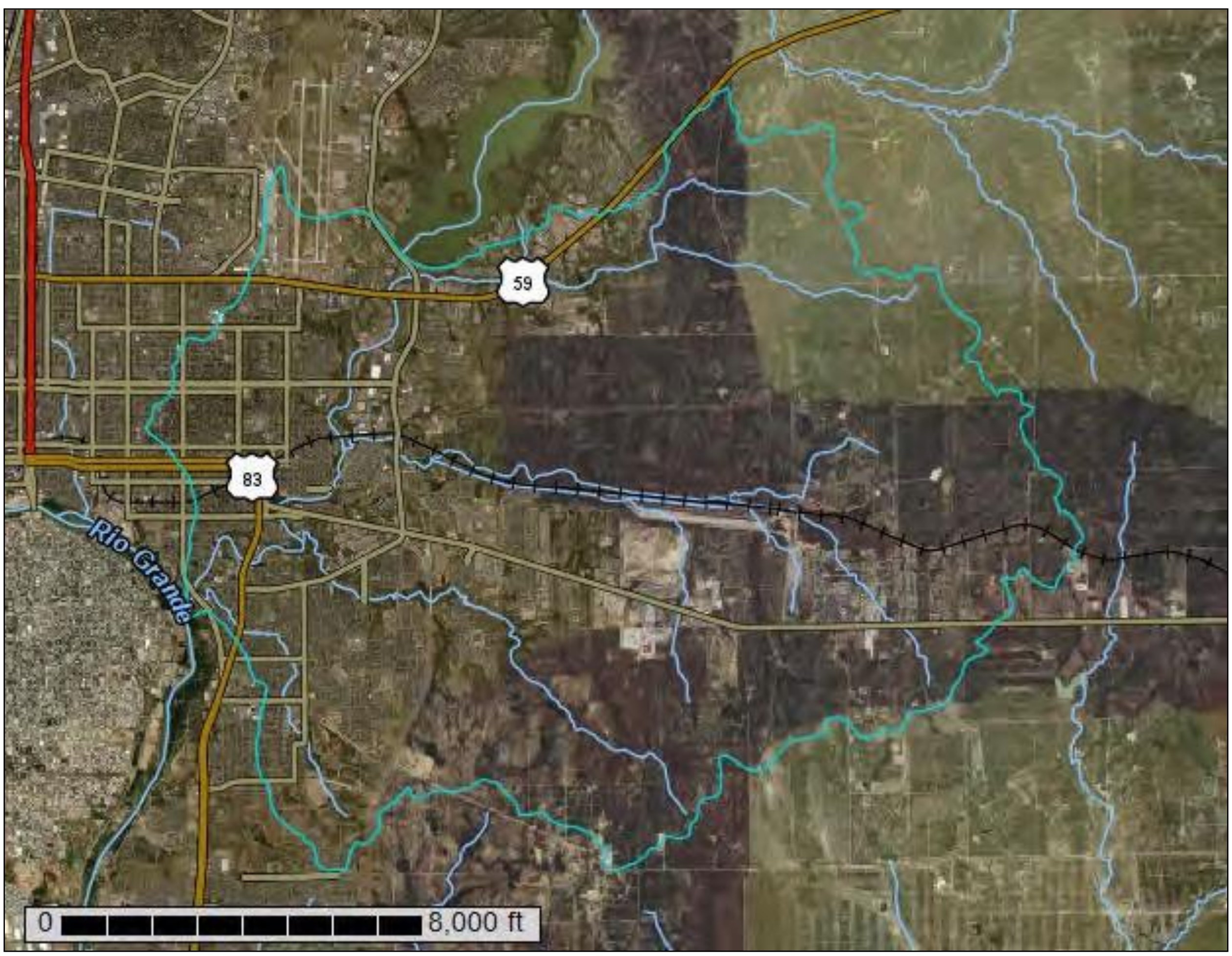
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Webb County, Texas

Chacon Creek Feasibility Study: Biological Assessment



December 5, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

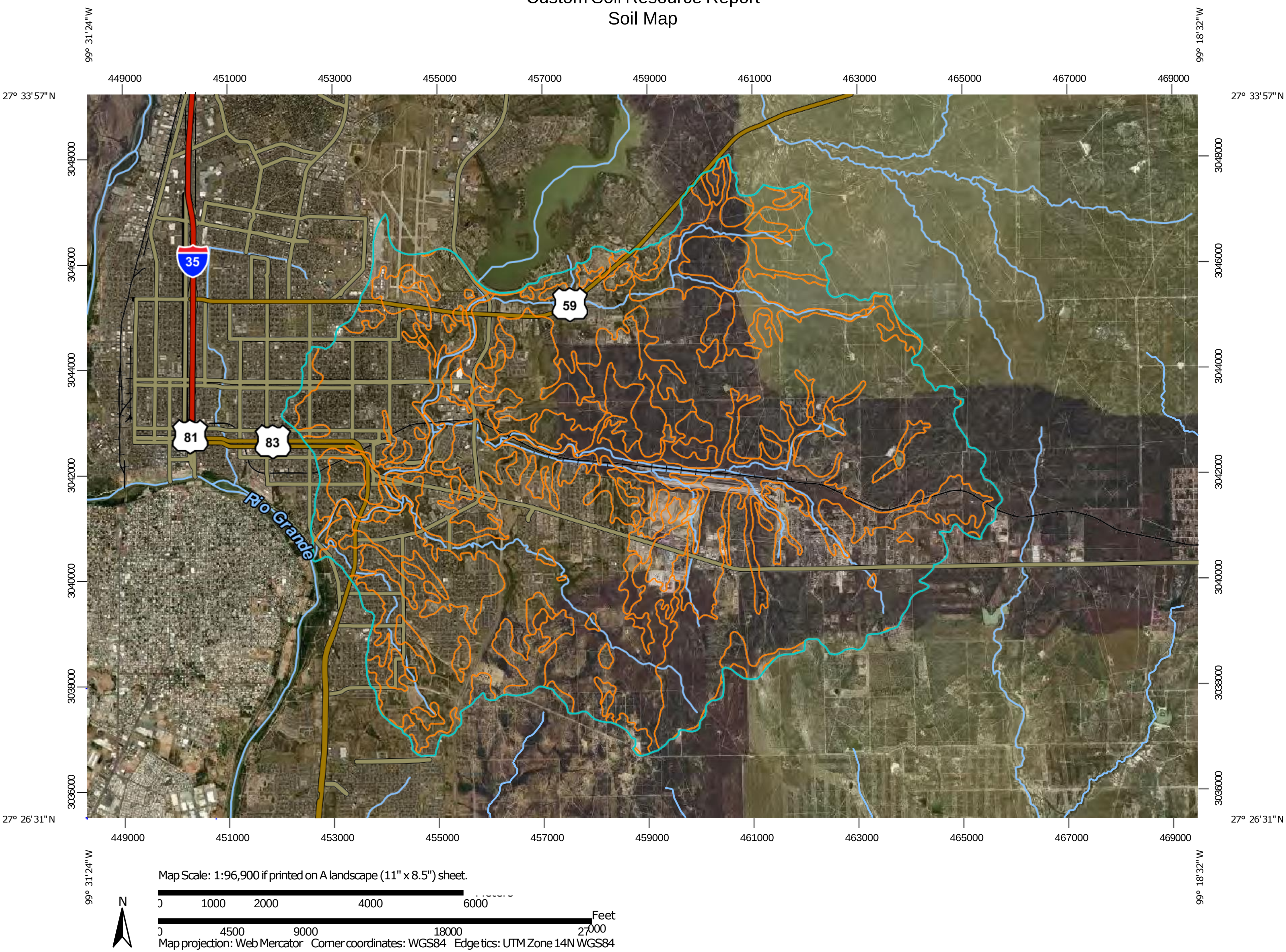
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:96,900 if printed on A landscape (11" x 8.5") sheet.

Meters
0 1000 2000 4000 6000

Feet
0 4500 9000 18000 27000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Webb County, Texas
Survey Area Data: Version 15, Nov 8, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 1, 1999—Feb 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CaB	Catarina clay, 0 to 2 percent slopes	1,551.5	6.4%
CfA	Catarina clay, 0 to 1 percent slopes, occasionally flooded	1,036.0	4.3%
CpB	Copita fine sandy loam, 0 to 3 percent slopes	6,943.9	28.7%
DAM	Dams	11.2	0.0%
HeB	Hebbronville loamy fine sand, 0 to 2 percent slopes	5.8	0.0%
JQD	Jimenez-Quemado complex, undulating	876.1	3.6%
LgA	Lagloria silt loam, 0 to 1 percent slopes	415.9	1.7%
MCE	Maverick-Catarina complex, gently rolling	9,159.4	37.9%
MgC	Moglia clay loam, 1 to 5 percent slopes	936.2	3.9%
NDF	Nido-Rock outcrop complex, hilly	43.3	0.2%
Pt	Pits	2.1	0.0%
Rg	Rio Grande very fine sandy loam, occasionally flooded	163.1	0.7%
Te	Tela sandy clay loam, 0 to 1 percent slopes, frequently flooded	206.9	0.9%
VkC	Verick fine sandy loam, 1 to 5 percent slopes	2,502.7	10.3%
VrB	Viboras clay, 0 to 3 percent slopes	181.6	0.8%
W	Water	160.8	0.7%
Totals for Area of Interest		**24,196.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Webb County, Texas

CaB—Catarina clay, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t12c
Elevation: 300 to 800 feet
Mean annual precipitation: 18 to 24 inches
Mean annual air temperature: 71 to 74 degrees F
Frost-free period: 280 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Catarina and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catarina

Setting

Landform: Ridges
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Calcareous, saline clayey alluvium

Typical profile

A - 0 to 3 inches: clay
Bnssy - 3 to 14 inches: clay
Bknssyz - 14 to 73 inches: clay
Bknyz - 73 to 80 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 10 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 35.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)

Hydric soil rating: No

Minor Components

Maverick

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Rolling Hardland 18-25" PZ (R083BY431TX)
Hydric soil rating: No

Brundage

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: CLAYPAN PRAIRIE 18-25 PZ (R083BY417TX)
Hydric soil rating: No

Viboras

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Monwebb

Percent of map unit: 1 percent
Landform: Drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Clay Flat 18-25" PZ (R083BY415TX)
Hydric soil rating: No

CfA—Catarina clay, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2t12f
Elevation: 280 to 780 feet
Mean annual precipitation: 18 to 23 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 280 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Catarina and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catarina

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Calcareous, saline clayey alluvium

Typical profile

A - 0 to 3 inches: clay
Bnssy - 3 to 14 inches: clay
Bknssyz - 14 to 73 inches: clay
Bknyz - 73 to 80 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 10 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 35.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Minor Components

Brundage

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: CLAYPAN PRAIRIE 18-25 PZ (R083BY417TX)
Hydric soil rating: No

Viboras

Percent of map unit: 1 percent
Landform: Ridges
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Maverick

Percent of map unit: 1 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Rolling Hardland 18-25" PZ (R083BY431TX)
Hydric soil rating: No

CpB—Copita fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t11s
Elevation: 350 to 840 feet
Mean annual precipitation: 20 to 23 inches
Mean annual air temperature: 72 to 75 degrees F
Frost-free period: 285 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Copita and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Copita

Setting

Landform: Low hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

A - 0 to 11 inches: fine sandy loam
Bk - 11 to 37 inches: sandy clay loam
Cr - 37 to 49 inches: bedrock
R - 49 to 80 inches: bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 35 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: Gray Sandy Loam 18-25" PZ (R083BY421TX)
Hydric soil rating: No

Minor Components

Verick

Percent of map unit: 4 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: SHALLOW RIDGE 18-22" PZ (R083BY575TX)
Hydric soil rating: No

Brundage

Percent of map unit: 3 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: TIGHT SANDY LOAM 18-25" PZ (R083BY441TX)
Hydric soil rating: No

Mcallen

Percent of map unit: 3 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Gray Sandy Loam 18-25" PZ (R083BY421TX)
Hydric soil rating: No

DAM—Dams

Map Unit Composition

Dams: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

HeB—Hebbronville loamy fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: djcf
Elevation: 100 to 400 feet
Mean annual precipitation: 18 to 28 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 300 to 330 days
Farmland classification: Farmland of statewide importance, if irrigated

Map Unit Composition

Hebbronville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hebbronville

Setting

Landform: Sand sheets
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands over calcareous loamy alluvium

Typical profile

H1 - 0 to 4 inches: loamy fine sand
H2 - 4 to 46 inches: fine sandy loam
H3 - 46 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: SANDY LOAM 20-30" PZ (R083EY702TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 15 percent
Hydric soil rating: No

JQD—Jimenez-Quemado complex, undulating

Map Unit Setting

National map unit symbol: djcg
Elevation: 100 to 1,000 feet
Mean annual precipitation: 17 to 22 inches
Mean annual air temperature: 70 to 75 degrees F
Frost-free period: 275 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Jimenez and similar soils: 48 percent
Quemado and similar soils: 40 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jimenez

Setting

Landform: Paleoterraces, knobs
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Gravelly and/or loamy alluvium

Typical profile

H1 - 0 to 13 inches: very gravelly sandy clay loam
H2 - 13 to 25 inches: cemented material
H3 - 25 to 60 inches: variable

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: 7 to 18 inches to petrocalcic
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum in profile: 80 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: GRAVELLY RIDGE 18-25 PZ (R083BY419TX)
Hydric soil rating: No

Description of Quemado

Setting

Landform: Paleoterraces, knobs
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Gravelly and/or loamy alluvium

Typical profile

H1 - 0 to 6 inches: very gravelly sandy loam
H2 - 6 to 12 inches: very gravelly sandy clay loam
H3 - 12 to 14 inches: cemented material
H4 - 14 to 60 inches: variable

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: 10 to 20 inches to petrocalcic
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: GRAVELLY RIDGE 18-25 PZ (R083BY419TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 12 percent
Hydric soil rating: No

LgA—Lagloria silt loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: djch
Elevation: 200 to 650 feet
Mean annual precipitation: 17 to 22 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 270 to 325 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Lagloria and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lagloria

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

H1 - 0 to 42 inches: silt loam
H2 - 42 to 63 inches: stratified very fine sandy loam to loam to silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: LOAMY BOTTOMLAND 18-35" PZ (R083BY426TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 10 percent
Hydric soil rating: No

MCE—Maverick-Catarina complex, gently rolling

Map Unit Setting

National map unit symbol: djcl
Elevation: 200 to 900 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Maverick and similar soils: 64 percent
Catarina and similar soils: 30 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Maverick

Setting

Landform: Ridges, interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous, saline, clayey residuum weathered from shale

Typical profile

H1 - 0 to 6 inches: clay
H2 - 6 to 15 inches: clay
H3 - 15 to 25 inches: clay
H4 - 25 to 60 inches: clay

Properties and qualities

Slope: 3 to 10 percent
Depth to restrictive feature: About 25 inches to densic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 15 percent

Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 16.0
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Description of Catarina

Setting

Landform: Valley sides, valley floors
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Calcareous, saline clayey alluvium

Typical profile

H1 - 0 to 10 inches: clay
H2 - 10 to 45 inches: clay
H3 - 45 to 60 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 15 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 35.0
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 6 percent
Hydric soil rating: No

MgC—Moglia clay loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: djcm
Elevation: 250 to 800 feet
Mean annual precipitation: 18 to 21 inches
Mean annual air temperature: 72 to 73 degrees F
Frost-free period: 260 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Moglia and similar soils: 77 percent
Minor components: 23 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Moglia

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous, saline, loamy residuum weathered from shale

Typical profile

H1 - 0 to 7 inches: clay loam
H2 - 7 to 30 inches: clay
H3 - 30 to 54 inches: clay
H4 - 54 to 60 inches: clay loam
H5 - 60 to 80 inches: clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Gypsum, maximum in profile: 20 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 40.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Saline Clay Loam 18-35" PZ (R083BY433TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 23 percent
Hydric soil rating: No

NDF—Nido-Rock outcrop complex, hilly

Map Unit Setting

National map unit symbol: djcq
Elevation: 300 to 8,700 feet
Mean annual precipitation: 10 to 35 inches
Mean annual air temperature: 52 to 73 degrees F
Frost-free period: 120 to 322 days
Farmland classification: Not prime farmland

Map Unit Composition

Nido and similar soils: 78 percent
Rock outcrop: 20 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nido

Setting

Landform: Ridges
Landform position (three-dimensional): Crest
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

H1 - 0 to 7 inches: fine sandy loam
H2 - 7 to 60 inches: bedrock

Properties and qualities

Slope: 3 to 20 percent
Depth to restrictive feature: 3 to 12 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: SHALLOW RIDGE 18-22" PZ (R083BY575TX)
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges
Landform position (three-dimensional): Crest
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Sandstone

Typical profile

H1 - 0 to 80 inches: bedrock

Properties and qualities

Slope: 3 to 20 percent
Depth to restrictive feature: 0 to 2 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 19.98 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 2 percent
Hydric soil rating: No

Pt—Pits

Map Unit Setting

National map unit symbol: djcv
Elevation: 20 to 8,750 feet
Mean annual precipitation: 20 to 24 inches
Mean annual air temperature: 73 to 74 degrees F
Frost-free period: 290 to 340 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Typical profile

H1 - 0 to 80 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: No

Rg—Rio Grande very fine sandy loam, occasionally flooded

Map Unit Setting

National map unit symbol: djcw
Elevation: 100 to 1,400 feet
Mean annual precipitation: 1 to 28 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 280 to 340 days
Farmland classification: Not prime farmland

Map Unit Composition

Rio grande and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rio Grande

Setting

Landform: Flood-plain steps
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

H1 - 0 to 6 inches: very fine sandy loam
H2 - 6 to 63 inches: stratified silt loam to loamy very fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None

Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: LOAMY BOTTOMLAND 18-35" PZ (R083BY426TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 15 percent
Hydric soil rating: No

Te—Tela sandy clay loam, 0 to 1 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2t12w
Elevation: 280 to 930 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 270 to 340 days
Farmland classification: Not prime farmland

Map Unit Composition

Tela and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tela

Setting

Landform: Drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy alluvium

Typical profile

A - 0 to 14 inches: sandy clay loam
Bt - 14 to 40 inches: sandy clay loam
Bk - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 8.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B
Ecological site: RAMADERO 18-25" PZ (R083BY429TX)
Hydric soil rating: No

Minor Components

Webb

Percent of map unit: 10 percent
Landform: Low hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: TIGHT SANDY LOAM 18-25" PZ (R083BY441TX)
Hydric soil rating: No

Catarina

Percent of map unit: 5 percent
Landform: Low hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Saline Clay Loam 18-35" PZ (R083BY433TX)
Hydric soil rating: No

Moglia

Percent of map unit: 4 percent
Landform: Low hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Saline Clay Loam 18-35" PZ (R083BY433TX)
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 1 percent
Landform: Depressions on drainageways
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: LAKEBED 18-35" PZ (R083BY425TX)

Hydric soil rating: Yes

VkC—Verick fine sandy loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t11w
Elevation: 200 to 900 feet
Mean annual precipitation: 17 to 24 inches
Mean annual air temperature: 71 to 74 degrees F
Frost-free period: 265 to 340 days
Farmland classification: Not prime farmland

Map Unit Composition

Verick and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Verick

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous loamy residuum weathered from sandstone

Typical profile

A - 0 to 6 inches: fine sandy loam
Btk - 6 to 15 inches: sandy clay loam
Crk - 15 to 80 inches: cemented bedrock

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: 6 to 16 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D

Ecological site: SHALLOW SANDY LOAM 18-25 PZ (R083BY440TX)
Hydric soil rating: No

Minor Components

Maverick

Percent of map unit: 8 percent
Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Rolling Hardland 18-25" PZ (R083BY431TX)
Hydric soil rating: No

Zapata

Percent of map unit: 8 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: SHALLOW RIDGE 18-22" PZ (R083BY575TX)
Hydric soil rating: No

Tela

Percent of map unit: 2 percent
Landform: Drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Hydric soil rating: No

VrB—Viboras clay, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: djd0
Elevation: 250 to 900 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 70 to 73 degrees F
Frost-free period: 260 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Viboras and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Viboras

Setting

Landform: Valley sides, valley floors
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Calcareous, sodic clayey residuum weathered from shale and siltstone

Typical profile

H1 - 0 to 9 inches: clay
H2 - 9 to 16 inches: clay
H3 - 16 to 28 inches: clay
H4 - 28 to 36 inches: clay
H5 - 36 to 60 inches: bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to densic bedrock
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 35.0
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Saline Clay 18-25" PZ (R083BY432TX)
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 13 percent
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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Appendix C

Chacon Creek Monitoring and Adaptive Management Plan

Chacon Creek Monitoring and Adaptive Management Plan

April 2018

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TETRA TECH

Contents

1.0 INTRODUCTION

This study is located in the City of Laredo (the City), Texas in the Lower Chacon Creek watershed. The City is just north of the Rio Grande in Webb County and is a major trucking route for international trade between the United States and Mexico. The City and Webb County are currently experiencing rapid growth causing increased encroachment on the Lower Chacon Creek watershed (Figure 1).

Chacon Creek is an important natural resource located on the eastern side of Laredo, Texas with a wide range of environmental, economic, recreational, and educational needs and opportunities. Years of neglect including illegal dumping, rapid urbanization, and storm runoff have led to contamination, erosion, and loss of wetland habitats and vegetation. Invasive plant species have seriously degraded the value of riparian and riverine habitats for wildlife, as well as altered soil productivity and increased the potential for fires.

A Feasibility Study and Environmental Assessment for Chacon Creek, Laredo, Texas (Study) was conducted by the U.S. Army Corps of Engineers (USACE) in cooperation with the City. The Study examined an array of alternatives to address each of the challenges to reduce flood threat, restore the aquatic and riparian ecosystems, and provide compatible recreational opportunities. The Tentatively Selected Plan (TSP) is a combined National Economic Development/National Ecosystem Restoration (NED/NER) Plan.

This Monitoring and Adaptive Management Plan (Plan) is intended to provide a method to evaluate the goals of the TSP by measuring success criteria through specific, on the ground monitoring of project components. The potential need for adaptive management where success criteria may not have been met is also described.

Adaptive management (AM) is defined as a rigorous approach for designing and implementing management actions to learn about critical uncertainties that affect decisions (Williams et al. 2012). The heart of adaptive decision making is the recognition of alternative hypotheses about resource dynamics (Williams and Brown 2012) and assessment through monitoring. Science-based monitoring is performed to see if actual outcomes match those predicted, and using these results to learn and adjust future management. All the monitoring and adaptive management criteria shall be used to evaluate the degree to which the project meets the goals described in Section 1 below.

1.1 PROJECT AND GOALS

The project goal for ecosystem restoration under the TSP is to provide a diverse and sustainable ecosystem for the Chacon Creek corridor. The primary objective is to improve the suitability and quality of the habitat in the study area in a manner that is sustainable and enhances the natural systems by resolving environmental degradation within the Chacon Creek corridor. The removal of problematic non-native vegetation and establishment of desirable native shrubs and trees is required to increase habitat suitability within the planning area. The increase in habitat quality will increase the amount of habitat for federal listed species and native wildlife.

1.2 AUTHORIZATION FOR MONITORING AND ADAPTIVE MANAGEMENT

Per Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007), feasibility studies for ecosystem restoration are required to include a plan for monitoring the success of the ecosystem restoration. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be need to attain project benefits." Therefore, Section 2039 also directs that a Contingency Plan (Adaptive Management Plan) be developed for all ecosystem restoration projects.

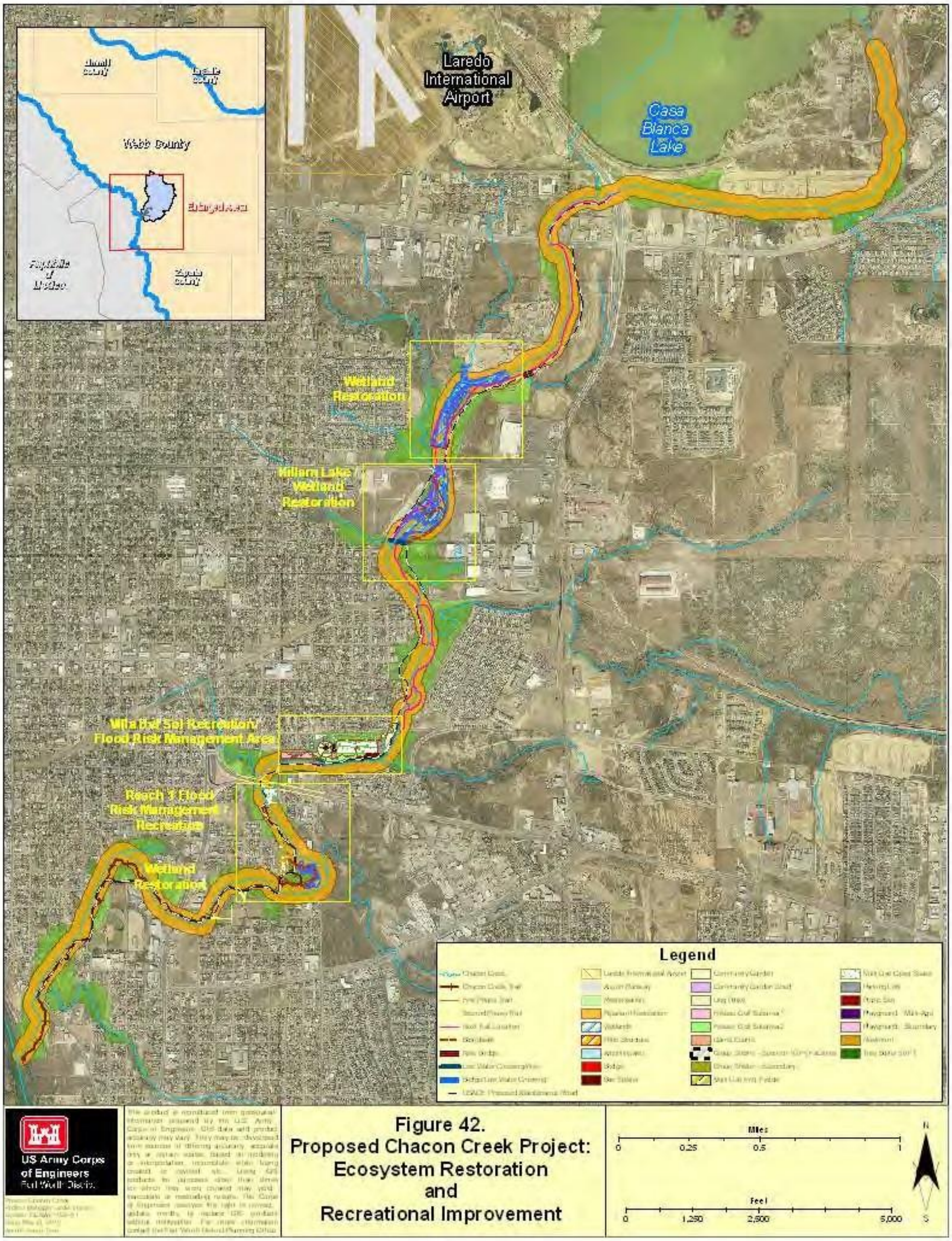
The restoration measures will be periodically surveyed to provide feedback on ecosystem response to the restoration and management measures proposed for the Chacon Creek corridor. By connecting the ecosystem response to the restoration as well as the management measures, potential beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project.

To accomplish this goal, periodic monitoring of the restoration measures by the Federal Government will be conducted during project implementation prior to the project being turned over to the non-Federal sponsor for operation and maintenance, and will be cost-shared between the Government and the non-Federal sponsor as part of the total project cost.

a. Action Implemented

The NER component of the TSP would restore three wetland sites and implement riparian restoration of over 400 acres of aquatic habitat. Figure 1 depicts the location of the aquatic ER component of the TSP. The ER component would restore three wetland sites totaling 16.75 acres and 401 acres of riparian habitat, by removing buffelgrass (*Pennisetum ciliare*) and other invasive non-native grasses and planting native species with temporary irrigation until plants are established. Additional riparian measures include the removal and control of salt cedar (*Tamarix* spp.; salt cedar). The TSP would also include the removal of debris as well as a concrete barrier from the streambed.

The NER Plan includes elements for improving water quality, improving herbaceous cover, reduction in erosion and turbidity, controlling invasive species, and enhancing the quality of wetland, riverine, and riparian habitats. The ecosystem restoration measures for the proposed action are expected to have long-term beneficial effects for the terrestrial and aquatic systems and associated wildlife in the project area by providing improved habitat and a potential corridor between areas of suitable habitat, and would therefore be wholly beneficial for the ocelot (*Leopardus* (=*Felis*) *pardalis*), Gulf Coast jaguarundi (*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*; jaguarundi), and Texas hornshell (*Popenaias popeii*).



(Image source: USACE, 2010)

Figure 1. Restoration Overview

1. Wetland measures

Wetland measures would contribute to ecosystem restoration by increasing the quantity and quality of wetland habitat and improving water quality. The wetland measures would create or expand existing wetland areas. This would be accomplished by constructing weir/riffle structures that would hold a shallow pool of water upstream of the weir, expanding the area of existing wetlands. On the downstream side of the weir, a riffle structure would extend five feet downstream for every one-foot of weir height. This riffle structure would add oxygen to the system and improve water quality. However, its primary purpose would be to prevent scour and provide support to the weir structure. Rain events would be the source for water and seepage from the dam at Lake Casa Blanca. For each site, various weir heights were considered to create wetland area.

The recommended plan includes three wetland areas that will total approximately 16.75 acres, which is an addition of 13.09 acres (Figure 2).

Wetland A, Scale A2

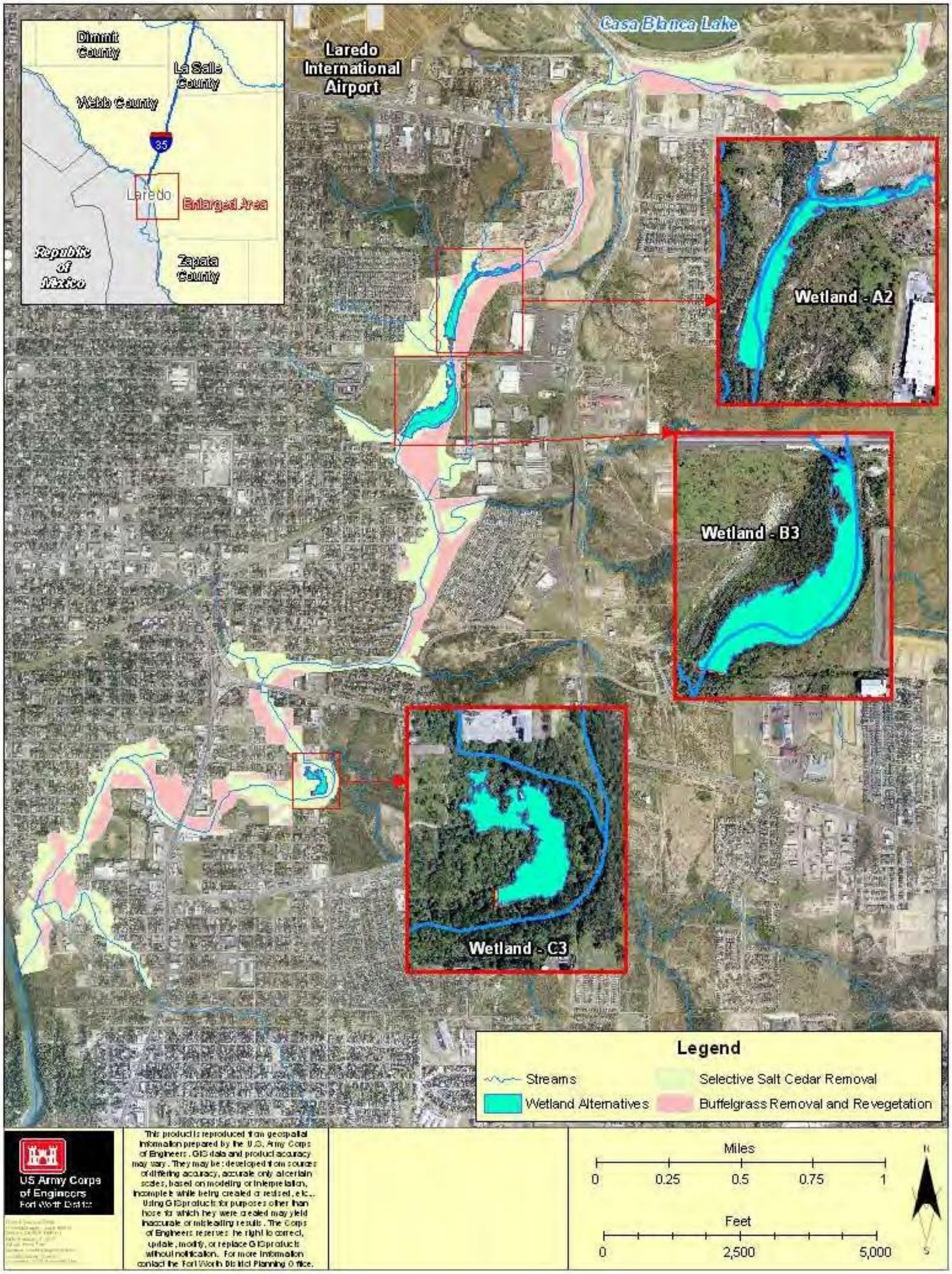
For Wetland A, a weir would be constructed that would raise water levels by two feet. A downstream riffle will be constructed that will primarily prevent scour and support the weir structure. This riffle structure will also enhance riverine habitat by adding oxygen to the water and provide positive changes to the habitat suitability in the area. In this area, upstream from the proposed weir, a concentrated animal feeding operation (CAFO) exists that adds nutrient runoff to the system. As part of the riparian measures, this facility will be removed in the study area.

Wetland B, Scale B3

For wetland B, a weir would also be constructed that would add approximately three feet of permanent water to the site; again, a riffle structure downstream from the weir would be constructed.

Wetland C, Scale C3

For wetland C, an off-channel weir would be constructed that seasonally would add up to three feet of water to the site, and a riffle structure downstream from the weir would be constructed. Extensive debris removal is included in this area. There were several woody species in the area; impacts to these will be avoided and minimized.



(Image source: USACE, 2010)

Figure 2. Wetland Measures Overview

2. Riverine Measures

The recommended plan does not include any additional riffle structures in the three identified riverine reaches.

3. Riparian Measures

The remainder of the study area, the area not included for wetland or riverine ecosystem restoration measures, was identified as "forested" riparian and "non-forested" riparian, and these areas were then used as scales for the riparian measures. The riparian measure, measure G, includes three scales to be implemented on 401 acres. For the area identified as "non-forested," the alternative (G1) includes removal and control of buffelgrass and other non-native species present, as well as planting native species and would include irrigation. An access road will be installed to support maintenance. For the area identified as "forested," the alternative (G2) consists of the selective removal and control of salt cedar, an invasive species, as well as the removal of debris. The third scale or alternative G3, the selected alternative, would be a combination of G1 and G2.

Riparian G, Scale G3

For this measure, scale G3 is a combination of scales G1 and G2. Scale G1 includes portions of the study area identified as non-forested riparian, and vegetation consists primarily of buffelgrass, an invasive species. In these areas, native species will be avoided, but otherwise this area will be cleared, grubbed, and treated for control of buffelgrass, followed by the installation of an irrigation system and replanting of native species, as described in the USFWS Site Visit Report in Appendix E, "U.S. Fish and Wildlife Service Coordination." G2 includes areas identified as forested riparian, and for this measure includes selective removal and stump treatment of salt cedar, as described in the USFWS Site Visit Report.

The riparian restoration consists of the removal and management of invasive species, as well as planting of native species in the riparian area. Salt cedar would be selectively removed from 251 acres, and buffelgrass would be removed from 150 acres within the study area. 150 acres of native species of trees, shrubs, and herbaceous vegetation would be planted in the riparian area. This would ultimately result in 401 acres of restored riparian habitat and 16.75 acres of wetlands. This would primarily have moderate long-term, beneficial impacts on vegetation, which would have indirect beneficial effects on water quality the other resources. Riparian restoration would increase habitat quality for species using the riparian corridors, including the ocelot and jaguarundi. The proposed action would also include the removal of debris as well as a concrete barrier from the streambed.

In total, there are three general ecosystem restoration activities in this study: the creation and restoration of wetlands, improvement to aquatic riverine habitat, and reforestation of riparian habitat. To evaluate these actions, the activities were separated into measures with a series of scales. Table 1 provides a summary of the above-described measures and scales.

Table 1. Ecosystem Restoration Summary

Measure	Scale	Description
Wetland Site A	A2	Weir height 2 feet, width 120 feet, to create approximately 5.99 acres of wetland
Wetland Site B	B3	Weir height 3 feet, width 190 feet, to create approximately 8.69 acres of wetland
Wetland Site C	C3	Weir height 3 feet, width 65 feet, to create approximately 2.07 acres of wetland, debris removal
Riparian G	G1	Reforestation of non-forested area, including buffelgrass control, planting, and irrigation
	G2	Removal of salt cedar from forested areas
	G3	G1 + G2

b. Project Requirements

Under Section 404 of the Clean Water Act (CWA) (33 USC 1344), Congress directed USACE *to regulate the discharge of dredged and fill material into all waters of the United States including wetlands*. Based on information gathered during biological surveys, approximately 4.62 acres of the restoration area are considered Waters of the United States. The work is proposed to be conducted under Nationwide Permit (NWP) 27 and coordination with the Texas Commission on Environmental Quality (TCEQ) regarding water quality certification.

- NWP 27 "Aquatic Habitat Restoration, Enhancement, and Establishment Activities" pertains to activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.
- Best management practices are also required where practicable to reduce the risk of transferring invasive plant and animal species to or from project sites. The TSP would not result in the loss of aquatic sites or streams therefore no mitigation would be required. Best management practices would be implemented to reduce the risk of spreading invasive species.
- The Texas Commission on Environmental Quality (TCEQ) is responsible for conducting Section 401 certification for the discharge of dredged or fill material into waters of the United States, including wetlands. The TCEQ conditionally certifies that the activities authorized by NWP 27 should not result in a violation of established Texas Surface Water Quality Standards as required by Section 401 of the Federal Clean Water Act and pursuant to Title 30, Texas Administrative Code, Chapter 279. General Condition 12 of the certification requires Soil Erosion and Sediment Controls.

Any additional Section 404/401 requirements for implementation and management of the proposed project should be amended to this Plan.

A Draft Biological Assessment (Study Appendix E. USFWS Coordination) was also developed for the project and any requirements of final coordination with the U.S. Fish and Wildlife Service (USFWS) should be amended to this Plan.

Project components, best management practices, and an evaluation of project success are described in Section 2.0 and address as many of the criteria as possible/are known at this time.

c. Operation, Maintenance, Repair, Replacement, and Rehabilitation

The Federal Government and the City would enter into a project partnership agreement (PPA) under which the City would accept the project following completion of construction and ensure its operation, maintenance, repair, rehabilitation, and replacement (OMRRR), in accordance with Federal regulations. The major OMRRR items include the following:

- Regular maintenance of park facilities
- Restriping access areas
- Debris cleanup
- Selective trimming in restoration areas
- Invasive species control

The tasks required under the TSP OMRRR will involve a modest increase in the types of maintenance activities the City is already accustomed to. Recreation maintenance requirements, such as grounds and equipment maintenance and debris cleanup, are things the City already performs to maintain the City parks grounds and facilities. In the case of the TSP, the City would have a larger facility to maintain than what is currently present in the Villa Del Sol neighborhood, as well as additional facilities in Reach 1 south of Highway 359. The ecosystem restoration maintenance activities of selective trimming and invasive species control are already activities the City performs as well, particularly the control of salt cedar.

After completion of the project, an Operation and Maintenance (O&M) Manual for the City would be prepared by USACE, and periodic inspections would be conducted to ensure that all required maintenance was being performed.

This Plan will also be an Appendix to the O&M Manual for implementation by the City.

2.0 MONITORING PLAN COMPONENTS, GOALS AND SUCCESS CRITERIA

The national and state trend for habitat loss is evident in the Laredo area, which makes this significant national, state, and local resource even more important. The Chacon Creek corridor is divided by the dam creating Lake Casa Blanca. A portion of the corridor on the western side of Chacon Creek and south of E Saunders St between the Lake Casa Blanca and the Rio Grande contains a CAFO adjacent to the stream channel. Further habitat degradation is resulting from the introduction and spread of exotic species. The introduction of exotic plant and animal species has rendered substantial effects on riparian areas, leading to displacement of native species and the subsequent alteration of ecosystem properties (NRC 2002). Problematic non-native woody and herbaceous plant species are found throughout the project area. The USFWS and Texas Parks and Wildlife Department (TPWD) recommended local elimination of these species because they limit the value of important riparian ecosystems.

Desirable habitat for migratory waterfowl and neotropical migrants is limited in the Laredo area. However, the project area is centrally located along the Rio Grande River, which runs from Colorado to the Gulf of Mexico, and provides an important corridor through the southwest. Any improvement to the documented degraded state of the riparian zone would increase the amount of scarce habitat along a documented migratory bird corridor.

The study area consists primarily of riparian habitat, yet the approximately 401 acres provide little quality habitat. Exotic species have become established in the riparian area. Non-forested riparian areas and forested areas with adequate solar exposure support a near monoculture of buffelgrass. In the forested riparian areas, salt cedar is becoming established and displacing native vegetation. Specific measures such as exotic species removal and revegetation in the riparian area could directly increase habitat quality and improve the health of the riparian habitat located within the study area. Any improvements to the riparian habitat including riparian woodlands and wetlands would make an important contribution to restoring the one of the last natural stream corridors in the City.

2.1 RIPARIAN HABITAT RESOURCES

a. Vegetation

Gould and et al (1969) divided Texas into ecological regions based on the distribution of vegetation. The study area is within the South Texas Plains Ecological Region. This South Texas region owes its diversity to the convergence of the Chihuahuan Desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande to the south, and coastal grasslands to the east. The South Texas Plains are characterized by a shrubland of mesquite (*Prosopis glandulosa*), blackbrush acacia (*Acacia rigidula*), spiny hackberry (*Celtis pallida*), and other shrubs intermixed with a variety of grasses. Forested areas can develop along small drainages and typically support small trees, such as sugarberry (*Celtis laevigata*) and ash species (*Fraxinus* spp.). The suppression of fire, multiple invasions of non-native plants, loss of wetlands, encroachment of brush, livestock grazing, and habitat fragmentation have arguably altered the current vegetation. A list of vegetation observed in the study area is included in the Study Environmental Appendix B, Addendum C.

As defined by species composition and general appearance, the vegetation communities that the USACE Project Development Team observed in the study area are typical of small drainages in the South Texas Plains. A Mesquite-Mixed Shrub-Buffelgrass shrubland is nearly ubiquitous throughout the study area, and a few remnant stands of Sugarberry-Mexican Ash (*Fraxinus berlandieriana*) forest are found in the middle portion of the study area.

The persistence of invasive non-native plant species, such as salt cedar, Arundo cane (*Arundo donax*), and buffelgrass (*Pennisetum ciliare*), has significantly degraded habitat value for wildlife and ecological function and has prevented the reestablishment of desirable native species. Other introduced invasive plant species include kleingrass (*Panicum coloratum*), Kleberg's bluestem (*Dichanthium annulatum*), and low abundances of white leadtrees (*Leucaena leucocephala*). These plants escaped from cultivated settings or introduced to provide forage to cattle and proliferated in an environment lacking species specific disease and pests. The plants have and will continue to colonize newly disturbed areas forming dense monotypic stands over wide areas and have little value to native wildlife. Buffelgrass is still being spread and cultivated in large areas as a "superior" forage for cattle. These plants alter fire regimes, out-compete native plant species, and in some cases exhibit allelopathic characteristics.

b. Invasive Plant Species

Several introduced, invasive plants are presently well established in the riparian shrubland habitat and throughout the project area. The most significant are buffelgrass, Kleberg bluestem, salt cedar, guineagrass (*Urochloa maxima*), Arundo cane, castorbean (*Ricinus communis*), and Russian thistle (*Salsola* spp.). Invasive white leadtrees are present at low abundance.

Unlike most native wood riparian plant species salt cedar can propagate in the absence of physical disturbance events in regulated waterways such as Chacon Creek. The seed and seedbed ecology of native woody species requires damp seedbeds found on the active floodplain to initiate germination and promote the establishment of native woody vegetation communities. Salt cedar can regenerate in the absence of physical disturbance events and consequently serves as a major habitat component in degraded riparian areas under altered hydrologic regimes, which are insufficient to support robust native woody species regeneration. The reduced amount of physical disturbance in the floodplain has increased the dominance of salt cedar stands over time.

Habitat characteristics of salt cedar systems confer mixed benefits to animal species. Although salt cedar is a non-native species and native vegetation stands are more desirable, it provides important habitat qualities in riparian areas where physical disturbances are absent and potential for native vegetation regeneration is low. Salt cedar provides vegetation structure and is an important habitat for nesting riparian bird species (Sogge et al. 2008; Paxton et al. 2011). Non-avian use of salt cedar is not fully understood; however, reptile and mammal use of both salt cedar and mixed habitats has been documented (Bateman and Ostoja, 2012).

Buffelgrass is perennial C_4 warm season bunchgrass introduced into areas of Texas from Africa as early as 1917, with increasing successful plantings occurring between 1949 and 1985 (Hanselka 1988). The species has infested areas in south Texas (Cox et al. 1988). The species is considered valuable for livestock and has led to increased cattle stocking rates but is of poor value for wildlife (Hanselka 1988). Buffelgrass is still being spread and cultivated in large areas as a “superior” forage for cattle.

Buffelgrass is present throughout the project area, particularly in open canopy and upland settings. The species exhibits a high tolerance to drought and grazing pressures, and vigorously responds to precipitation events (Marshal et al. 2012). Buffelgrass is ecologically problematic due to its dense monotypic stands, which grow, senesce, and dry in total synchrony, unlike the diverse native vegetation where species avoid competition by partitioning phenological niches (Wolkovich and Cleland 2014). As a result, buffelgrass stands are extremely susceptible to wildfire, unlike the native riparian shrubland vegetation which is very well adapted to wildfire. Once established, the invasive grasses create an increased potential for wildfire and grass cover and a domino syndrome of loss of biodiversity and collapse of the ecosystem. The presence of buffelgrass in south Texas has resulted in reduced forb species richness, density, and total cover (Sands et al. 2009).

The introduction and spread of buffelgrass presents a threat to biodiversity in the study area (Marshall et al. 2012). Buffelgrass is ubiquitous throughout the study area and forms a major component of the herbaceous understory. This non-native species competes with native grasses and forbs and forms extensive monocultures. Although the percent cover of buffelgrass was as high as 80 percent in some areas, this species does little to prevent erosion and does not provide suitable forage for most species. Buffelgrass reaches greater densities compared to native grasses, is fire tolerant, and promotes a grass-fire cycle that is capable or replacing native vegetation (McDonald and McPherson 2011).

c. Wildlife

The South Texas Plains support a wide variety of wildlife (Gould, 1969). Dense riparian vegetation is often an important source of forage and cover that is lacking in the more xeric upland habitats. A list of wildlife observed in the study area is included in the Study Environmental Appendix B, Addendum D. Common birds include the Altimira oriole (*Icterus gularis*), Chachalaca (*Ortalis vetula*), green jay (*Cyanocroax yncas*), olive sparrow (*Arremonops rufivirgatus*), road runner (*Geococcyx californianus*), scaled quail (*Callipepla squamata*), and white-tipped dove (*Leptotila verreauxi*). Also, three rare tropical birds that are considered "South Texas Specialty Species" (Woodin, 2000) were recorded along the Rio Grande in Laredo. These include the White-collared Seedeater (*Sporophila torqueola*), Clay-colored Robin (*Turdus grayi*), and Red-billed Pigeon (*Columba flavirostris*).

Common mammals of the South Texas Plains include badger (*Taxidea taxus*), bobcat (*Felis rufus*), eastern cottontail (*Sylvagus floridanus*), gray fox (*Urocyon cinereoargentus*), javelina (*Tayassu tajacu*), ringtail raccoon (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), and a variety of small mammals including mice and rats.

Common snakes in the South Texas Plains include the blotched water snake (*Thamnophis marcianus transversa*), diamondback water snake (*Nerodia rhombifera*), Mexican racer (*Coluber constrictor oaxaca*), Texas glossy snake (*Arizona elegans*), western diamondback rattlesnake (*Crotalus atrox*), and the Texas indigo snake (*Drymarchon corais*). Common lizards of the South Texas Plains include the blue spiny lizard (*Sceloporus cyanogenys*), southern prairie lizard (*Sceloporus undulatus consobrinus*), Texas banded gecko (*Coleonyx brevis*), Texas spiny lizard (*Sceloporus olivaceus*), and Texas spotted whiptail (*Cnemidophorus gularis*).

d. Riparian Habitat Goals, Success Criteria, and Monitoring Components

The goals related to riparian vegetation include: controlling weed species and exotic woody plant species; survival of planted native trees, shrubs and herbaceous vegetation, and establishment and survival of native vegetation within the project area. For the purposes of this plan, weeds are defined as non-native herbaceous plants and exotic woody plants are invasive and/or phreatophytic trees. Based upon these goals, success criteria, and related monitoring components are noted in Table 2 below. Specific monitoring component methods are described in Section 3.0.

Table 2. Riparian Habitat Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Components
Control weeds and exotic and invasive vegetation species	Maintain the site with no more than 25% weed/exotic herbaceous species	Measure % of weeds and exotic herbaceous species within treated areas
	Maintain the site with no more than 15% exotic woody plant species	Measure % of exotic woody plant species within treated areas
Survival of planted native trees, shrubs	Maintain 80% survival of planted trees and shrubs	Initial inventory of trees and shrubs on pre-defined transects and monitoring of subsequent % survival.

Goal	Success Criteria	Monitoring Components
and herbaceous species	Ensure a growth rate of 1-plant per ft^2 for planted native seed	Random plot measurement along transect in treated areas
Establishment and survival of native vegetation	Survival of at least 80% of native trees and shrubs that established through natural recruitment	Measure % of native species within treated areas and compare to previous year
Increase wildlife habitat	Habitat criteria are the same as vegetation criteria above	Vegetation monitoring components described above
Eliminate presence of debris	Absence of debris accumulation in project area	Monitor for presence/absence of debris accumulation

2.2 AQUATIC RESOURCES

a. Aquatic Habitat

Vegetation removal, urban development, flow alteration, and exotic species invasion have all impacted the aquatic habitat of Chacon Creek. The Chacon Creek low-flow channel generally carries less than five cubic feet per second (cfs) during normal conditions. The narrow stream channel is usually lined and commonly shaded from overhanging vegetation. The lower reach of Chacon Creek is characterized by deeper and wider pools as groundwater and backwater influences from the Rio Grande are realized. This riverine habitat is a narrow non-continuous band within the channel.

In the upper reaches of the creek, some stretches of stream channel become shallow and wider, with thick stands of cattail *(*Typha spp.) and could be considered as herbaceous wetlands. Three additional areas that could be considered palustrine wetlands also occur in the study area. They are characterized by at least some herbaceous emergent vegetation, such as spike rush, along the channel edges and persistent stems of inundated woody vegetation within areas of open water. Although these high value aquatic habitats persist in the study area, poor water quality, human caused disturbance, scour during high flows, sedimentation, and infestation of invasive species has contributed to their degradation.

The enhancement of three wetland sites, totaling 16.75 acres, would increase the quantity and quality of wetland habitat, as well as increase water quality. These permanent wetlands would provide a water source for wildlife, including migrating ocelot and jaguarundi (Figure 2).

b. Aquatic Species

In October 2006, a fisheries survey was conducted on Chacon Creek in Laredo, Webb County, Texas, by the USFWS and City Environmental Services Department personnel. The purpose of this survey was to determine baseline fish-community structure within the area of Chacon Creek. Three sites were selected to sample fish. Table 3 lists the species and numbers collected. For the full baseline fisheries survey report, see the Study Appendix B “Ecosystem Restoration” (Environmental).

Table 3. Chacon Creek Fish Species Collected October 2006

Family	Species	Count
Atherinidae	Inland Silverside (*Menidia beryllina*)	113
Centrarchidae	Bluegill Sunfish (*Lepomis macrochirus*)	9
Characidae	Mexican Tetra (*Astyanax mexicanus*)	19
Cichlidae	Rio Grande Cichlid (*Cichlasoma cyanoguttatum*)	1
	Blue Tilapia (*Tilapia aureus*)	9
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	33
Cyprinidae	Blacktail Shiner (*Cyprinella venusta*)	68
	Sand Shiner (*Notropis stramineus*)	3
Poeceliidae	Western Mosquitofish (*Gambusia affinis*)	102
	Sailfin Molly (*Poecillia latipinna*)	65
Total		**442**

The fisheries survey and an index of biotic integrity (IBI) were used to assess the aquatic habitat in the study area. An IBI provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these metrics to define species richness, trophic composition, and abundance. The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages. Each metric is scored by Environmental Protection specialists with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric's score for a total score. An IBI can then be converted to a habitat index by dividing the IBI score by the maximum IBI score possible. For the full HEP and IBI reports, see the Study Environmental Appendix B.

c. Aquatic Habitat Value

The IBI score for existing aquatic habitat is 27, which when converted to an HSI, is .49. Table 4 provides the existing acres and habitat units of the riverine system on Chacon Creek.

Table 4. Existing Aquatic Habitat Value

Cover Type	Acres	HSI	HU
Aquatic	.96	0.49	.47

d. Water Quality

The Rio Grande is the City's primary source for public water supply. Non-point source (NPS) pollution, which comes from many diffuse sources and is caused by precipitation runoff moving over and through the ground, is the main issue confronting Rio Grande water quality. The Texas Commission on Environmental Quality (TCEQ) assessed the water quality of the Rio Grande downstream from Texas Mexican International Railway Bridge and found that it does not support either recreational use or fish consumption due to elevated levels of fecal coliform bacteria.

Although no direct water quality measurements are available for Chacon Creek, there is substantial illegal dumping and a CAFO are located within the floodplain. Additionally, there is considerable urban development both encroaching on the floodplain and immediately adjacent to Chacon Creek. Storm water runoff that collects in residential areas is concentrated in roadways and in most places enters the study area without any man-made diversions or natural buffers. Further, runoff transports oil, grease, pesticides, and other natural and human-made pollutants, finally depositing them into Chacon Creek and wetlands, as well as underground sources of drinking water. The placement of flow control devices or the creation of natural vegetative buffers could improve habitat conditions in aquatic, wetland, and terrestrial habitats.

The increase of impervious surfaces in the western and lower Chacon Creek watershed contributes to the rapid flooding and high flow volumes characteristic of Chacon Creek after high rainfall events. The sediment and pollution in turn contributes to turbidity in the stream and wetlands. High turbidity leads to increased water temperature and limits growth of aquatic plants, both of which reduce dissolved oxygen in the aquatic system.

The enhancement of three wetland sites, totaling 16.75 acres, would increase the quantity and quality of wetland habitat, as well as increase water quality.

e. Aquatic Habitat Goals, Success Criteria, and Monitoring Components

The goals related to aquatic resources include improving the quantity and quality of wetland habitat which is expected to improve water quality and aquatic habitat for native fish species. Based upon these goals, success criteria and related monitoring components are noted in Table 5 below. Specific monitoring component methods are described in Section 3.0.

Table 5. Aquatic Habitat Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Components
Create and Maintain Wetland Habitat	Maintain wetland area created by weir/riffle structures	Measure total wetland area and wetland vegetation and compare to previous year
Maintain integrity of weir/riffle structures	Functional weir/riffle structures that create wetland habitat	Monitor weir/riffle structures for function and integrity.
Improve water quality	Decrease in turbidity nutrient concentrations and increase in DO	Monitor water samples for turbidity, dissolved oxygen, and nutrients. Measure stream channel depth, flow and substrate. Compare to previous year
Improve IBI and HSI values	Improved species richness and abundance	Measure IBI and HIS values and compare to 2006 data

2.3 THREATENED AND ENDANGERED SPECIES

The USFWS lists seven Federally endangered species that are known to occur in Webb County (see Table 6); three of which are identified as potentially occurring in the vicinity of the study area.

Table 6. Federally Listed Threatened and Endangered Species, Webb County, Texas

Common Name	Scientific Name	Status	Study Area Potential
Ocelot	*Leopardus pardali*	Endangered	Minimal
Gulf Coast Jaguarundi	*Herpailurus yagouaroundi cacomitli*	Endangered	Minimal
Texas Hornshell	*Popenaias popeii*	Endangered	Minimal

No Federally designated critical habitats for these species occur within Webb County.

The Fort Worth District engaged in initial formal consultation with USFWS as required as a condition of Section 7 of the Endangered Species Act (ESA) if a proposed action is likely to adversely affect a listed species. A Biological Assessment, which determines whether a proposed action is likely to adversely affect listed species, proposed species, or designated critical habitat, would be submitted to USFWS and a draft is included in the study documentation (Appendix E). A Biological Opinion, prepared by USFWS and documents whether the proposed action will jeopardize the continued existence of a listed species, would be included in the final study documentation.

a. Ocelot

In 1982, the ocelot was designated as an endangered species under the ESA, a status that extended U.S. protections to the species throughout its range in 22 countries, including Texas, Mexico, and Central and South America. No critical habitat has been designated for this species.

The ocelot is a medium-sized cat, measuring up to three feet in body length and weighing as much as 35 pounds. It is slender and covered with attractive, irregular-shaped rosettes and spots that run the length of its body. Historically, the ocelot occurred in Arkansas, Arizona, southern California, Texas, Mexico and southward through Central and South America to Peru, Uruguay, and northern Argentina (Navarro-Lopez 1985). Today it ranges from southern Texas and northern Sonora, Mexico to Central America, Ecuador and northern Argentina, but in reduced numbers (Tewes and Everett 1986; Emmons 1990; Murray and Gardner 1997). In the U.S. habitat for the species consists of Tamaulipan brushland, which is a unique ecosystem only found in south Texas and northeastern Mexico. The species is primarily nocturnal, although some diurnal activity has been documented. The reproductive season is year-round, with spring or autumn breeding peaks noted in Texas and Mexico.

Fragmentation of Tamaulipan brush habitat and habitat loss due to brush clearing are primary reasons for ocelot decline. Additionally, ocelots require thick vegetation for foraging, resting, and establishing dens and corridors, such as rivers, shorelines, and natural drainages to travel between optimal habitat areas.

b. Gulf Coast Jaguarundi

The jaguarundi was listed as endangered on June 14, 1976. The jaguarundi has two distinct color phases, red and gray, although the latter phase has also been called blue. The study area provides moderate to low quality habitat for ocelot and Gulf Coast jaguarundi. These cats are not likely residents in the study area due to proximity to urban infrastructure and restricted spatial area, but are known to use the riparian zone of the Rio Grande near the mouth of Chacon Creek. These cats may forage or migrate through Chacon Creek.

The jaguarundi historically occurred in southeast Arizona, south Texas, Mexico and Central and South America as far south as northern Argentina. Today this cat has a similar distribution, but in reduced numbers, although it probably no longer occurs in Arizona (Tewes and Schmidly 1987). Habitat requirements in Texas are like those for the ocelot: thick, dense thorny brush lands or chaparral. Approximately 1.6 percent of the land area in south Texas is this type of habitat (Tewes and Everett 1986). The thickets do not have to be continuous but may be interspersed with cleared areas. Jaguarundi possibly shows a preference for habitat near streams (Goodwyn 1970; Davis and Schmidly 1994) and may be more tolerant of open areas than the ocelot.

Little is known of jaguarundi reproduction in the wild. Den sites include dense thickets, hollow trees, spaces under fallen logs overgrown with vegetation, and ditches overgrown with shrubs (Tewes and Schmidly 1987; Davis and Schmidly 1994). The jaguarundi is primarily diurnal, although some nocturnal activity has been recorded (Konecny 1989; Caso 1994). However, it appears to be less nocturnal than the ocelot. Habitat loss and alteration due to brush-clearing activities, human encroachment, and human persecution are the main cause for the decline in jaguarundi populations (USFWS 1995).

c. Texas Hornshell

The Texas hornshell was listed as endangered on March 3, 2018. The Texas Hornshell is a medium-sized freshwater mussel species approximately 3 inches in length with a laterally compressed shell. Shell color ranges from dark brown to green and individuals can be differentiated by distinct lines of color on the shell. Juvenile Texas hornshell mussels have distinct green rays on the shell (Carman 2007).

The Texas hornshell is an endemic freshwater mussel found in medium to large waterways in the Rio Grande drainage in Texas and New Mexico. The species historically ranged from the Pecos River near Roswell, New Mexico to the confluence with the Rio Grande and southeast to the Gulf of Mexico (USFWS 2016). It is thought that the species has been extirpated from the Rio Grande downstream of Laredo, however the exact upstream and downstream limits of the species are not known. The Texas hornshell primarily occurs in shallow, slow-running perennially flowing water tucked under travertine shelves and among large diameter channel bed materials, such as boulders, where soft sediment accumulates (Carman 2007).

The life history of the Texas hornshell is similar to other freshwater mussels. The species is a benthic filter feeder, subsisting on microorganisms, inorganic, and organic materials from the water (Howard and Cuffey 2006). Spawning generally takes place from March to August. Reproduction occurs when males release sperm into the water column, which is drawn into the body of female mussels. Fertilization and the development of larvae takes place in the gill chamber, or marsupial chamber, of female Texas hornshell mussels over a 4-6-week period after which glochidia, microscopic mussel larvae, are released. Glochidia are released in a sticky mucous net or string and must attach to the gills, head, or fin of a host fish. Glochidia are parasitic and will die if they do not attach to a host fish where they feed on fish body fluids. Glochidia metamorphize to juveniles in about 30 days at which point the juveniles will release from the host fish a drop into channel substrate. The lifespan of the Texas hornshell is estimated to be 20 years, however precise longevity is unknown (Carman 2007).

Freshwater mussels such as the Texas hornshell are considered the most rapidly declining group of aquatic organisms in North America (Winemiller et al. 2010). The primary threats to species viability are related to accumulations in fine sediment, reduction in surface water flows, and water quality impairments (USFWS 2016). The entire range of the Texas hornshell has been fragmented by large dams and reservoirs, effectively precluding recolonization of the species in channel segments where it was extirpated, leading to reduced dispersal and fragmented populations. Additionally, the presence of dams has diminished or removed periodic flood pulses from river ecosystems. Dams may also reduce habitat due to excessive silt deposition upstream of dam features. Conservation of mussel species also requires to the conservation of their host fish species (Carman 2007).

d. Threatened and Endangered Species Goals, Success Criteria, and Monitoring Components

Goals for threatened and endangered species are directly related to the Riparian and Aquatic resource goals. Habitat quantity and quality must be improved to increase threatened and endangered species use and occupation of the project location. Increased habitat quantity and quality could possibly also increase threatened and endangered species survival and potentially reproductive output. Based upon these goals, success criteria and related monitoring components are noted in Table 7 below. Specific monitoring component methods are described in Section 3.0.

Table 7. Threatened and Endangered Species Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Component
Improve potential ocelot habitat	Establishment, increase and survival of potential habitat for the ocelot	Measure vegetation composition, size of stand, height, density, nearness to water and compare to previous year
Improve potential jaguarundi habitat	Establishment, increase and survival of potential habitat for the jaguarundi	Measure vegetation composition, size of stand, height, density, nearness to water and compare to previous year
Improve potential Texas hornshell habitat	Establishment, increase and survival of potential habitat for the Texas hornshell	Monitor water quality, stream characteristics, and wetland acreage as described in section 3.2

3.0 METHODS AND IMPLEMENTATION

Reporting would occur by December 31 of the first-year post-construction and October 31 of each Target Year (TY) thereafter during which monitoring occurs. It is assumed that all restoration measures would be sustainable with minimal maintenance following the 10-year establishment period after which only maintenance of exotic plants and weir/rifle structures would be required. Monitoring of all restoration measures would occur during each year of the establishment period, during the growing season, to quantify and report the status of success criteria. The restoration of wetlands, control of salt cedar, buffelgrass, Arundo cane, and other invasives treated during implementation would each be monitored at 2-year intervals following successful treatments. Monitoring for debris accumulation-periodic maintenance is included for each measure. The findings of the monitoring reports would be used to determine the sustainability of the restoration measures. Bi-annual monitoring would continue until all success criteria are met or City coordination with resource agencies determines that the measures are self-sustaining. If success criteria are not met, adaptive management measures would be implemented as described below for each restoration measure.

All initial soil preparation, planting, and temporary best management practices (BMPs) would be completed during TY1. The following information would be reported for each restoration site at the end of TY1:

- Qualitative description of the restoration sites with photographs
- Qualitative and quantitative description of any temporary BMPs installed
- Volume, location, and area of herbicide application, as recorded using Global Positioning System (GPS) or similar navigation system

3.1 RIPARIAN HABITAT

a. Evaluation of % weed or % exotic woody and herbaceous plant species

Monitoring would occur during TY1, TY3 and every two years thereafter or until it is determined that the project has met the success criteria. Monitoring components requiring geographic location information will be recorded in EPSG:26914 NAD83/UTM Zone 14N using a Global Navigation Satellite Systems (GNSS) device such as a GPS or similar navigation system. The following information would be reported:

- Percent cover and height of woody and dominant herbaceous plants by species, as quantified using pre-defined 10-meter line intercept transects situated perpendicular to the nearest shoreline and passing through the widest part of the restoration site; at least one line-intercept transect would be surveyed every 100 meters (or part thereof) of the restoration site (as measured parallel to the river). The same transect would be surveyed during subsequent monitoring years.
- Percent cover and height of exotic woody and herbaceous plants, particularly salt cedar, castor bean, Arundo cane, and buffelgrass.
- Any areas that contain any of the State-listed noxious weeds shall also be noted, including geographic coordinates to indicate the location, area, and percentage cover.
- Presence and acreage of suitable habitat for the ocelot and jaguarundi and proximity to water.
- Qualitative description of the restoration sites with photographs taken at defined points and directions.
- The geographic location of herbicide treatments, including the volume and date of application shall be recorded.

Since the goal is to maintain a level of no more than 25 percent weeds or exotic herbaceous plants, areas that contain greater than 25 percent shall be flagged and the geographic location recorded. The goal is to maintain a level of no more than 15 percent exotic woody vegetation. Any areas that contain more than 15 percent exotic woody vegetation shall also be flagged. Areas containing greater than 25 percent weeds or greater than 15 percent non-natives shall be treated as described under Section 4.1 Adaptive Management.

b. Survival of Planted Trees and Shrubs and establishment of Native Vegetation (not planted)

Monitoring would occur during TY1 and TY3 and every two years thereafter, to determine if goals are being met. The following information would be reported: Monitoring components requiring geographic location information will be recorded in EPSG:26914 NAD83/UTM Zone

14N using a Global Navigation Satellite Systems (GNSS) device such as a Global Positioning System (GPS) or similar navigation system. The following information would be reported:

- Percent cover and height of trees and shrubs by species, as quantified using a densitometer pre-defined 10-meter line intercept transects situated perpendicular to the nearest shoreline and passing through the widest part of the restoration site; at least one line-intercept transect would be surveyed for every 100 meters (or part thereof) of the restoration site (as measured parallel to the river). The same transect would be surveyed during subsequent monitoring years.
- Percent mortality of planted trees and shrubs, as quantified by enumerating up to 80 live and 20 dead specimens following the transect within the restoration site. GPS location of area with more than 20% mortality will be recorded.
- Number, percent cover, and height of natural establishing native trees and shrubs will also be quantified along the transect.
- Qualitative description of the restoration sites with photographs at defined points and locations

The goal is to maintain less than 20 percent mortality of planted trees and shrubs Areas containing greater than 20 percent mortality shall be treated as described under Section 4.1 Adaptive Management.

c. Survival of Planted Grass Seed

Monitoring would occur during TY1, to determine if goals are being met. The following information would be reported:

- Percent cover of herbaceous plants by species, as quantified using three randomly located 1-square-meter quadrats within every 0.5 acre of restoration site or any part thereof.
- Qualitative description of the restoration sites with photographs.

Native grass seed was planted in disturbed areas such as staging areas and areas not planted with trees and shrubs. The success criteria are to ensure a growth rate of 1-plant per ft^2 for planted native seed. Within each planting area, a 60-foot north to south transect shall be established. The transect would then be marked every 10 feet. A two-foot square grid shall be placed along every 10-foot increment with the middle of the grid at the 10-foot increment mark. One quarter of the grid (1 foot by 1 foot) shall be randomly chosen to be inventoried for grass species present within that sub-plot. The species and quantity of each sub-plot shall be analyzed. The sub-plots shall be added and averaged in order to determine if the criteria of 1 plant per square foot has been met. Grass monitoring should be conducted annually.

If the native grass seed planting does not meet the criteria, then measures shall be taken as described under Section 4.1 Adaptive Management to meet the criteria.

3.2 AQUATIC RESOURCES

a. Creation and Maintenance of Wetland Habitat and Improved Water Quality

Monitoring would occur during TY1 and TY3 and every two years thereafter, to determine if goals are being met. The following information would be reported:

- The total area of the shallow pools of water created by the weirs would be measured and compared to the previous years.
- Within pools created by the weirs, the presence of wetland vegetation species and percent cover would be recorded and compared to the previous year to determine development of wetlands.
- Monitor weir/riffle structures for function and integrity.
- Using infield monitoring equipment (i.e. probes, test kits) monitor water quality for turbidity, depth, flow, oxygen, and note channel substrate at each location (sand, gravel, cobble etc.) at representative points along the stream reach downstream of each weir/riffle structure. At these same locations take one water sample for nutrient analysis (ammonia, total kjeldahl nitrogen, nitrate, nitrite, ortho phosphate, total phosphate) to be analyzed using in-field test kits or at an approved laboratory. This data will be compared to the previous year's data.
- Qualitative description of the restoration sites with photographs

If the goals of increased wetland habitat and improved water quality are not being met then Adaptive Management as described in Section 4.2 would be implemented.

b. Improve IBI and HSI Values

To assess IBI and HSI values fish monitoring would be conducted at the same locations and following the protocols used by USFWS and City Environmental Services Department in the 2006 study. IBI and HSI values would be calculated and compared to the 2006 data.

If the goals of improved IBI and HSI values are not being met then Adaptive Management as described in Section 4.2 would be implemented.

3.3 THREATENED AND ENDANGERED SPECIES

Threatened and endangered species monitoring would consist of potential habitat surveys. Habitat for the ocelot and jaguarundi is described as Tamaulipan brushland, consisting of thick, dense thorny brush lands or chaparral. The thickets do not have to be continuous but may be interspersed with cleared areas. Jaguarundi possibly shows a preference for habitat near streams (Goodwyn 1970; Davis and Schmidly 1994) and may be more tolerant of open areas than the ocelot. The Texas hornshell primarily occurs in shallow, slow-running perennially flowing water tucked under travertine shelves and among large diameter channel bed materials, such as boulders, where soft sediment accumulates.

During Riparian Habitat and Aquatic Resources monitoring as described in Section 3.1 and 3.2, information would be gathered on attributes associated with suitable habitat for the listed species. For the ocelot, and jaguarundi, these attributes would include vegetation species composition, size of vegetation stands, height, density, proximity to water, and presence, and cover of non-native and invasive species. For the Texas hornshell monitoring would include monitoring water depth, velocity, and noting presence of travertine shelves and type of channel substrate. During vegetation and wetland surveys it would be noted if the current vegetation and wetland/stream channel are meeting suitable habitat requirements for the listed species. Each year this data would be compared to previous year to track the progress of habitat development. Any changes to the proposed measurements or methodology as dictated by the project Biological Opinion, would be incorporated into this Plan.

4.0 ADAPTIVE MANAGEMENT

The ecosystem restoration component includes restoration of three wetland, as well as riparian measures that would restore 401 acres of riparian habitat. The proposed action would require regular/annual maintenance, including invasive and exotic vegetation management, and repair/maintenance of wetland weir structures.

4.1 RIPARIAN HABITAT

a. Weeds and exotic woody and herbaceous plant species

Based upon monitoring results, if there are 25% or greater weeds or 15% or greater exotic woody or herbaceous species within the project area, management actions should be implemented. It is expected the following species could occur on any of the sites: buffelgrass, Arundo cane, castor bean, Kleberg bluestem, salt cedar, guineagrass, Russian thistle, and white leadtrees.

Vegetation management would consist of exotic and invasive species control consisting of selective removal of salt cedar resprouts and treating buffelgrass and salt cedar cut stems with herbicides glyphosate and/or imazapyr. Since initial treatment of invasive species occurred at all sites, treatment would entail resprout management. Resprouts should be treated using a whip or stump application. Whips are less than three feet tall and less than four inches in diameter. Herbicide (Garlon ® 3A or similar) should be applied directly to the stem between 2-18 inches above the ground. Resprouts larger than a whip should be cut and the stump should be treated with herbicide. When possible, plants should be uprooted and all material removed. Seeding with native species after mowing can also aid in competition against weed species.

Treatments would be documented in terms of size, species treated, and treatment methods. These areas would specifically be looked at during monitoring of the following year.

If weed species are kept to the lower percentages as defined in this plan for the one to five-year time frame, there will be a greater chance of them remaining at low levels after that time, barring any major disturbance.

b. Planted Trees and Shrubs

The success criteria for planted trees and shrubs is to maintain 80% survival. Based upon monitoring of survival of planted trees and shrubs, if this has not occurred, any planted material that has died shall be replaced to meet these criteria. Any new plantings required shall be documented and monitored during the following year as part of the annual monitoring. Native species survival would determine when to stop irrigating.

c. Planted Grass

The success criteria for planted native grass is to ensure a growth rate of 1-plant per ft^2. Based upon the annual monitoring, if this criterion has not been met, additional native grass seed shall be installed. Any new grass seed installation required shall be documented and monitored during the following year as part of the annual monitoring.

d. Naturally established native vegetation

Based upon results of initial monitoring, 80% of naturally established native vegetation should survive in the following years. If this criterion has not been met, reasons for the reduction should be explored. Depending on the reason, adaptive management should take place as appropriate. The following are potential reasons that have been previously addressed in this plan:

- *Weeds and Non-Native Invasive Species* – If weeds and/or invasive species begin to out compete the naturally established native vegetation, then adaptive management measures as described in Section 4.1 should be carried out. The success criteria triggers should be the same for weeds (no more than 20%) and non-native invasive species (no more than 15%).
- *Other potential environmental factors* - For all areas of planted or naturally established vegetation, if survival is an ongoing issue in a particular area, other potential environmental factors should be explored. These may include issues with soils, depth to groundwater, and herbivory by wildlife, etc. If this occurs, these areas should be noted during annual monitoring and recommendations for follow up monitoring should be described in the annual report.

If 80% revegetation has not occurred in the revegetation zone by the end of monitoring year 1, then revegetation methods may be augmented and supplemental reports may be required.

4.2 AQUATIC RESOURCES

a. Creation and Maintenance of Wetland Habitat and Improved Water Quality

If the weir/riffle structures are functioning properly then wetland area above the weir/riffle structures and dissolved oxygen below the structures should increase. If these goals are not met or any indication of loss of integrity to the structures is observed then maintenance to the weir/riffle structures is recommended. If nutrient analysis indicates that nutrient levels are not decreasing, then efforts to identify the source of the contaminants should be identified and best management practices employed.

b. IBI and HSI Value

The goals of improved IBI and HSI values are directly related to meeting the Vegetation and Wetland habitat goals. If IBI and HSI values are not improving then Adaptive Management as described under the previous sections such as vegetation retreatment and maintenance of the weir/riffle structures is recommended.

4.3 THREATENED AND ENDANGERED SPECIES

Improving Threatened and Endangered Species Habitat is directly dependent on meeting the Riparian Habitat and Aquatic Resource goals. If the goals of increasing and improving Threatened and Endangered Species Habitat are not being met then Adaptive Management as described under Riparian Habitat Section 4.1 and Aquatic Resources 4.2 should be implemented.

5.0 ANALYSIS AND REPORTING

Written monitoring/compliance reports will be provided to the USACE, Fort Worth District. The first monitoring report will be provided to the USACE in December following implementation of ecosystem restoration measures and the first full growing season. Monitoring will continue annually thereafter for 10 years or until 100% success of the riparian habitat and aquatic resource areas has been achieved. Written monitoring reports will include:

- The name of the responsible party contact for coordinating with the USACE regarding written reports, monitoring results, on-site inspections, restoration success, and general compliance with the terms of the permit.
- The first report shall detail the pre-construction conditions of the project area. The report would include all findings of each of the monitoring component described in Section 3.0. This first cumulative report would have initial information on each of the components. Therefore, for each item monitored (vegetation, wetland habitat, debris, water quality, etc.), the report would provide initial findings, a determination if success criteria have been met for that year, and any recommendations for adaptive management based upon those results.
- Each report shall include photographs, maps, and a description of the impacts to “waters of the United States" (WOTUS) as appropriate. Compliance reports are required even if no work is conducted during the reporting period.

If any adaptive management occurs after the first year of monitoring, these actions would be tracked so that they can be monitored in the following year. The subsequent annual reports would cover any changes from the previous year to the current year, evaluate the status of the established success criteria, and again provide any recommendations for adaptive management based upon that years’ results.

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APPENDIX F

RECREATION RESOURCES

TABLE OF CONTENTS

INTRODUCTION

As noted in the Texas Parks and Wildlife Department (TPWD) Land and Water Resources Conservation and Recreation Plan 2005, older adults and minorities choose to participate less than other population groups in traditional TPWD programs and services, such as visiting state parks and recreational fishing. Distance to a state park is a major factor for residents choosing where to recreate, which may increase in importance as gasoline prices continue to escalate. As of 2005, 75 percent of all Texans live within 60 miles of the I35-I45-I10 corridor and the Lower Rio Grande Valley. This interstate corridor connects the state's four major population centers including Dallas, Fort Worth, Houston and San Antonio. The interstate corridor is expected to have the fastest growth in the state according to U.S. Census Bureau projections and the TPWD report, and supply of public lands is low. Approximately 27 percent of the TPWD sites are located within the corridor.

According to Texas A&M's *Texas Outdoors*: *A Vision for the Future* and a 2001 survey conducted by Texas Tech University (TTU):

- Most outdoor recreation participation occurs close to home. Texas A&M University, *Texas Outdoors*: *A Vision for the Future*.
- The most-desired activities among Texans who experienced activity constraints close to home included fishing (21%), trail activities (17%), and boating and other water-related activities (13%). Texas A&M University, *Texas Outdoors*: *A Vision for the Future*
- The most-desired activities among Texans who experienced activity constraints away from home included fishing (18%), camping and active outdoor recreation activities (16%), hunting (14%), and trail activities (26%)." TPWD Wildlife Land and Water Resources report.
- In the survey, 37 percent of the respondents stated that they would be interested in visiting a state park; but only 33 percent of Texans responding had done so within the last 12 months. *Texas Parks and Wildlife for the 21st Century*, Texas Tech University, 2001.

A TPWD survey for 2001 evaluated the total population's participation rates in various outdoor activities, which are reported in Table F-1 on the next page. Also noted within the report, TPWD has designated priority state parks and wildlife management areas to be those that are relatively large and have significant natural resources or recreation value. During the next decade, TPWD will focus on expanding these priority areas to improve access, recreation experience, wildlife habitat and resource protection. In addition to managing the state's park and wildlife management lands, TPWD has programs that enable it to partner with local governments and private landowners to provide some recreational opportunities such as hunting.

Table F-1. Texas Population Participation in Outdoor Recreation

Outdoor Recreation Activity	Participation
Picnicking	45%
Visiting Historic Sites	41%
Swimming in Natural Waters	39%
Fishing	38%
Visiting a Park or Natural Area within one mile of home	35%
Taking Trips or Outings to View Wildlife	34%
Visiting Texas State Park	33%
Motorboating (excluding Jet Skis)	30%
Camping	27%
Bicycling	20%
Hiking	19%
Hunting	16%
Jet Skiing	12%
Canoeing/Kayaking	6%
Mountain Biking	5%
Rock Climbing	5%
Sailing	4%

Source: *Texas Parks and Wildlife for the 21st Century*

RECREATION IN THE SOUTH TEXAS PLAINS ECOREGION

The South Texas Plains Ecoregion (Figure F-1 on page F-3), contains five State Parks, two State Historical Sites, one State Natural Area, and one International / State Park. From Laredo, there is one recreation site over 5,000 acres within a 90-minute drive - Chaparral WRDA (not shown in Figure F-1). The 90-minute distance is defined by TPWD as the distance most residents are willing to travel for day-use activities. Texans are willing to drive further distances for longer stays, and tend to be attracted by the given destination’s amenities and environment. The 90-minute driving distance was assumed to be equivalent to the 100-mile radius used for illustration purposes.

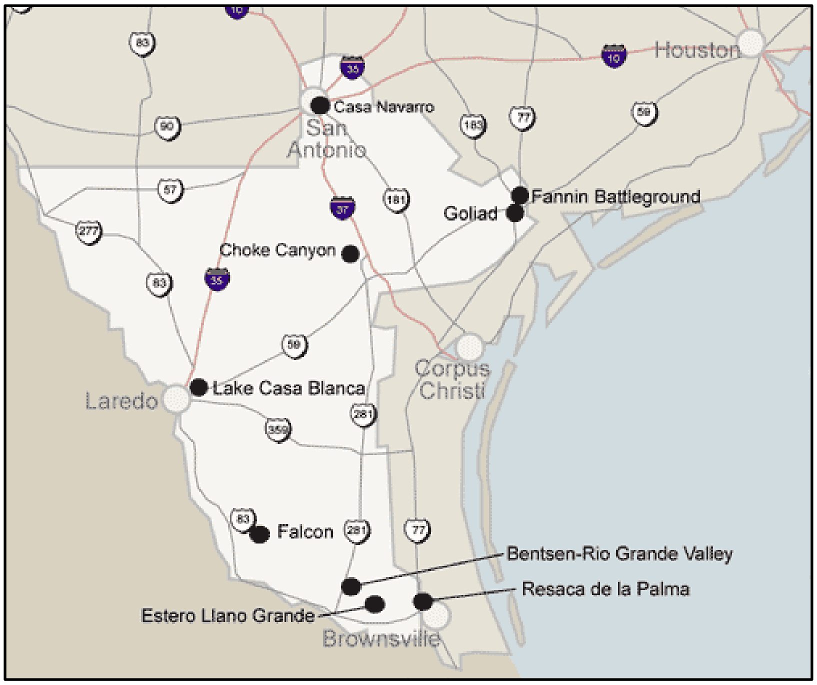

Figure F-1. TPWD South Texas Region

Source: TPWD Website http://www.tpwd.state.tx.us

Table F-2 illustrates those parks that are easily accessible to citizens of Laredo and the South Texas Development Council of Governments (STDCOG) region.

Table F-2. South Texas Plains Ecoregion Parks and Recreation Areas

Areas Managed by TPWD	Acres	TPWD Priority*	Type	2001 Visitation Estimate
Bentsen-Rio Grande Valley	760	2	State Park	102,974
Casa Navarro		Medium	State Historical Site	
Choke Canyon Calliham	1,100	NA	State Park	194,935
Choke Canyon SP – South Shore	385	NA	State Park	150,296
Falcon	572.6	NA	State Park	143,390
Fannin Battleground	13.6	High	State Historic Park	
Goliad		NA	State Park	Not reported
Government Canyon	8,622	8	State Natural Area	
Lake Casa Blanca	371	NA	International / State Park	145,185
Chaparral WRDA (rank = 8)	15,200	3	Wildlife Management Area	3,973

* Rankings were reported per type

Source: TPWD Land & Water Conservation and Recreation Plan

There are over 459 vertebrate species, more than 1,510 plant species in the South Texas Ecoregion, as well as several endangered species within this zone, with Webb County reporting 15–19 species, Jim Hogg County 9–10 species, Zapata County 20–27 species, and Starr County 28–35 endangered species. Other areas of the ecoregion along the valley and within the neighboring coastal zone contain among the highest number of endangered species in the state. Presence of these species helps fuel the ecotourism industry within the area. Some of TPWD's priority parks are also located within the South Texas Plains Ecoregion and the Lower Rio Grande Valley. Priority Parks for TPWD within this region and Laredo area include Chaparral Wildlife Management Area, Bentsen-Rio Grande Valley State Park and Las Palomos-Resaca de la Palma Unit.

Tourist Hotspots

Although the Rio Grande Valley is not within the 90-minute driving range buffer, it is easily accessible for destination travel as is the Gulf of Mexico from Matamoras, Mexico to Corpus Christi, which includes the spring break hotspot of Padre Island and important "wintering Texan" destinations, such as wildlife refuges at Copano-Aransas Bay, World Birding Center (Bentsen-Rio Grande Valley State Park, Resaca de la Palma and Estero Llano Grande is a part of this center) and the Coastal Birding Trail. Water bays within "destination" range of less than 200 miles include Laguna Madra and Corpus Christi Bay. Copano-Aransas Bay, San Antonio Bay, and Matagorda Bay are within a 300-mile range. As marketed by the Laredo Chamber of Commerce, Laredo is also within 150 miles from Monterrey, Mexico. Matamoras, Mexico, a small, colonial-style town, is on the coast near Brownsville, Texas and is also a popular tourist destination. The rest of this section provides brief descriptions of some of the main tourist hotspots.

Lake Casa Blanca International State Park

Consisting of 371 land acres and 1,650 lake surface acres, Lake Casa Blanca International State Park is located on Lake Casa Blanca, east of Laredo in Webb County. Park facilities include restrooms with showers; picnic sites; and campsites with water and electricity (30 amps), a Texas State Park Store, playgrounds, basketball, volleyball and tennis courts, a baseball field, an amphitheater (capacity is 500 includes stone benches, no stage, and no electricity), a boat ramp, two miles of mountain bike trails, and a trailer dump station. Five day-use group facilities within the park include the following:

- Group recreation hall with electricity, water, stove, refrigerator, air conditioning/heating, indoor restrooms, picnic tables, and BBQ pit
- Sports Group Picnic Pavilion with picnic tables, large BBQ pit, nearby water facility, nearby volleyball and basketball courts, well-lighted outside
- The partially enclosed El Ranchito group picnic pavilion has water, electricity, outdoor restrooms, volleyball court, playground, BBQ pit, and outdoor picnic tables. A portion of the facility is enclosed and has picnic tables near a fireplace; another section is screened for food preparation.
- Lago Vista group picnic pavilion has picnic tables, electricity, water, BBQ pit, and outdoor restrooms.
- Rock Barn (La Hacienda) is an enclosed building with an outdoor slab, picnic tables, BBQ pit, and a restroom facility nearby, which is accessible to the disabled (no air conditioning).

- Group picnic pavilion (Bird Aviary) with a capacity of 35, has six tables under a metal roof, electricity, water, and a large BBQ pit with a playground and restrooms nearby.

  Source: http://www.tpwd.state.tx.us/spdest/findadest/parks/lake_casa_blanca/

Falcon State Park and Zapata County Attractions

Falcon State Park was listed as a significant economic contributor for Zapata and Starr Counties. The park is 572.6 acres (144 developed) located north of Roma at the southern end of the 98,960-surface-acre International Falcon Reservoir in Starr and Zapata Counties. The park was leased from the International Boundary and Water Commission in 1949 and was opened to the public in 1965. The lake runs 60 miles behind the Falcon Dam. The reservoir was built in 1953 for conservation, irrigation, power, flood control, and recreational purposes. It is the second largest fresh water lake in Texas. Falcon Reservoir was voted the number one bass fishing spot in Texas by the Bass Fishing Clubs. There is year round fishing for black bass, white bass, stripers, crappie, as well as catfish.

Falcon State Park features camping, swimming, fishing, water skiing, and boating. Entrance fees are $2.00 per day, per person for people 13 and older. Group school-sponsored trip entrance fee per person (day-use only) is $1.00–5.00. There are special entrance rates for holders of the Texas State Parks Pass, Youth Group Annual Entrance Permit, and the Texas Parklands Passport (Bluebonnet Pass). The park includes the following recreation facilities:

- One-mile, self-guided nature trail
- 12 screened shelters (12’x18’) with picnic table, BBQ pit, ceiling fan, and 20 amp electricity
- 12 air-conditioned shelters (12’x18’) with picnic table, BBQ pit, fire ring, 50 amp electricity, blinds on three windows, steel door with deadbolt lock, which lease for $30 per night or $180 per week with a refundable $5 key deposit.
- 31 campsites with electric, water, and sewer hookups, BBQ pit, covered picnic table, fire ring, 50 amp electricity, leasing for $14 per night or $84 weekly rate.
- 36 campsites with water, BBQ pit, covered picnic tables that lease for $4 per night; 31 campsites (all pull-through) with electric and water hookups, BBQ pit, covered picnic table, fire ring, 50 amp electricity, and an accessible restroom, that leases for $12 per night or $72 per week.
- Restrooms with showers
- Fish-cleaning shelter
- Playgrounds
- Trailer dump stations
- Group recreation hall with kitchen for day or overnight use
- Texas State Park Store
- Three miles of hiking/mountain biking trails that make a complete loop around the park, with signs that detail plant life on a one-mile self-guided nature trail

- New boat ramp with three 24’ lanes providing access to boaters to an elevation of 269’ and a single 24’ lane to an elevation of 259’. The new ramp is in use when the lake is above 261 feet.
- Temporary ramp that provides access when levels drop below the 261-foot level. Four-wheel drive is recommended for temporary ramp use. Sometimes lake conditions make the temporary ramps unusable.
- One (100-person capacity) group recreation hall, with kitchen, BBQ pit, stove, refrigerator, ceiling fans, 100 chairs, sink, hot water, A/C, heat, horseshoe pit, swings, and basketball goal. It leases for $120 per day with a minimum of two consecutive days. An additional $3 for excess vehicle parking is charged when applicable.

  Source: http://www.tpwd.state.tx.us/spdest/findadest/parks/falcon/

Zapata County Attractions

- Falcon State Park
- Los Ebanos Golf Course – nine-hole course, driving range, putting green, ladies’ club, men’s club, tournaments sponsored by various organizations.
- Historic sites and museums: La Paz County Historical Museum and Col. Antonio Zapata Museum
- One library
- RV Parks
  - Beacon Lodge and RV Park – 19 rooms, all with boat parking, recreational hall, laundromat, and tournament facilities
  - Falcon Heights Motel and RV Park – 12 rooms, most with boat parking
  - Lakefront Lodge and RV Park – 18 rooms, most with boat parking, seasonal scheduled activities, cabins, boat ramps, and docks on Falcon Lake
  - New Harbor Lodge and RV Park – Eight apartments, most with boat parking, 75 full hookups, cable TV, laundromat, recreation hall, pull-through, showers, concrete patios, efficiency apartments
  - Four Seasons Mobile Home and RV Resort – RV and mobile home hookups, fishing and boating facilities, cable TV, laundromat, recreation hall, planned activities, showers
  - San Ygnacio RV Park
  - Stinson RV Park – RV hookups, satellite TV, laundry, showers, rec room
  - Sunset Villa RV and Mobile Home Park – on the lake, covered fishing dock, boat slips, cable TV, shower, laundry room
  - Sunshine RV Park
  - Twin Coves Fishing Camp – boating, canoeing, kayaking, fishing, full RV hookups, cabin rentals and tent sites, camping, bird watching, hiking, and biking

Monterrey, Mexico

Promoted as a tourist amenity on the Laredo Chamber of Commerce website, Monterrey Mexico is within 150 miles of Laredo and is the third largest city in Mexico. Monterrey's population is approximately three million and is one of the most educated populations in Mexico. The city supports more colleges, universities, and institutes of technology than any other Mexican city. Tourist attractions include restaurants, modern shopping malls, cathedrals, museums, Parque La Pastora (zoo, amusement park, water park, lake, and wooded area), bullfights, rodeos, soccer events, tennis and golf centers, cinemas, Macro Plaza, Expo and Convention Center, Monterrey Grand Prix, and cultural attractions.

Macro Plaza is six-blocks long and contains smaller plazas connected by pedestrian walkways with fountains, parks, benches, shade trees, the city theatre, band stands, and the Faro de Comercio, which is the highest monument in Mexico. Horse-drawn carriage tours and trolley systems are available to tour the Zona Rosa, which includes the Macro Plaza, Barrio Antiquo, and the downtown area. The San Pedro Garza Garcia is a high-tech complex with an observatory, science garden, pre-hispanic garden, open aviary, and IMAX dome theatre. The city is situated in the mountains, which also contain canyons and desert areas attractive to tourists. Some of Mexico's best hiking, mountain biking, cave exploring, and nature areas are located within fairly close proximity to the city. Chipinque National Park borders the Garcia Garza subdivision, approximately 15 minutes from the city's center and supports trail-based recreation including jogging, hiking, mountain biking. (Recent civil unrest (Summer 2006) as evidenced by Presidential elections and protests will reduce likelihood of tourist forays into Mexico until conditions are deemed safe for tourism.)

TPWD and Private Land Recreation within South Texas Plains Ecoregion

Hunting

The majority of hunting within the region occurs on private lands, many of which partner with TPWD and the Natural Resources Conservation Service (NRCS). TPWD assists with hunter education and promotion of the sport, as well as by providing incentive programs with cost-sharing potential. Lease-hunting is an important source of income for private landowners in the region. Within Laredo's destination driving distance, the TPWD Chaparral Wildlife Management Area (15,200 acres) provides public hunting opportunities including daily small game hunting and big game hunting. TPWD regulates hunting through a permit system. Huntable species include mourning dove, scaled quail, bobwhite quail, white-tailed deer, feral hogs, javelina, and coyotes. The WMA is also used by primary and secondary schools, colleges and wildlife management field days, workshops and nature tours. The WMA is open April 1 through August 31 for non-hunting day use. Public hunting is scheduled annually.

Two walking trails on the Chaparral WMA include the Arena Rojo, a wheelchair-accessible half-mile nature trail, and the Camino de Fiero trail (2.5 miles long). An 8.5 mile self-guided Paisano Driving Trail with 49 stops provides education on wildlife, habitat, and management techniques. Bicycling upon the Paisano is permitted. A wheelchair-accessible wildlife viewing tower is located at the water hole on the nature tour route.

Camping in the Chaparral WMA is only allowed in designated campgrounds that have pull-through sites. No electrical or water hookups are available. Other campgrounds are available for hunters during hunting season. Restrooms and drinking water are available only at the primitive campground. There is also a wheelchair-accessible restroom at the main campsite, which is available except during hunts when the facilities are reserved for hunters.

Birding, Butterflies, and Ecotourism (Nature Tourism)

According to the *Texas Parks and Wildlife for the 21st Century* survey of large Texas landowners with 640 acres or more, 11% of the landowners are very interested and 22% are somewhat interested in opening their land to provide more recreational opportunities for the public, such as ecotourism including bird-watching and butterfly-watching. Ecotourism (nature tourism) is a significant economic component for the region and is one of the fastest growing recreational activities nationwide. Revenue from bird watchers was estimated to be approximately $90 million dollars per year according to the report. Two relatively new facilities (also birding-related recreation enterprises) take tourists on canoeing and river exploration trips on the Rio Grande to new birding lodging facilities. Other outfitters on the Arroyo Colorado provide additional services and there are at least four Valley nature festivals that generate significant income to the local economies.
http://riograndewaterplan.org/downloads/waterplan2006/ch01-generaloverview.pdf

Public and private landowners are providing important habitat and potential public access for these activities. To encourage participation, TPWD will provide liability protection for participating landowners. According to the Region M Regional Water Plan, several protected areas set aside for wildlife habitat are typically open to nature tourism. Refuges and preserves within the Rio Grande Water Development Board (RGWDB) region (larger area than STDCOG area) include the Lower Rio Grande Valley National Wildlife Corridor/Refuge, Laguna Atascosa National Wildlife Refuge (NWR), Santa Ana NWR, Anzalduas County Park, Falcon State Park (SP), Bentsen-Rio Grande Valley SP, Boca Chica SP, Las Palomas WMA, Arroryo Colorado WMA, Sabal Palm Audubon Center and Sanctuary, the Nature Conservancy's Chihuahua Woods Preserve, and South Bay Coastal Preserve. At the time of writing for the Water Board's report, the World Birding Center ($20–25 million project) was in the final stage of planning.
http://riograndewaterplan.org/downloads/waterplan2006/ch01-generaloverview.pdf

Three hundred species of butterfly migrate through the region. There are active initiatives with TPWD and various nature centers for one particular species - the Texas Monarch Butterfly. Laredo is within one of the two flyways for the annual Monarch Migration during the last days of September and in early spring. TPWD sponsors the Texas Monarch Watch Volunteers to help assess the health of this population and to promote ecotourism. See Figure F-2 on the next page.

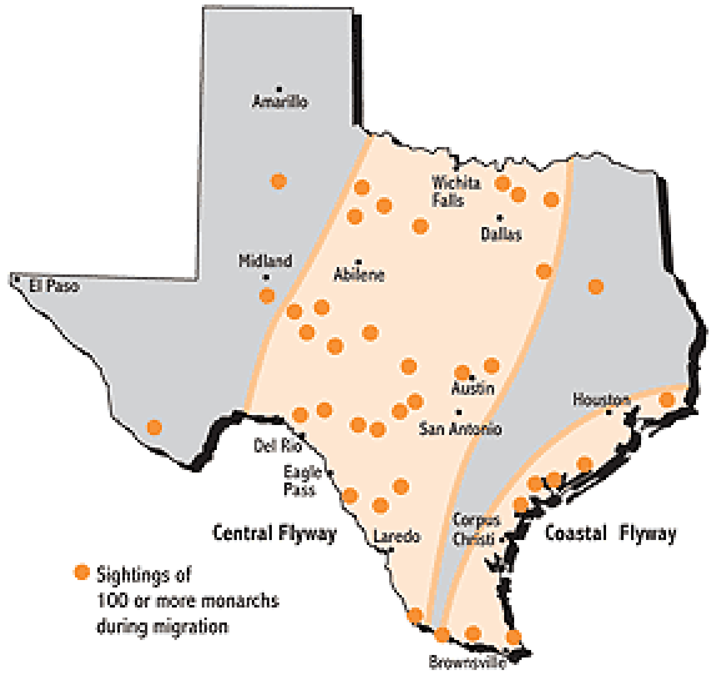

Figure F-2. Monarch Butterfly Migration Routes in Texas

Santa Ana NWR (Alamo, Texas) is a 2,088-acre refuge, which contains the convergence of two major migratory waterfowl flyways, the Central and Mississippi flyways. More than half of all butterfly species in the U.S. are found in this refuge according to the RGWDB report. More than 397 species of birds and 300 species of butterfly are found on the refuge. According to the report, riparian habitats will likely suffer from diminishing water supplies, including pumping of the groundwater and additional reservoir development (Texas and Mexico). Destruction of these habitats will impact the ecotourism industry and wildlife populations.

The refuge provides a visitor center open seven days a week except major holidays, butterfly garden, 12 miles of foot/bicycle trails, and access roads open to hiking, seven-mile auto/bicycling tour road (some accessible), and 60-passenger interpretive tram ($3.00 for adults/$1.00 for children). Tour group rates are $25.00, school groups - free admission, bicycles/foot entry - $3.00 (per family group) or $3 per auto.

World Birding Center (WBC) in the lower Rio Grande Valley (Brownsville, Mission, Texas) provides information to visitors regarding landowners who offer birding opportunities in the area. The WBC is recognized as a world-class birding destination and was built by partners including TPWD, U.S. Fish and Wildlife Service, and nine valley communities. The WBC is a network of nine sites dotted along 120 miles of river road from South Padre Island west to Roma. Over 10,000 acres will be opened, many for the first time and all prime viewing areas. The WBC mission is to protect native habitat while increasing the understanding and appreciation of the birds and wildlife. The headquarters is located in Mission, Texas, at the Bentsen-Rio Grande Valley State Park. Plans include offering public viewing stations, watching towers, interpretive centers, and programs. http://www.worldbirdingcenter.org

Many festivals are conducted throughout the region and geared to promote ecotourism and generate revenues for residents of the South Texas Ecosystem and neighboring Coastal Prairie Ecoregion. A brief list of some of these festivals, found on the World Birding Center and TPWD websites, is provided in Table F-3.

Table F-3. Ecotourism Festivals in the South Texas and Coastal Ecoregions of Texas

Date	Event
September 16, 2006	South Padre - Pelagic birding trip with Sea Life Paulagics, LLC; http://www.paulagics.com/site/
September 28 - October 1, 2006	Corpus Christi - Celebration of Flight
October 8 2006	Nationwide - The Big Sit! http://www.birdwatchersdigest.com/site/funbirds/bigsit/bigsit.aspx
Oct 13-14, 2006	Natural Bridge Caverns Nature Fest, Natural Bridge Caverns, San Antonio
October 2006	NABA Rio Grande Prix of Butterflying; http://www.naba.org/nababp/Grande%20Prix/Rio%20Grande%20Prix%201.htm
October 19-22, 2006	Texas Butterfly Festival; http://www.texasbutterfly.com
October 26-29, 2006	Wild in Willacy; http://www.wildinwillacy.com
November 1-6, 2006	Tamaulipas - El Cielo Butterfly Festival; http://www.elcielofestival.com/id22.html
November 8-12, 2006	Harlingen - Rio Grande Valley Birding Festival; http://www.rgvbirdfest.com
November 16-19, 2006	Kingsville - South Texas Wildlife and Birding Festival; http://www.kingsvilletexas.com
November 23-26, 2006	Tamaulipas - El Cielo Military Macaw Festival; http://www.elcielofestival.com/id24.html
December 14, 2006 - January 5, 2007	Nationwide - Christmas Bird Count; http://www.audubon.org/bird/cbc/getinvolved.html
February 15-18, 2007	Brownsville International Birding and Nature Festival; http://www.brownsville.org/2006BirdFest/AboutFestival.htm
February 18-22, 2007	El Cielo Nature Festival; Tamaulipas; http://www.elcielofestival.com/id25.html
February 22-25, 2007	Celebration of Whooping Cranes and Other Birds, Port Aransas
February 2007	Nationwide - Great Backyard Bird Count; http://www.birdsource.org/gbbc/
March 29 - April 1, 2007	Galveston Island Nature Tourism Council, Galveston
March 29 - April 1, 2007	Texas Tropics Nature Festival, McAllen; http://www.mcallenchamber.com/visitors/naturefest
April 21-29, 2007	Great Texas Birding Classic; GTBC Official Site: Gulf Coast Bird Observatory; http://www.gcbo.org/gtbc.html
May 12, 2007	Nationwide - International Migratory Bird Day; http://www.birdday.org
May 18-22, 2007	Valley Nature Center - Dragonfly Days

Texas Coastal Birding Trail (TCBT). The TCBT (shown in Figure F-3) has three areas (Upper Texas Coast, Central Texas Coast, and Lower Texas Coast) with trails that pass through 308 distinct wildlife-viewing sites and conveniences such as boardwalks, parking pullouts, observation platforms, and landscaping to attract native wildlife. The Upper Coast covers driving loops from the Louisiana border, through the Houston and Beaumont coastal areas, and down to Brazosport. The Central Coast starts near Matagorda Bay, traveling through the Victoria and Corpus Christi areas, and ends just south of Kingsville. The Lower Coast encompasses the southern tip of Texas along the border with Mexico, from South Padre Island, through Brownsville, Harlingen, and McAllen, and west toward Laredo.

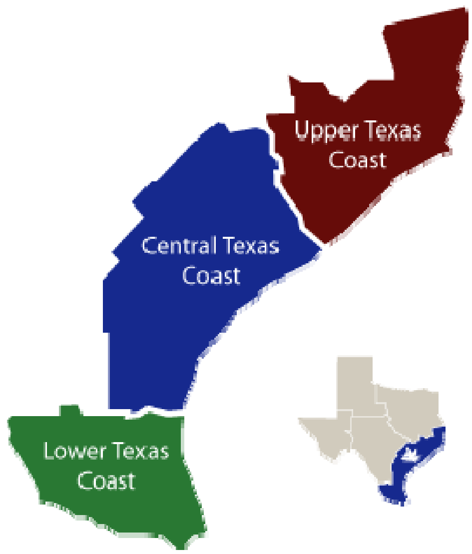

Figure F-3. Texas Coastal Birding Trail

Source: http://www.tpwd.state.tx.us/huntwild/wild/wildlife_trails

Heart of Texas Wildlife Trail (HTWT). The HTWT (shown in Figure F-4 on the next page) is composed of several driving loops within the TPWD South Texas Ecosystem Region and portions of the Hill Country. The trails extend south toward Laredo and are connected to 239 sites on public and private land where birds and wildlife can be viewed. Amenities in the region include bed and breakfasts with nature trail access, hiking, and mountain biking. Also nearby are nature centers, guided tours, bat-watching and cave visits, partnering ranches with wildlife photography blinds, area lakes, rivers, orchards, and wildflower areas, which are attractive to birds, butterflies, dragonflies, and other wildlife.

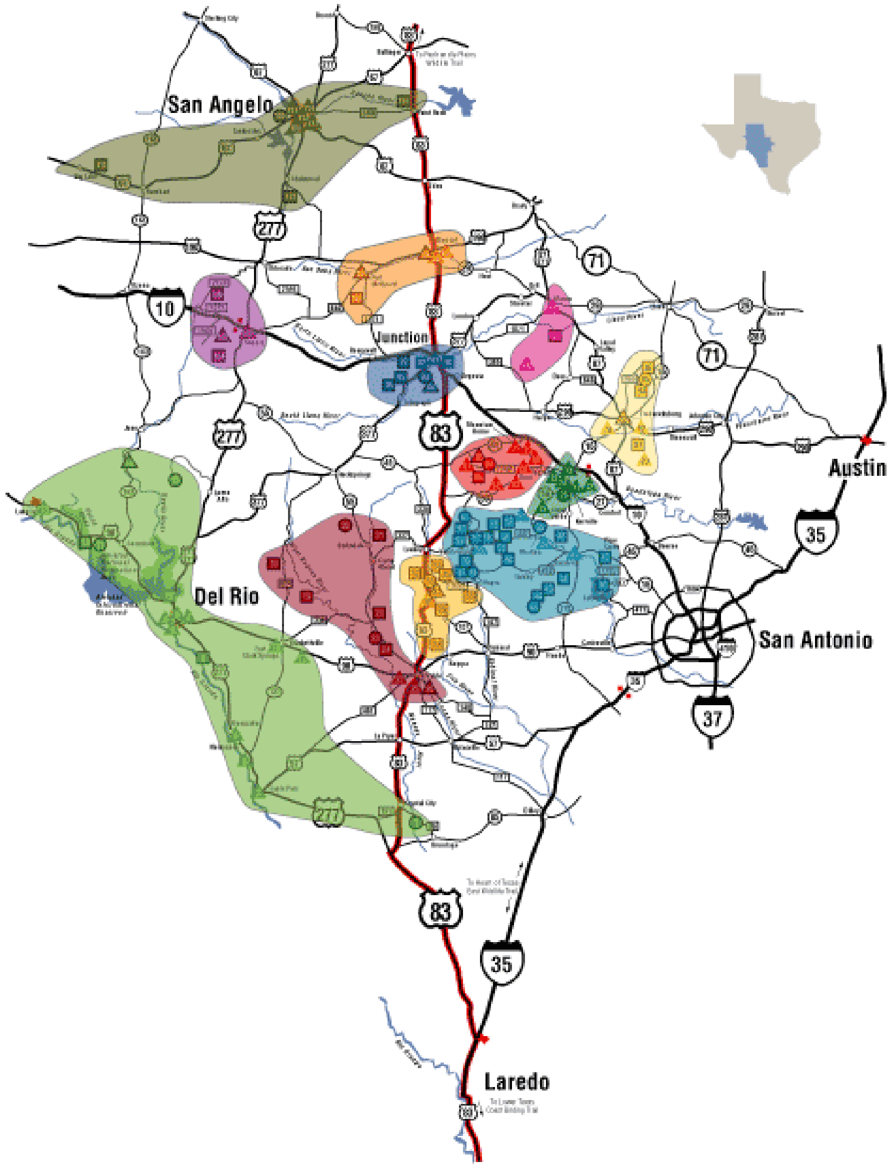

Figure F-4. Heart of Texas Wildlife Trails

Source: http://www.tpwd.state.tx.us/huntwild/wild/wildlife_trails

Historic Tourism

Another growing recreation industry is historic tourism. Many communities, large and small have combined forces to market their historic features and to partner with TPWD in the preservation of historic sites and the enhancement of designated historic trails and corridors. South Texas is rich in historic character dating back to ancient native tribes and the colonial periods of settlement by the French, Spanish, and those from the colonial United States era. Fannin Battleground and Casa Navarro are two TPWD historic sites in South Texas Ecoregion, but they are not within the STDCOG region nor within a 90-minute drive from Laredo. Local governments and private industry provide several more historic places and are actively marketing to the tourists and wintering residents.

Water Recreation

According to TPWD *Texas Parks and Wildlife for the 21st Century*, approximately 39% of Texans enjoy swimming, 38 percent fish in salt or fresh water, and 30 percent had been motor boating within the previous year. Approximately 52 percent of Texans desire a high priority for TPWD to provide increased access for water-based recreational opportunities, such as swimming, fishing and boating. Of the top 20 percent most visited parks, 14 are located adjacent to water and provide water-based recreational opportunities. Water-related recreational activities (boating, sport fishing, bird watching) and commercial fishing in the lower Laguna Madre and adjacent waters were also important economic contributors. The 1995 estimate of revenue from water-related recreational activities for the Laguna Madre to South Texas and the state was $221 million. The impact of commercial fishing in South Texas was $63.1 million.

Fishing and boating enthusiasts are the main user groups of reservoirs and rivers. More than 2.4 million anglers in Texas spent a combined total of approximately 2.7 billion for fishing-related goods and services in 2001. Commercial fishing and recreational anglers using coastal areas generate more than $2 billion in economic output each year. Fishing and/or boating enthusiasts provide the largest source of revenue for TPWD, and many are strong supporters for improved water quality and quantity and aquatic habitat conservation. The percentage of Texans who fish has been on the decline over the past two decades, which corresponds to the migration to urban centers. During this period, saltwater fishing has increased. Identified limiting factors include limited access, increasing average age of anglers, time constraints, costs of fishing equipment, and competing interests for leisure time. Fish hatcheries are needed to continually stock sport fish species, and TPWD plans to replace, renovate, or evaluate several fish hatcheries for replacement or long-term maintenance needs.

Participation for other water-based recreation is increasing. Reports from the National Sporting Goods Association cited a 13-percent increase in the use and purchase of paddle craft. In response to growing demand, TPWD has created a series of paddling trails along the coast. Local communities are increasingly interested in creating access points and facilities for these trails. The most significant threat to water-based recreation is water quantity and quality. Increasing conflicts among water user groups, trespass onto private lands, destruction of natural resources, and conflicts with jetskiers are some examples of the threat. On the coast, conflicts often occur between recreational anglers and commercial anglers.

State (TPWD) Support for Local Parks

TPWD supports local communities with park development through a competitive grant program and technical assistance. As stated in the TPWD report, local parks tend to focus on recreational activities that are generally more active and often require highly developed infrastructure (ball fields, golf courses, and swimming pools). Some parks also provide recreation areas that preserve important land and water resources. Local recreation providers tend to provide recreation and leisure programming to address a wider segment of the public, such as fitness centers, child development, and sports programs. All of these facilities improve the quality of life for residents, as well as economic benefits.

As reported by TPWD, Laredo ranked fourth among the major metropolitan areas in the number of TPWD Recreation and Conservation Lands, with approximately 60 acres per 1,000 people. With federal resources included, Laredo's service area (90-minute-drive distance) ranked eighth in the state. This same area ranked fifth (72.7 acres/1,000) in the total amount of TPWD and Federal hunting acreage, and second in the total TPWD and Federal campsite acreage per 1,000 people, with approximately 86.8 acres/1,000 people. Total local parks acres for Laredo was listed as 0.90 acres per 1,000 people, for a total of 79 parks (city and county parks) and 164.15 total city park acres – thirteenth among major metropolitan areas.

In regard to total TPWD and federal hiking trail miles, the Laredo service area ranked twelfth with approximately 25.72 miles/100,000 people. Laredo ranked 25th (last among the major centers) in the total TPWD and Federal Equestrian Trail Miles (0.0 miles/100,000) acreage available. In regard to biking miles, Laredo service area ranked fifteenth with 6.98 miles per 100,000 people. The cities with the fewest acres per 1,000 people were Laredo with 0.9 acres/1,000 people (164.15 acres) followed by Pasadena, McAllen, El Paso, Abilene, and San Antonio. The lower Rio Grande Valley had few recreational opportunities, with Harlingen providing the most (21 acres/1,000 people) followed by Brownsville and McAllen (1.2 acres/1,000). Many of these cities are within the South Texas Plains Ecoregion. According to TPWD's report, the department has a local park grant commitment for Webb County in the range of $1 – 10 million dollars, $100 thousand – $1 million for Starr County, and $0 for Zapata and Jim Hogg Counties.

Laredo Chamber of Commerce

The Laredo Chamber of Commerce website claims "the best white-tail deer hunting in Texas... haven for those seeking warm weather... a city with vision... historically rich community, and … one of the top fresh water lakes in South Texas." Other cultural activities and events promoted include symphony concerts, arts center, live theater performances, and "the largest George Washington's Birthday celebration in the nation." To welcome new residents and to encourage community participation, the Chamber recommends The Newcomers and Friends of Laredo social club. The club has a wide variety of activities for the entire family, including monthly luncheons, a children's play group, adult socials, and various special interest groups. Source: http://www.laredochamber.com

CITY OF LAREDO

According to Texas Parks and Wildlife Department Land and Water Resources, Conservation, and Recreation Plan, there are approximately 0.90 acres of local parkland per 1,000 in the City of Laredo. There are approximately 6.98 miles of Federal Biking Trail Miles per 100,000 residents, and no public lands are designated for equestrian trail riding. A total of 25.72 miles of federal/state hiking trails exist with TPWD contributing 1.79 miles with 23.93 miles supplied by federal sources. The Laredo area contains approximately 86.8 public-owned campsites per 100,000 people, which are all managed by the TPWD. Approximately 72.7 acres of public lands are available for hunting, which are also managed by TPWD.

City of Laredo Parks and Recreation Department

The City of Laredo Parks and Recreation Department (LPRD) is in charge of maintaining and creating open space and parks, as well as numerous programs designed to provide quality recreation to the residents of Laredo and tourists visiting or traveling through the area. Table F-4 provides a general overview of amenities maintained and provided by the LPRD.

Table F-4. Recreation Amenities in the City of Laredo

Recreation Feature	No.	Additional Information
City Cemetery	1	Maintained by Parks Department
Civic Center		Leased space, 24,470 sq ft banquet and exhibit hall, four meeting rooms. Hosts conventions, stage shows, trade exhibits, family gatherings, wedding anniversaries, and other parties. Auditorium has 1,979 capacity. Ballroom can accommodate 250 people.
Little League and Softball Fields	18	
Nature Trails	5	
Rental Pavilions and Pools	5	
Parks – Neighborhood and Community	61	Total of 365.19 acres, not including new facilities planned for 2004
Plazas	4	
Recreation Centers	6	Gyms, exercise gyms, multipurpose game rooms, kitchens. Each offers an ideal setting to practice leisure, ranging from basketball, volleyball, and golf to weight lifting and cardiovascular activities, guitar, bridge games, and cooking classes. Ballet folklorico, karate, photography, chess, computer, aerobics, sports leagues – volleyball, basketball, softball. Lamar Bruni Vergara Technological Recreation facility (Rec Center), second of its kind in the nation, offers technology-aided recreation and will include computers, cameras, and musical synthesizers available to all children.
Senior Citizens Centers	2	
Skate Parks	6	
Splash Parks	2	
Swimming Pools	6	Civic Center Pool, Del Mar Pool, Freddy Benavides Pool, Thomas Pool, Three Points Pool
Summer Program Sites	9	
Tennis and racquetball courts		
Veterans Field	1	
Special Events	varies	Skateboard competition, tennis, track and field, baseball skills competition, baseball camp, 4th of July fireworks at Veterans Field, Fishing Derby for physically and mentally challenged, Summer Camp Program free to children ages 6 to 15.

On the next page, Table F-5 is a complete inventory of the existing parks and recreational facilities in the City of Laredo. New facilities were planned for 2004, which would increase total park acres by 39.01 acres. Table F-6 shows the Five Year Management Plan Capital Improvement Projects planned for the LPRD. The LPRD website also indicated other items planned for future development, as shown in Table F-7.

Table F-5. City of Laredo Developed Park and Recreation Inventory

City of Laredo Parks Open Space Master Plan May 2008

City of Laredo Developed Park & Recreation Inventory

LOCATION	ADDRESS	CITY COUNCIL DIST #	ACRES	AMPHITHEATER	AUDITORIUM	BALLROOM	BASEBALL FIELDS	BASKETBALL COURTS	BBQ PITS	BENCHES	BOXING	CONCESSION	DRINKING FOUNTAINS	EXERCISE STATION	FOOTBALL	GYMNASIUM	HOCKEY RINK	KITCHEN	LITTLE LEAGUE	MEETING ROOM	MULTI-PURPOSE FIELD	PAVILION	PICNIC TABLES	PLAYGROUND	POLICE SUB-STATION	POOL	RAQUETBALL COURTS	RESTROOMS	SENIOR CENTER	SHADE STRUCTURE	SPLASH PARK	SKATE PARK	SOCCER	SOFTBALL	TENNIS	TRAILS (Miles)	VOLLEYBALL	WEIGHT ROOM
CENTURY CITY PARK	120 CENTURY CITY BLVD	I	2.58					1		4				1										1												Y		
CIGARROA RECREATION CENTER (13,400 sq ft)	2201 ZACATECAS	I	1								1		2			1		1		1					1			Y										1
EL EDEN / NEWMAN NEIGHBORHOOD PARK	2307 Cessata	I	11.41							4														1						1						Y		
FREDDIE BENAVIDES SPORTS COMPLEX	2201 ZACATECAS	I	14.81				1	3		4		1	1								1			1		1		Y					1		4	Y	1	
GEORGE WASHINGTON PARK	1100 NIXON DRIVE	I	0.5					1		10			1											1				N										
MARIO TIJERINA / SOUTH LAREDO PARK	2300 SALTILLO	I	3.89					1		6			2											2				N		1		1	1	1		Y		
DRYDEN PARK	2700 DIAZ ST	II	10.3				1			4		1	1						2			1	6					Y		4						Y		
EAST HACHAR RECREATION CENTER (13,400 sq ft)	1102 SMITH	II	0.74													1		1		1					1			Y										1
EASTWOODS PARK	2607 Derby	II	4.16					1		10			2						1			1	4	2								1	1			Y		
LOMA ALTA PARK	200 CADIZ	II	6.5					1															3	1						3						Y		
VILLA DEL SOL PARK	S. ESPANA & CHACON	II	1.2					1		4			1								1		4	1				N		4						Y		
GARCIA-VELA BALL PARK	200 ARKANSAS	III	4									1	1						1									Y		2								
CANIZALES BOXING GYM (2,994 sq. ft)	1810 GUADALUPE	III	0.29								2		1															Y		1								
M.E. BENAVIDES SPORTS COMPLEX	600 S. BARTLETT	III	18						22	6		1	1								1		22	1				Y		6				3		Y		
MARKET STREET TENNIS COMPLEX	1300 MARKET ST	III	[illegible]							1		1	1							1			2	1				Y		1					[illegible]			
NATURE QUEST TRAIL		VIII	0.34																																			
SANTA FE PARK	510 CANONES	III	13.3					3	6	15			1						1		1		10	1				Y		8								1
SANTA RITA PARK	63 PRADA MACHIN	III	22.14							2		1	1										5					Y		3			3			Y		
THREE POINTS PARK / POOL	2200 CORTEZ	III	3.3					1		2			1										6	1		1		Y		1								
CHACON HIKE & BIKE TRAIL (12,500 L FT)	RIO GRANDE TO HWY 359	II-III	2.25							18													1							1						2.367		
ALBERT OCHOA / NIXON PARK	1900 PLUM	IV	6				1	1		6		1	1								1		7	2			4	Y							2	Y		
CRUZ LITTLE LEAGUE FIELD	200 W. TRAVIS	IV	1.8									1	1						1									Y										
EAST CENTRAL PARK / ANDRES RAMOS JR	4300 SPRINGFIELD	IV	1.26					1		6			1											1												Y		
INNER CITY PARK	202 W. PLUM	IV	3.62							5														2				N								Y		
INNER CITY TECH REC / AQUATIC CENTER (11,980 sq ft)	302 W. PLUM	IV	0.26										3					1		1						1		Y										
K. TARVER RECREATION CENTER (13,400 sq ft)	2902 TILDEN	IV	1.74										3			1		1		1				1	1			Y		Y								1
OCHOA / SANCHEZ PARK	3200 MONTERREY	IV	1.5					1		7			1								1		4	1				N		2								
TODDLER PARK (HEALTH DEPT.)	2600 CEDAR	IV	0.54							4														1				N										
ZC. LINEAR PARK SOUTH (DR CECILIA MORENO)	319 W. LYON	IV	1							1			1	1									2					N		3	1	1				Y		
ZC. LINEAR PARK SOUTH (JOSE "PEPE" MORENO FIELD)	SAN FRANCISCO AND LYON ST	IV	1					4	3	6		1	1						1			1	4	1				Y								Y		
AL KING LITTLE LEAGUE FIELD	2500 SAN DARIO	IV	1.6									1	1						1									Y		2								
ZC LINEAR PARK NORTH (LAFAYETTE TO LYON)	LAFAYETTE TO LYON ST	IV-V								6																										Y		
BASE COMMUNITY SPORTS COMPLEX	CHERRY HILL AND SANDMAN	V	25.7						1	10		4	4						3			1	6			1	2	Y		2			3	2	1	Y		
BLAS CASTANEDA PARK (NORTHEAST HILLSIDE)	5700 McPHERSON RD.	V	2.2					1		8			1											1						1		1				0.26		
CHAPARRAL PARK	600 CHAPARRAL	V	1.7					1		4			2								1			2				N										
EISTETTER PARK	4301 SAN FRANCISCO	V	3.5					3		17		1	2						1		1	3	16	1				Y		4						Y		
NOON LIONS PARK	5700 GALLAGHER	V	3							13			1								1			2						2						0.16		
NORTHEAST HILLSIDE RECREATION CENTER (13,400 sq ft)	320 WYOMING	V	0.31													1		1		1								Y										1
TAYLOR BALL PARK	400 W. TAYLOR	V	2.5				1					1																		1								
ZC LINEAR PARK NORTH RYAN ST(PEDESTRIAN BRIDGE)		V																																				
ANDREW TRAUTMAN / RANGEL FIELD/POOL	218 W. DEL MAR BLVD.	VI	7				1	1	6	16		1	2						2			2	11	1		1		Y								Y		
LAS BRISAS PARK	800 INTERNATIONAL BLVD	VI	1.3					1		4			1											1													1	
ST. JAMES COMMUNITY BASEBALL FIELDS (3)	400 ST. JAMES	VI	6				1			6		1	1						2									Y		8								
CANIZALES PARK	2100 LAFAYETTE	VII	1.8					1		4			1								1			1				N		1								
FARIAS RECREATION CENTER (13,400 sq ft)	4418 OLD SANTA MARIA	VII	2.83										1			1		1		1								Y										1
FARIAS SPLASH PARK	1600 ORTIZ	VII	0.08																									N		1	1							
FATHER MCNABOE SPORTS COMPLEX	1200 QUAIL CREEK	VII	73.71	1			1	2	17	8		1	3						3		2		24	1				Y		8	1	1	4		4	Y		
LAFAYETTE STREET PARK	1802 LAFAYETTE	VII	2.8					1	4	4			1				1						4							2	1	1				Y		
LILIA PEREZ SENIOR CTR/FARIAS SENIOR CTR (1,800 sq ft)	4420 OLD SANTA MARIA	VII																		1								Y	1									
TREE FARM NURSERY	1400 LOWRY RD	VII	2.59																																			
ZC LINEAR PARK SOUTH (OKANE)	OKANE ST	VIII	0.5					1		4																										Y	Y	
ALDO TATANGELO WALKWAY	300 SAN AGUSTIN	VIII	1.1																									N										
CIRCLE DRIVE PARK	CIRCLE DR. @ DAVIS	VIII	0.16																					1				N		1								
CIVIC CENTER AUDITORIUM/BALLROOMS	2200 SAN BERNARDO	VIII	3.5		1	1														4																		
CIVIC CENTER POOL COMPLEX	2200 SAN BERNARDO	VIII										1	2													1		Y		2						Y		
[illegible] MARTIN FIELD	200 CONVENT	VIII	1.5																		1																	
EL CUATRO PARK	300 SANTA CLEOTILDE/GRANT	VIII	1.8					1		10			1						1				6	1				N										
EL PASEO DEL ANTIGUO		VIII	0.35																									N										
LA LADRILLERA / JOSE ORTIZ-ELIDA VALDEZ PARK	1900 PINDER	VIII	8.89					1		3			1										4	1				N		8			1					
LA LADRILLERA SENIOR REC CTR (4,956 sq ft)	1900 PINDER	VIII	0.11															1		2								Y	1									
LAS PALMAS TRAIL (2,813 L FT)	EAST OF BRIDGE II	VIII	1.14																									N								0.57		
LOS DOS LAREDOS PARK	1300 PIEDREGAL	VIII	13					7	22	26			4										30	2				Y								Y		

City of Laredo Developed Park & Recreation Inventory

LOCATION	ADDRESS	CITY COUNCIL DIST. No	ACRES	AMPHITHEATER	AUDITORIUM	BALLROOM	BASEBALL FIELDS	BASKETBALL COURTS	BBQ PITS	BENCHES	BOXING	CONCESSION	DRINKING FOUNTAINS	EXERCISE STATION	FOOTBALL	GYMNASIUM	HOCKEY RINK	KITCHEN	LITTLE LEAGUE	MEETING ROOM	MULTI-PURPOSE FIELD	PAVILION	PICNIC TABLES	PLAYGROUND	POLICE SUB-STATION	POOL	RAQUETBALL COURTS	RESTROOMS	SENIOR CENTER	SHADE STRUCTURE	SPLASH PARK	SKATE PARK	SOCCER	SOFTBALL	TENNIS	TRAILS (Miles)	VOLLEYBALL	WEIGHT ROOM

DOWNTOWN PLAZAS	ADDRESS		ACRES	BASKETBALL COURT	BENCHES	DECORATIVE FOUNTAIN	DRINKING FOUNTAINS	KIOSK	MONUMENTS	PICNIC TABLES	POLICE SUB-STATION	RESTROOMS	SHADE STRUCTURE
BRUNI PLAZA	1000 SAN BERNARDO	VIII	1.77		8	1	1		Y		1	Y	
EL MERCADO	500 SAN AGUSTIN	VIII	1.77		10	1			Y			Y	
JARVIS PLAZA	1300 MATAMOROS	VIII	1.77		54		2	1	Y	4		Y	3
SAN AGUSTIN PLAZA	200 SAN AGUSTIN	VIII	1.77		32		2	1	Y			Y	
ST. PETER'S PLAZA	1600 MATAMOROS	VIII	1.77	1	12		1						
TOTAL PLAZAS			8.85	1	116	2	6	2		4	1		3
TOTAL DEVELOPED ACREAGE			340.55										

Developed Park Sites/Facilities

Trails/Right of Way

* Linear Park System along the Zacate Creek (ZC) encompasing a series of recreational facilities. Total acreage and amenities for all of these linear system are reflected here.

Table F-6. City of Laredo Capital Improvements Planned for Parks and Recreation

Capital Improvement Project	Planned Date	Description	Total
Baseball/Softball Sports Complex at TAMIU		Development of tournament play facility for baseball/softball fields to include concession, bathrooms, irrigation, and landscaping.	1,025
Central Laredo Senior Citizen Center		Construction of community center to provide recreational services for elderly. Note: Operations will be impacted.	
Cigarroa Recreation Boxing Gym		Construction of approximately 4,400 sf for a boxing gym facility adjacent to the existing Cigarroa Recreation Center located in South Laredo.	525
Eastwood Park	FY 2006 – in progress	Phase I: Baseball field, play module, grading irrigation, soccer field (completed). Phase II: Completion of baseball field to regulation standards, playground equipment, basketball courts, pavilion, and parking (completed). Phase III: Skate ramp and park lighting. Located N. of Clark Blvd. between Loop 20 and Ejido.	575
Father McNaboe Park Improvements	FY 2006 FY 2007 FY 2008	Continued improvements to the south portion of McNaboe Park to include drainage, parking, irrigation system, landscaping, and lighting for use of athletic fields. Phase III: Installation of playground, pavilion bb court, vb court, picnic areas, shades, and walking trail. Splash park amenities.	3,150
Lafayette Linear Park	FY 2006 FY 2007 FY 2008	Continuation of construction of a linear park to meet some of the park needs in west Laredo, to include covered playground module, security lighting around splash park, and other improvements, including an outdoor hockey rink. Addition of a soccer field.	468
Larga Vista Park		Improvements to include playground, basketball courts, soccer fields, and irrigation.	150
Lyon Street Spray Park		Construction of a “Zero Depth” spray park at Zacate Creek and Lyon St.	250
Santa Fe Park Phase II	FY 2006 FY 2007	Community park located in South Laredo, west of Hwy. 83 and north of Santa Rita Subdivision. Phase I included the addition of picnic tables, park benches, and barbecue pits. Phase II will include walking path, restrooms, concession pavilion, and other related improvements. Design and improvements to retention pond to include multipurpose fields.	300
Cemetery Land Acquisition	FY 2007	Purchase new cemetery site.	550
Cemetery Renovations	FY 2007	Reconstruction and rehabilitation of roadways throughout current cemetery, approximately 4,535 linear feet.	379
Chacon Creek Recreation Improvements	FY 2007 FY 2008 FY 2009 FY 2010	Development of Chacon Creek according to Carter Burgess Master Plan from Lake Casa Blanca to Rio Grande including: trails, crossings, intermodal nodes, restrooms, fountains, bike nodes, excluding drainage and other non-recreational improvements. Phase 1: Rio Grande to Hwy. 359 (shared 50% II, 50% III); Phase II: Hwy. 359 to Tex Mex Railroad (Dist. II); and Phase III: Tex Mex Railroad to Hwy. 59 (Dist. II).	15,284

Capital Improvement Project	Planned Date	Description	Total
Cielito Lindo Park	FY 2007 FY 2008	Develop a 3.35 acre park area in the Cielito Lindo Subdivision to include: walking trail, basketball court, playground module, park benches, drinking fountain, lighting, parking, and other amenities	320
Civic Center / Convention Center	FY 2007 FY 2008	Funds for Civic Center. Improvement design and construction of existing feasibility or design and construction of a new convention center. Feasibility Study completed in ‘05.	4,900
Cruz Field Imp.	FY 2007	Purchase and installation of bleachers with attached shade structure	25
Dryden Park	FY 2007	Phase 1: Construction of a new Senior Baseball field within the existing Dryden Baseball Field Complex and addition of a minor/major little league field to replace parking used by baseball fields. Phase II: Addition of playscape, parking, and pressbox	399
East Side Recreation Center	FY 2007	Phase I: Acquisition and design for rec center. Phase II: Design and partial construction. Phase III: complete construction. Maintenance operations will be impacted.	2,650
Eistetter Park Lights	FY 2007	Installation of park lights to better illuminate the park (50) and domed basketball court (100)	150
Eleden Recreation Center	FY 2007	Recreation center at the Sierra Vista/Los Obispos area with outdoor community park amenities. Operations and Maintenance will be impacted.	2,990
Garcia Vela	FY 2007	Development of a Little League Field east of the existing Garcia-Vela field to include fencing, hydroseeding, irrigation, bleachers, lighting, and other necessary amenities	200
Heritage Park	FY 2007FY 2008	Phase I: Basketball court, walking trail, soccer field. Phase II: Playground module, landscaping, and irrigation	600
Heritage Park	FY 2007	Purchase and installation of a pre-fabricated pedestrian bridge to connect Heritage Park to the San Jose Subdivision	300
Independence Regional Park	FY 2007 FY 2009	Creation of an open space and linear park system using the existing creek at Century City, Independence Hills, Freedom Park, and Los Presidents Subdivision. Development of a park site on Century City Blvd. to Merida Avenue including 70 acres of Vaquillas Tract and Old Landfill. Operations and maintenance will be impacted.	3,263
Market Street Courts	FY 2007	Resurface 9 tennis courts to include the placement of 18 new tennis net poles at Market Street Tennis court facility. Lighting and rehab of existing improvement (Restrooms and office)	300
Municipal Golf Course	FY 2007 FY 2009	Analysis of current course deficiency in the city of Laredo. Identify possible locations and economic feasibility of a municipality run golf course in the City of Laredo.	5,600
Northwest Recreation Center/Pool	FY 2007 FY 2008	Phase 1: Acquisition and design of 3–5 acres for recreation center and pool. Phase II: Construction of rec center in NW Laredo with a “Zero Depth” family oriented pool with bathhouse, concession stand, parking, lighting, landscaping, and pumps adjacent to the recreation center. Operation will be impacted.	2,445

Capital Improvement Project	Planned Date	Description	Total
Recreation Center Gym Rehabilitation	FY 2007 FY 2008 FY 2010	Rehabilitation of recreational center's gym flooring	350
Rio Grande Ecosystem Restoration	FY 2007 FY 2008 FY 2009	Restore approximately 130 acres of forested riparian habitat and floodplain wetland habitat along the Rio Grande in Southwest Laredo.	4,118
Santa Rita Park	FY 2007 FY 2008	Park to be developed in Santa Rita Subdivision. Phase I: Playground, walking trails, baseball field, basketball courts, soccer field, parking, benches, picnic areas. Phase II: park benches, sidewalks, irrigation system, and landscaping.	1,479
Taylor Park Improvements	FY 2007	Installation of an automatic irrigation system and construction at parking lot.	300
ATV Trail & Facility	FY 2008	Acquisition and development of an all-terrain vehicle trail and park, to include shades, picnic areas, restrooms, lighting, irrigation, and other park improvements	830
Camera Surveillance System	FY 2008	Provide additional surveillance cameras throughout the park system to deter vandalism, to include Dryden Park, Eastwoods Park, Ladrillera Seven Flags Park, Zacate Creek, and Father McNaboe	600
Canizalez Park Additions	FY 2008	Additional park amenities at the end of Lafayette Street past the west side of the Lafayette Overpass as follows: Phase I: Play module and shade structure; Phase II: Pavilion and restrooms	270
Century City Park	FY 2008	Development of park including jogging trail and playscape	150
Civic Center Pool Bathhouse Rehabilitation	FY 2008	Redesign roof and secure bathhouse. Roof has numerous leaks. Repairing roof will allow the department to contract with a concession area to provide service to the public.	200
Downtown Plaza Improvements	FY 2008	Improvements to all downtown plazas, including new lighting, additional brick pavers, foundation renovation, fencing, landscaping, irrigation, and Bruni Plaza water fountain repair.	123
Las Minas Branch	FY 2008	10,000 sq. ft. branch library to serve West/North areas of Laredo; Staffed by one professional librarian and three clerks to serve increased population in this area.	1,750
Los Martinez Park	FY 2008	Acquisition and development of a neighborhood park to include jogging trail, soccer fields, and basketball court.	175
Monterrey St. Acquisition	FY 2008 FY 2010	Project involves the acquisition of property along Zacate Creek to create green space for park development. Project will also require relocation of benefits	1,175
North Central Park	FY 2008 FY 2009	Acquisition, design, and development of property in north Laredo for a park. A joint-use agreement has been executed with the County of Webb to share the costs incurred in acquisition and development. Operations will be impacted.	2,825

Capital Improvement Project	Planned Date	Description	Total
River Vega Acquisition	FY 2008 FY 2009 FY 2010	Acquisition of Vega Land along Rio Grande River for future nature trails and green space - approximately 250 acres. Conceptual master plan design.	6,020
Salt Cedar Removal	FY 2008	Identify and initiate the proper and expedient removal of invasive salt cedars along Las Palmas, Chacon Trail, Zacate Creek, and other identified River Vega property	1,100
Slaughter Park	FY 2008 FY 2009	Acquisition of approximately 37 acres of land located south of Chacon St., north of the Rio Grande River, between Stone and Tiden. This space is to be used for multi-purpose fields, playground areas, nature trails, and other recreational amenities. Rehab of existing house. Maintenance operations will be affected.	6,820
Soccer fields New	FY 2008	Acquisition and improvements of soccer field to improve facilities. To replace fields by the Base.	1,000
Three Points Pool Conversion to Spray Park	FY 2008	Place cool deck and add additional lighting to pool area. Age of pool is approximately 20 years. Placement of a water spray station playground for children.	250
Trautman Park – Pool Improvements	FY 2008 FY2009	Placement of cool deck around pool, construction of restrooms, play water station. Reconstruction of parking lot (150) and walking track	650
Village Heights Park Development	FY 2008	5.5 acres located north of Shiloh and south of Borchers Elementary School, to include athletic fields, landscape, etc.	500
Farias Park Improvements	FY 2009	Develop park area behind Farias Rec Center to include perimeter fencing, parking improvements, multi-purpose field, playground module, landscape, irrigation, lighting, and other amenities.	250
Indian Sunset Muller Park	FY 2009	Development of 21.83 acres in the Indian Sunset Neighborhood into an environmentally friendly design that protects the wetland area and offers passive recreational amenities with athletic fields in the areas away from the pond. Operations will be impacted	500
Los Dos Laredos Park	FY 2009	Installation / construction to replace existing restrooms building	75
Santo Nino Branch Expansion	FY 2009 FY 2010	Implement designed expansion of branch to accommodate population growth in South Laredo and include increased operational costs. Expansion will enable present staff better visibility and control of increasingly growing patronage	825
Water Park	FY 2009	Development of a water park. Feasibility Study (50). Maintenance operations will be impacted.	5,050
Devine Mercy Recreation Center	FY 2010	Design and construction of a recreation center and additional park improvements	2,750

Source: City of Laredo website, August 2007.

Table F-7. Future Projects by City of Laredo Parks and Recreation Department

Future Project	Description
Cigarroa Boxing Gym	This project is proposed to be attached to the existing Cigarroa Recreation Center. The gymnasium will include an elevated boxing ring, free weights area, and boxing and kick boxing heavy bags, speed bags, double end bags, treadmills, mirrored studio, lockers, and restrooms with showers.
Larga Vista Park	The City of Laredo and Webb County came together on an agreement for the improvement of Larga Vista Park. Park improvements consist of a walking trail, landscaping, irrigation system, basketball courts, a playground module, pavilion, picnic tables, and park benches.
El Eden Recreation Center	Exercise room, indoor walking and jogging track, and a basketball gymnasium are just a few of the many amenities that will be included in the El Eden Recreation Center. The 18,000 sq. ft. facility and park will rest on approximately 13.4 acres of land in the El Eden Subdivision and will boast, among those features already mentioned, a multi-purpose room and office space.
North Central Park	Neighborhood park to be located in District VI, north of Shiloh and east of McPherson Rd. The proposed project is to be part of a linear park from Bob Bullock Loop to I-35 along Manadas Creek that will feature shaded areas, little league fields, walking trail, and neighborhood connections.
Slaughter Soccer Complex	The facility is proposed to be located on approximately 35 acres on the southwest corner of E. Chacon and S. Stone. It was recently acquired to develop adult and youth soccer. The complex will have an automatic irrigation system, landscaping, concession building with restroom, playground module, walking trail, pavilions, park benches, picnic tables, shades, storage room, and other park improvements.

City of Laredo Existing Recreation

Information regarding the City of Laredo’s existing recreation was garnered from the 2008 City of Laredo Parks and Open Space Master Plan, which is a 10-year strategic plan for implementing the needs/desires of the community. The city is known as the “Gateway City” and is the principal port of entry into Mexico, the fourth busiest port in the entire U.S. and the fastest growing city in the nation. The City of Laredo is defined by a comprehensive parks system including mini-parks, neighborhood parks, community parks, sports complexes, linear parks, and a State park. The city’s plan addressed present and future growth within the city limits as well as in Extraterritorial Jurisdiction (ETJ).

The city’s population was estimated at 176,576 according to the U.S. Census 2000 and is now estimated to be 220,534 residents, which is a 24.9 percent increase over the 2000 Census. Rapid growth has increased the need for acquiring new lands for parks and to secure a park dedication land ordinance to obtain lands sufficient for the future populations. The newly developed areas of the City are severely lacking quality parks and recreation infrastructure and services.

According to the plan, current inventory within the city is as follows:

- 340.55 acres of developed parkland
- 512.93 acres of parkland owned, but undeveloped
- 181.17 acres of undeveloped River Vega parkland is available

- 191.73 acres of land is currently in acquisition phase, pending finalization
- 1,226.38 total acreage

Methodology

Methodology used by the City to assess recreation demand and future needs was described in the master plan and included interviews with key City of Laredo staff, organized recreation providers and user groups, phone surveys for each of the eight Council Districts, four public meetings for the eight Council Districts (April 2007), inventory/supply analysis, GIS analysis of land use, projected growth, the City's Thoroughfare Master Plan, consideration of natural land features such as slope and hydrography, and facility standards analysis, including park service areas. The Park Dedication Ordinance adopted in April 2008 provided definitions of park classifications. The department adopted a modified version of the standards published by the National Recreation and Parks Association (NRPA).

As of January 2007, the City standard per 1,000 population is 6.0 acres of parkland (includes neighborhood and community park acreage). As shown in Table F-8, the City of Laredo includes a total of 1,226.38 acres of parkland. Of this, 997.95 acres are neighborhood and community parks for an existing ratio of 4.53 acres per 1,000 at the current population estimate of 220,534. The Texas State Data Center estimated the city's 2010 population at 263,286.

Table F-8. City of Laredo Census Population and Park Acreage

Council District	2007 Census Population[1]	Park Acreage[2]
1	29,388	112.64
2	26,850	241.56
3	27,528	256.68
4	27,552	20.34
5	27,121	106.73
6	28,420	215.07
7	26,811	145.44
8	26,864	127.93
Total	220,534	1,226.38
2010 Estimate[1]	263,286	

[1] Population estimates from Texas State Data Center
[2] City of Laredo Parks and Leisure Service (Developed, Undeveloped, and Pending Acquisition)
Source: City of Laredo Master Plan

Metro Park needs were met by Lake Casa Blanca International State Park, which has 2,201 acres. The standard of five acres per 1,000 is far exceeded by the ratio of 9.16 acres per 1,000 population.

In March 2007, The Earl Survey Research Laboratory at Texas Tech conducted a telephone survey for the city's Parks Department. The survey yielded 535 completed surveys (3,408 calls made) with 60%

English/40% Spanish and a response rate of 15.3%. Overall cooperation rate of 71.7 percent was obtained for successful calls.

Priorities were established on a community planning district basis. A total of 12 separate planning districts were defined. Districts 1–8 corresponded to the respective eight City Council Districts. The remaining four represented the moderate to high growth areas in the ETJ. With the exception of District 4, acquiring new park land was the first or second priority cited by respondents. New Open Space (green space) was rated no lower than the fifth priority.

Needs were categorized by a priority level system using high, medium, and low rankings and corresponding time schedules in Table F-9. Table F-10 provides proposed neighborhood and community parks by planning district.

Table F-9. Priority and Timeframe for Implementation

Priority	Timeframe (years)
High	1–3
Medium	4–6
Low	7–10

Table F-10. Proposed Neighborhood and Community Parks by Planning District

Planning District	New Neighborhood Parks	New Community Parks
1	6	1
2 (Chacon Creek Area)	10	0
3	1	0
4	1	0
5	11	1
6	3	0
7	7	1
8	0	0
9 (ETJ)	21	2
10 (ETJ)	16	1
11 (ETJ)	4	1
12 (ETJ)	60	1
Total	140	8

Goals and Objectives - City of Laredo Parks and Open Space

The Laredo Parks and Open Space Master Plan report also summarized the department's Goals and Objectives and provided recommendations for indoor and outdoor recreation priorities by District and a cursory review of operating policies. The action plan and implementation strategies plan was described, including probable costs, timelines, funding sources, and O&M cost estimates (as a supplement). Goals and objectives defined by the department include the following:

- Provide a variety of recreational experiences that appeal to all segments of the population of Laredo.
- Enhance the physical attractiveness of Laredo by developing parks and open space amenities.
- Protect the natural resources of Laredo and Webb County by preserving those resources.
- Improve the quality of the urban environment by providing adequate parks and open space within the City of Laredo.
- Require the dedication of parks and open space in new residential subdivisions.
- Provide adequate linkages between parks and design urban transporation corridors to optimize access to open space.
- Develop neighborhood playgrounds in each neighborhood in conjunction with school districts.
- Integrate arroyos and drainage basins into the park system to expand park resources.
- Provide parks and open spaces that are safe for use by persons of all ages and abilities.
- Improve maintenance and enhance the appearance of city parks, arroyos, and drainage basins.
- Access existing parks using Crime Prevention Through Environmental Design (CPTED) methods. Redesign and make improvements as required.
- Limit obstacles to the disabled and the elderly.
- Segregate age groups by facility design to enhance the sense of security in all parks and open spaces.
- Expand the range of recreational opportunities available to all age groups.
- Coordinate recreational programs with school curricula.
- Develop joint facilities and maintenance agreements in conjunction with schools and universities.
- Coordinate cultural programs of interest to visitors and senior citizens.
- Increase private sector involvement in developing and maintaining parks and open spaces.
- Expand private sector support of park development and cleanup activities.
- Increase the use of native plant materials and xeriscape to reduce maintenance and irrigation costs.
- Encourage the planting of trees in parks and along streets.
- Encourage the joint development of open spaces by private interests and public agencies that provide additional recreational and open space opportunities.
- Develop an Adopt-A-Park program to build neighborhood support for local parks.

Sustainability

The Laredo Parks Department uses two guiding principles to promote sustainability:

1. Sustainable Planning – Interconnectivity of parks and pathways to create healthy communities
2. Long-term Park Sustainability – Incorporation of a variety of landscapes in the parks system to balance manicured and naturalized spaces to reduce maintenance requirements; multiuse parks designed to include attractive wetlands or ponds, which are highly sought after community amenities, and provide added value by contributing to surface and groundwater quality.

Safety and Security

To reduce fear and incidence of crime, the department uses the strategies of incorporating Crime Prevention Through Environmental Design in park planning. Focus is on incorporating design principles that reduce, or make it more difficult to carry out, inappropriate behavior and encourage resident/user interaction, vigilance, and control over the neighborhood. Design should consider the following guidelines:

- Maximize the ability to spot suspicious people and activities.
- Encourage intended use of public space by residents.
- Identify ownership by delineating private space from public space.
- Use physical barriers to restrict entry.
- Take into account the surrounding environment.
- Minimize the use of space by conflicting groups.
- Ensure buildings and areas are clean, well-maintained, and graffiti-free.

Identity and Character

Identity and character of a recreation facility should define the place as "made-in-Laredo" and incorporate principles of accessibility, connectivity, diversity, sustainability, safety, and security.

Park Classification, Associated Amenities, and Demand for New Parks

Survey results indicated that there was a "great amount of support for acquisition of new parkland, as well as development to new passive and active recreational amenities." Public meetings indicated again that more land was needed for parks and the amenities on them, as well as a demand for soccer fields throughout the City. To further estimate demand, the Laredo Parks and Recreation Department adopted a modified version of the National Recreation and Parks Association (NRPA) standards as minimum standards to guide the department's activities in land acquisition and facility design and development. Table F-11 describes the park types according to City of Laredo standards for size and service area and as compared to the NRPA standard.

Table F-11. Park Classification in Laredo

Classification	Size	Service Area	NRPA Standard
Mini Park	2 acres or less	¼ mile	NA
Neighborhood	2–15 acres	½ – 1.5 miles	1 acre/1,000 pop
Community	16–99 acres	2–5 miles	5 acres/1,000 pop
Metropolitan	100–499 acres	Entire City	5 acres/1,000 pop
Regional	500+ acres	Regional	NA

Source: City of Laredo Parks and Recreation Master Plan 2008

Mini Parks are the smallest park units and are used to meet limited or isolated recreational needs, such as scenic overlooks, unique recreational opportunities, and public use areas such as urban plazas. The following typical features are found at these parks. City of Laredo Parks and Recreation Master Plan 2008.

- Active Uses
  - Volleyball Courts
  - Playgrounds
  - Horseshoe Pits
  - Splash Areas
  - Skateboard Areas
  - Tot lots / Children's Play Areas
- Passive Uses
  - Picnic Areas
  - Seating Areas / Pavilions
  - Arbors
  - Fountains
  - Scenic Overlooks
  - Themed Gardens

Neighborhood Parks provide space and recreation activities for the immediate neighborhood in which they are located. It is considered an extension of neighborhood residents' "out-of-yard" and outdoor use area. Size is limited to 2–15 acres and service radius is one-half to 1.5 miles, but is also defined by arterial street patterns that form the limits of a neighborhood or recreation service area. Population generally ranges from 1,000 to 5,000 who will use the facility. The service standard for this park is one acre per 1,000 residents served. The following facilities are typical of Neighborhood Parks.

- Active Uses
  - Multipurpose ball fields
  - Volleyball Courts
  - Tennis Courts
  - Archery ranges

- Playgrounds, tot lots
- Handball Courts
- Open Spaces/Fields
- Horseshoe Pits
- Swimming Pools
- Skate Park
- Other features as needs or site conditions allow
- Basketball; half-court, full-court, or tri-court configuration

- Passive Uses
  - Nature Study Areas
  - Seating Areas / Pavilions
  - Cultural Activities Facilities
  - Gardens
  - Open Spaces/Fields
  - Individual/Group Picnic Areas – benches and tables
  - Trails
  - Unstructured turf Grass Play Area for children, young adults, and families

- Other
  - Limited Parking
  - Restrooms
  - Sport facilities compatible with a neighborhood setting and site constraints

Park objectives for neighborhood parks include the following:

- Central location for equitable pedestrian access within a definable neighborhood service area, preferably in association with an elementary school, middle school, high school, or fire station/library.
- Neighborhood compatibility with setting and park site constraints.
- Orientation: Serves all age groups with an emphasis on youth and families in neighborhood settings.
- Function: To provide a combination of active recreation and passive activities, both outdoor and indoor facilities, and special features as required or needed.

Community Parks are defined for a service area, the entire city, or a significant geographic segment of the city's population. Size ranges from 15 to 99 acres with a general service area of 2–5 mile radius. The standard is five acres per 1,000 residents served. The following elements are typically found in Community Parks.

- Active Uses
  - Recreation Center
  - Tot Lots / Children's play areas
  - Sport/recreation facilities based on city demand
  - Community Pool/Water Feature

    - Soccer Fields
    - Softball, Little League baseball, Jr. Pony League Baseball
    - Football
    - Roller Hockey/Skate Board Area
    - Tennis courts
    - Basketball courts
    - Volleyball Courts
    - Archery Ranges
    - Handball Courts
    - Swimming Pools
    - Skate park
- Passive Uses
    - Individual and Group Picnic Shelters and facilities
    - Amphitheater/Performing arts and Pavilions
    - Nature Study Areas
    - Seating Areas/Pavilions
    - Cultural Activities Facilities
    - Gardens
    - Trails
    - Open Spaces / Fields
    - Horseshoe Pits
    - Shuffleboard Courts
    - Hike and Bike Trails
- Other
    - Limited Parking
    - Restrooms
    - Sport facilities compatible with neighborhood setting and site constraints
    - Park maintenance and Equipment Storage building

Community Parks objectives include the following:

- Location
    - Central location for service area, preferably adjoining or immediately adjacent to a collector street
    - Community-wide vehicular access, reducing neighborhood traffic impacts
    - Connectivity to off-street community trail and bike lane systems and adjoining or adjacent to schools, libraries, police, and/or fire facilities.
    - Design, amenities, and use compatible with the community setting and park site constraints.
- Program
    - Off-street parking calculated to satisfy demand of park and recreation activities provided
    - Bike racks and public transit station at the site and both on-site and street parking
    - Restrooms adequately sized for activities and population, and at minimum include:
        - Male restrooms – 2 water closets, 4 urinals, 4 lavatories

    - Female restrooms – 6 water closets, 4 lavatories
    - Located within a reasonable walking distance from children's play equipment and other high-use areas at one or more sites

- Orientation: Multi-purpose service area or community-wide recreation resource serving most of the city's population and possibly ETJ population

- Function: Provide opportunities for indoor and outdoor recreation of a diverse mix of uses and experiences, including walking and bicycling, outdoor performances, various programmed and non-programmed field sports, swimming, and special events

Metropolitan Parks are large parks that serve several communities and the entire city and range in size from 100–499 acres. These are natural areas or are developed for a variety of outdoor recreation such as ball fields, playgrounds, boating, fishing, swimming, camping, picnicking, and trail systems. The city's service standard is five acres per 1,000 residents. *The metropolitan park acreage needs were easily met with the State park.*

Regional Parks are very large multiuse parks that serve several communities within a particular region. They range in size from 500 acres and up and serve those areas within a one-hour driving distance. These parks provide both active and passive recreation for all age groups. They can include nature preserves, nature study areas, wildlife habitat, and conservation areas.

Special Use Parks are often designed as a revenue-generating enterprise created to satisfy the demand for a particular sport, recreational activity, or special event. A Special Use Park may also be a sports park combined with enterprise activities and administered as a community recreation resource. Size is determined by land availability and facility market demand for the recreational programs. Location is determined by property opportunity, size objectives, and service area. These parks are often managed in public and private partnerships. They have special recreation programming, sports, and special event attractions and activities for all age groups. The minimum size varies depending on intended use and programming. They are oriented toward single-purpose use and typically fall into the following categories.

- Special Event Facilities
  - Performing Arts Parks
  - Theaters Community
  - Amphitheaters

- Passive Recreation Facilities
  - Community Centers
  - Senior Centers
  - Arboretums
  - Marinas
  - Gardens
  - Zoos
  - Nature Centers
  - Museums/Historical Areas

- Specialized Sport Facilities
  - Tennis Centers
  - Skate parks
  - Softball/Baseball Complexes
  - Sports Stadiums
  - Hockey Arenas
  - Golf Courses
  - Aquatic Parks
  - Football Stadium
  - Soccer Stadium
  - Other sports facilities

There is an expressed desire for additional special-use facilities in Laredo, including a mountain bike park, spray parks, and motorized vehicle trail areas. The following Special Use Areas were specified as needed and recommended:

- *Motorized vehicle trail in the northwestern part of the City (District 9 EJ)*
- *Water Park (District 5)*
- *Sports Complex (Multiuse Leisure Centre)*
- *Off-leash Dog Parks*

School Parks are created by combining the resources of two public agencies, which expands the recreational, social, and educational opportunities available to both entities in a cost efficient, cost effective manner. School park sites often complement other public recreation or open lands. Criteria established for neighborhood parks and community parks should be used for school parks. If athletic fields are present, they should be oriented to the youth as opposed to adult programs.

Trail and Pathway Classifications and Standards for the City of Laredo

The City's goal is to have a wide variety of trails to reach destinations within and outside the city. The citywide trail system *should include linkages to trail systems for access to neighborhoods, schools, and parks and be comprehensively planned with the City's Transportation Plan and other municipal policies and included in the Master Park System Plan*. A variety of landscapes should be encouraged in the design of these systems. On the next page, Figure F-5 illustrates the City's future plans for linear corridors and parks, which would contain a significant portion of the proposed trail systems.

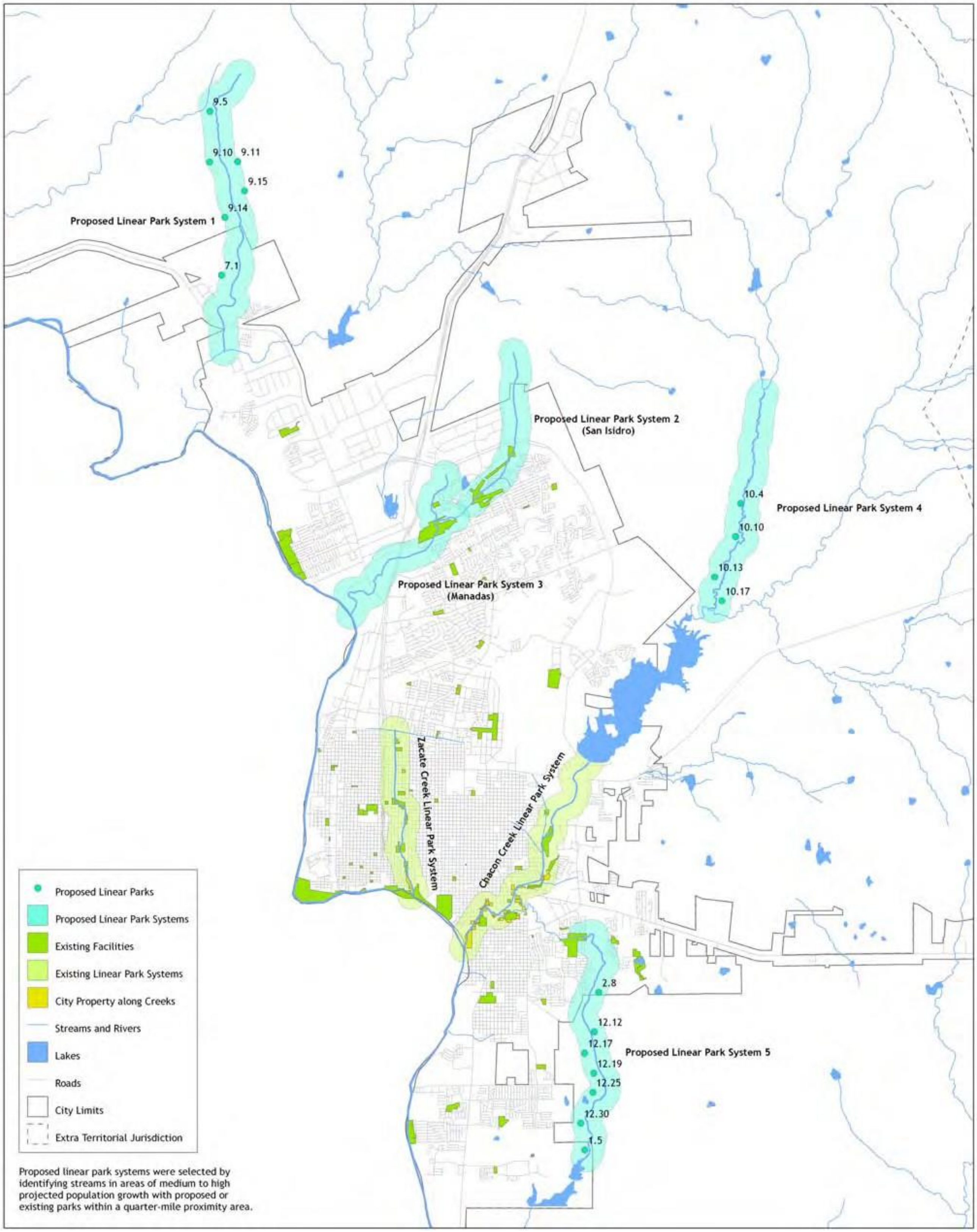

Figure F-5. City of Laredo Proposed Linear Parks

Source: City of Laredo Parks and Recreation Master Plan 2008

Trail classifications and minimum standards are described as follows:

- *Paved Class I Shared-Use Paths* accommodate non-motorized wheel and pedestrian use and are often located within a designated greenbelt and/or utility corridor. *Width ranges from 10 to 14 feet with two-foot shoulders and a minimum 10-foot height clearance.*
- *Class II Bike Lanes are associated with roadways* and defined by standards of minimum five-foot width (one foot wider than AASHTO minimums).
- *Class III Bike Routes (Shared Route)* usually involve a combination of wide curb/land (12–14 feet in width) and *are designated as a bicycle route*. *Shared-use Soft Surface Trails are designed for a 6- to 10-foot trail width and are intended for predominantly recreation use*.
- *Local Soft Surface Trails are used for areas with less intense use and intended to preserve the natural setting in which they are located*. The facilities are narrower and have somewhat tighter design clearances, which are appropriate for pedestrian and limited mountain bike use.
- *Local Paved Paths are narrower (4–6 feet) than Class I trails* and are intended to have the same general design specifications for shoulders, grade, and sight distance as other paved facilities.
- *Hillside Connection Trails are intended to provide pedestrian access along steep terrain and are narrower facilities (3–6 feet) with gravel or wood mulch surfaces.* Grades are steeper and paths might be unsuitable for ADA compliance or for all types of bicycles.
- *Neighborhood Paths are located along roadways* and can be paved or soft-surfaced. These facilities are generally not intended for bicycle use, with *a minimum 5-foot separation from roadway and more preferred*.

The following facilities are desirable in association with or within a short linkage to the trail systems:

- *Diverse landscapes*, such as manicured turf, treed parks, constructed naturalized landscapes, forests
- Active *tot lots with play equipment and seating for parents*
- *Secluded seating areas*
- *Water play areas*
- *Spaces that encourage social interaction*

Latent Demand

Table F-12 illustrates the latent demand estimated by the City after considering citizen, expert, and governmental input for the master plan. This information was garnered from the Parks Department Master Plan. The green-shaded amenities are cost-sharable items under USACE recreation authority as limited by primary authorities, such as flood risk management and ecosystem restoration.

Table F-12. Latent Demand and Projected Recreation Deficiencies, Laredo, Texas

Amenity	Existing	Target Based on 2007 Population	Target Based on 2015 Population	2015 Surplus/ Deficiency
Competitive Soccer Field	12	44	60	(48)
Football Field	0	11	15	(15)
Competitive Baseball Field	22	44	60	(38)
Competitive Softball Field	7	44	60	(53)
Basketball Court	32.5	44	60	(28)
Tennis Court	17	55	75	(58)
Volleyball Court	3	11	15	(12)
Indoor Recreation Center	8	7	10	(2)
Swimming Pool	6	11	15	(9)
18-Hole Golf Course	2	4	6	(4)
Playground	46	221	302	(256)
Picnic Table	211	368	503	(292)
Large Pavilion	11	44	60	(49)
Multipurpose Court	0	9	12	(12)
Skating Facility (Hockey Rink)	2	2	3	(1)
Paved Trail (miles/system)	3.88	11.0	15.1	(11)
Skate Park	7	11	15	(8)
Multipurpose Field	16	11	15	1
Splash Park	5	11	15	(10)
Water Park	0	1	1	(1)

Extracted from Outdoor Recreation Facility Standards and Comparison of Deficiencies table, Locally Adopted Standards as of September 2007 as recommended by the City of Laredo Parks and Recreation Board.

Recommendations from the Parks Department Master Plan

Key parkland acquisitions identified in the Master Plan included future greenbelt and riverfront land, such as the proposed project lands in Chacon Creek. Acquisition of land to develop *interconnectivity and park enhancements* was also mentioned. Natural buffers or corridors around areas with significant wildlife or vegetation habitat is desirable, as is additional open space to support expansion of passive, nature-oriented, recreation activities (walking, nature appreciation, picnicking, unprogrammed open space use). The plan recommended acquisition of parkland in established communities as opportunities develop.

The plan proposed the acquisition over the next 10 years of 148 new parks: 37 new neighborhood parks within the existing eight Council Districts, three new community parks within the existing Council Districts, 101 new neighborhood parks proposed in the ETJ, and five new community parks proposed in the ETJ. The master plan included the following recommendations:

- Begin development of inventory of vacant parkland

- Upgrade existing facilities (lighting, washrooms, play facilities)
- Extend the use of existing facilities/design for intensified use (multiuse/basketball courts, festival areas)
- Convert under-used facilities to meet other facility requirements
- Restrict access by non-priority users
- Enhance access for multi-use facilities (commuter pathways, parking lots)
- Expand service areas to maximize use of facilities in all areas of the City
- Use non-municipal resources to expand supply (commercial areas)
- *Designate Preservation Areas* – environmentally significant areas that are sensitive to human activity, including ravines, coulees, swamps, rivers, or drainage courses, wildlife habitat, important natural or historical features, regionally significant sites with unique natural resources, heritage sites, and historically significant areas

CHACON CREEK PROJECT

The Chacon Creek Project is located within the city limits of Laredo (Planning District 2), and includes portions of the Chacon Creek and Lake Casa Blanca. The major arterial roadways that cross the creek are Meadows Road, State Highway 359, U.S. Highway 83, Clarke Street, and U.S. Highway 59. Loop 20 (Bob Bullock Loop) does not cross the creek, but intersects U.S. Highway 59 in the vicinity of the northern limits to the project. A significant amount of traffic occurs on all of these roads. Bus routes along these roads also exist. Lake Casa Blanca, its associated State Park, and Casa Blanca Golf Course are located on the northern end of the Chacon Creek Project. Dryden Park is located on the southern end. Slaughter Park is relatively close to the area and within linkable distance on the southwestern end. A palustrine semi-permanently flooded wetland with an unconsolidated bottom, colloquially known as Killam Lake, is located north of the Clark Street crossing. A few smaller public lands within the creek's vicinity are not identified in the city's GIS database. See Figure F-6 on the next page, which was created by USACE GIS for illustration purposes only.

Survey results for District 2 indicated that the most important items to the community were: *1) acquisition of parkland, 2) trails, 3) picnic shelters, 4) open space, 5) water park, 6) flower garden, 7) baseball field, 8) basketball court, 9) football field, and 10) outdoor pool. New indoor amenities desired included: 1) community center, 2) senior center, and 3) indoor pool.* A new community center was planned and designed in 2008 near the Clark area, which was originally planned for a soccer complex in the Chacon Creek Master Plan. Additional changes to the Master Plan have occurred since its publication, and *most of the sports fields were eliminated from the proposed areas*. *Trails began construction in 2007 with TxDOT funding on phase 1*. Additional funding for other phases is still desired and sought after in the USACE – City of Laredo partnership.

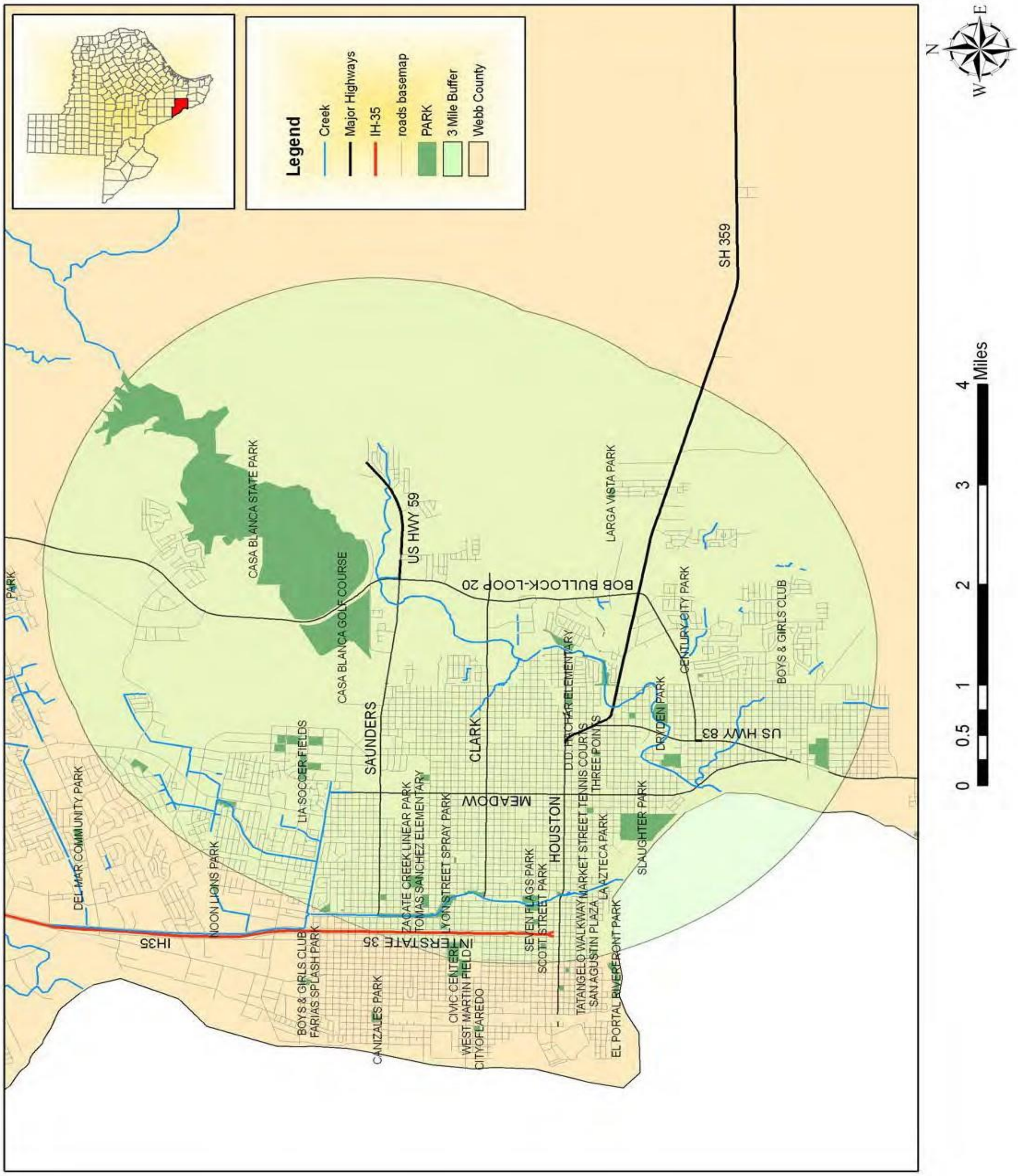

Figure F-6. City of Laredo Existing Recreation Facilities, Three-mile Buffer

Source: USACE, SWF-PER. GIS data, for illustration purposes only

The Chacon Creek Master Plan was prepared by Carter Burgess. It was adopted in May 2008 after revisions made by Jacobs Engineering Group, as shown in Figure F-7 on page F-39.

To accommodate the Federal project with flood risk management, ecosystem, and recreation aspects, an additional park design was considered for a buyout area in the Loma Alta Subdivision. Current planning by the Parks Department is focused toward a *baseball/softball complex* in this area.

The recreation amenities in the Chacon Creek Master Plan will address some of the City's recreation demand for facilities, activities, and open spaces. Many of the proposed facilities are cost-sharable with the USACE partnership. **However, federal restrictions limit funding assistance for "passive" recreation and associated facilities, such as parking areas, restrooms, and utilities.**

Table F-13 lists the desired facilities as identified in the City's new Master Plan and based on the current inventory and facility standards as recommended by the Laredo Parks and Recreation Board.

Table F-13. Latent Demand for District 2

Amenity	NRPA Minimum Standards A	Locally Adopted Standards B	2008 Inventory	Based on 2007 Pop. Est. 26,850		Based on 2010 Pop. Est. 32,055		Based on 2015 Pop. Est. 36,767	
				Target	Surplus / (Deficiency)	Target	Surplus / (Deficiency)	Target	Surplus / (Deficiency)
Competitive Soccer Fields	1 / 10,000	5,000	2	5	(3)	6	(4)	7	(5)
Football Fields	1 / 20,000	20,000	0	1	(1)	2	(2)	2	(2)
Competitive Baseball Fields	1 / 5,000; 1 lighted field / 30,000	5,000	3	5	(2)	6	(3)	7	(4)
Competitive Softball Fields	1 / 5,000	5,000	0	5	(5)	6	(6)	7	(7)
Basketball Courts	1 / 5,000	5,000	1	5	(4)	6	(5)	7	(6)
Tennis Courts	1 / 2,000	4,000	0	7	(7)	8	(8)	9	(9)
Volleyball	1 / 5,000	20,000	0	1	(1)	2	(2)	2	(2)
Indoor Recreation Center		45,000	1	1	0	1	(0)	1	(0)
Swimming Pools	1 / 20,000	20,000	0	1	(1)	2	(2)	2	(2)
Golf Course - 18 holes	1 course / 50,000	50,000	0	1	(1)	1	(1)	1	(1)
Playgrounds		1,000	4	27	(23)	32	(28)	37	(33)
Picnic Tables		600	17	45	(28)	53	(36)	61	(44)
Large Pavilions		5,000	2	5	(3)	6	(4)	7	(5)
Multi-purpose Court	1 / 10,000	25,000	0	1	(1)	1	(1)	1	(1)
Skating Facility (hockey rink)	1 / 100,000	100,000	0	0	(0)	0	(0)	0	(0)
Paved Trails (miles/system)	1 system / region	20,000	1.2	1.3	(0.2)	1.6	(0.4)	1.8	(0.7)
Skate Park		20,000	1	1	(0)	2	(1)	2	(1)
Multi-purpose Field		20,000	0	1	(1)	2	(2)	2	(2)
Splash Park		20,000	0	1	(1)	2	(2)	2	(2)
Water Park		250,000	0	0	(0)	0	(0)	0	(0)

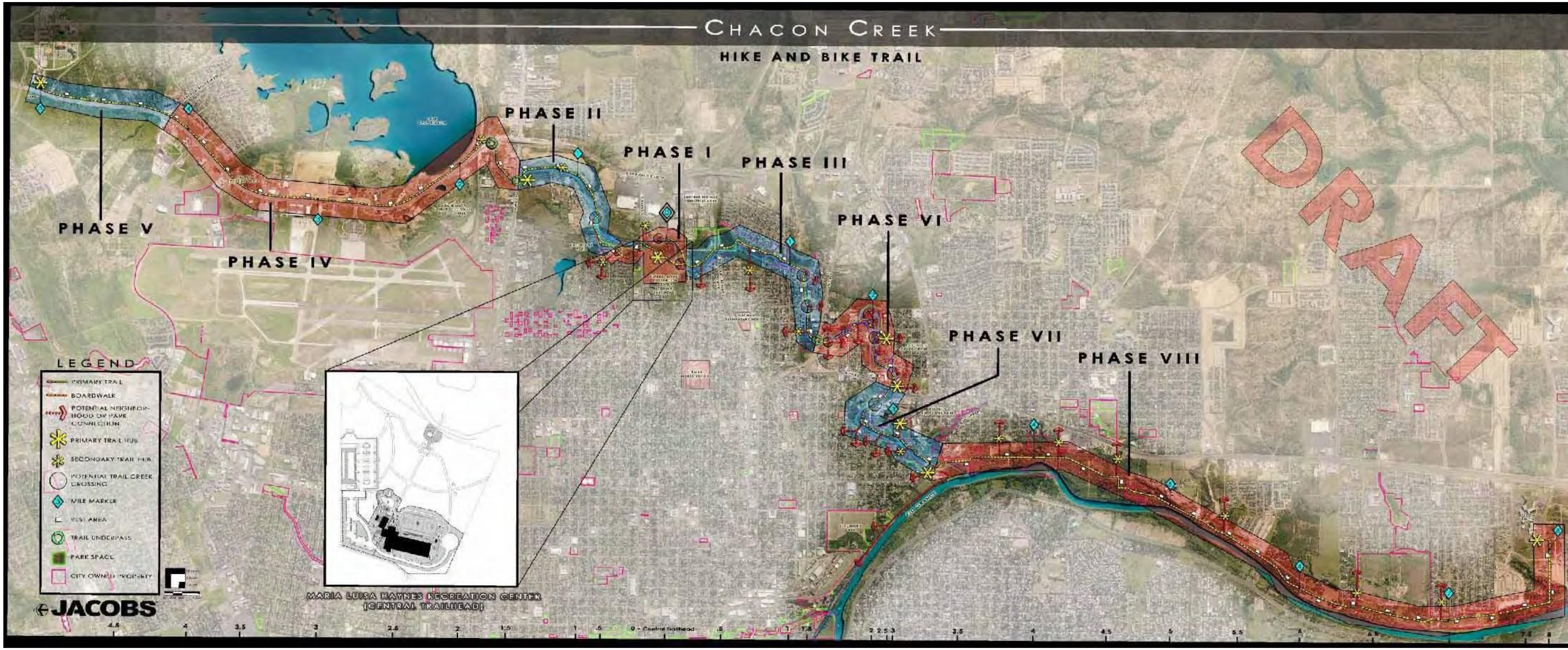

Figure F-7. Chacon Creek Master Plan Conceptual Map

Source: JACOBS, 2008

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Table F-14 on the next page provides the projected cost estimates to implement the plan for District 2 (not including the Federal project buyout area).

On page F-43, Table F-15 provides the implementation cost estimates for District 2 recreation.

USACE provides only limited cost-share assistance (for grading and the like) for active recreation features such as sport fields. During the planning processes, economic justification for recreation will determine USACE's partnership role in recreation, as well as other multi-use goals and objectives. *The city has begun developing trails in the portions not expected to undergo modification of the channel.* A *grant from the Texas Department of Transportation for three miles of hike/bike trails* was received and implemented per LPRD staff. *Note that the TxDOT and Federal Highway Administration have provided funding for this project, which is not capable of consideration for additional funding from Federal sources.*

Because the City is invested financially and has approved the new Master Plan version by Jacobs, it is recommended that features (and cost estimates) defined for this process be viewed as the starting point for economic justification of recreation. If needed, additional facilities or other modifications to recreation plans can be made as agreed to among the partners.

Table F-14. Implementation Cost Estimates for District 2 Recreation

Park & Open Space Master Plan
Implementation Cost, District 2

	2008 # built		2008 cost	2009 # built		2009 cost	2010 # built		2010 cost	2011 # built		2011 cost	2012 # built		2012 cost
Neighborhood Playground	175,000		-	189,000	2	378,000	204,120	3	612,360	220,450		-	238,086		-
City Playground	325,000		-	351,000		-	379,080		-	409,406	3	1,228,219	442,159		-
Sprayground	350,000		-	378,000		-	408,240	1	408,240	440,899		-	476,171		-
Skate Park	500,000		-	540,000		-	583,200		-	629,856		-	680,244		-
Baseball/Softball Practice Field (Backstop and Infield Only)	45,000		-	48,600	2	97,200	52,488	3	157,464	56,687		-	61,222		-
Baseball Field (300')	250,000		-	270,000		-	291,600		-	314,928	4	1,259,712	340,122		-
Softball Field (225')	200,000		-	216,000		-	233,280		-	251,942		-	272,098		-
Soccer Field (300'L x 180'W)	80,000		-	86,400		-	93,312		-	100,777	5	503,885	108,839		-
Basketball Court (94'L x 50'W)	50,000		-	54,000	2	108,000	58,320	3	174,960	62,986	3	188,957	68,024		-
Tennis Court	55,000		-	59,400		-	64,152		-	69,284	9	623,557	74,827		-
Sand Volleyball Court	25,000		-	27,000		-	29,160		-	31,493	2	62,986	34,012		-
Picnic Shelter (20x20)	12,000		-	12,960	4	51,840	13,997	6	83,981	15,117	33	498,846	16,326		-
Trail (6' Wide Concrete L.F. cost)	26		-	28	2,112	58,164	30	3,168	94,226	32	3,960	127,206	35		-
Flower Garden (sq. ft. cost)	10		-	11	100	1,080	12		-	13		-	14		-
Family Aquatic Center	3,000,000		-	3,240,000		-	3,499,200		-	3,779,136	1	3,779,136	4,081,467		-
Land per acre	45,000		-	45,000		-	45,000		-	48,600		-	48,600		-
Indoor Rec Center	4,867,088		-	5,256,455		-	5,676,971	1	5,676,971	6,131,129		-	6,621,619		-
Indoor Soccer Field	12,205,631		-	13,182,081		-	14,236,648		-	15,375,580		-	16,605,626		-
Indoor Tennis Court	1,369,178		-	1,478,712		-	1,597,009		-	1,724,770		-	1,862,751		-
Indoor Pool	8,190,875		-	8,846,145		-	9,553,837		-	10,318,144		-	11,143,595		-
TOTAL			-			694,284			7,208,202			8,272,504			-

	2013 # built		2013 cost	2014 # built		2014 cost	2015 # built		2015 cost	2016 # built		2016 cost	2017 # built		2017 cost	TOTAL COST
Neighborhood Playground	257,132		-	277,703	2	555,406	299,919		-	323,913		-	349,826		-	1,545,766
City Playground	477,532		-	515,734		-	556,993		-	601,552		-	649,677		-	1,228,219
Sprayground	514,265		-	555,406		-	599,838		-	647,826		-	699,652		-	408,240
Skate Park	734,664		-	793,437		-	856,912		-	925,465		-	999,502		-	-
Baseball/Softball Practice Field (Backstop and Infield Only)	66,120		-	71,409		-	77,122		-	83,292		-	89,955		-	254,664
Baseball Field (300')	367,332		-	396,719	2	793,437	428,456		-	462,733		-	499,751		-	2,053,149
Softball Field (225')	293,866		-	317,375		-	342,765		-	370,186		-	399,801		-	-
Soccer Field (300'L x 180'W)	117,546		-	126,950		-	137,106		-	148,074		-	159,920		-	503,885
Basketball Court (94'L x 50'W)	73,466		-	79,344	2	158,687	85,691		-	92,547		-	99,950		-	630,604
Tennis Court	80,813		-	87,278		-	94,260		-	101,801		-	109,945		-	623,557
Sand Volleyball Court	36,733		-	39,672		-	42,846		-	46,273		-	49,975		-	62,986
Picnic Shelter (20x20)	17,632		-	19,042	4	76,170	20,566		-	22,211		-	23,988		-	710,837
Trail (6' Wide Concrete L.F. cost)	37		-	40	2,112	85,463	44		-	47		-	51		-	365,059
Flower Garden (sq. ft. cost)	15		-	16		-	17		-	19		-	20		-	1,080
Family Aquatic Center	4,407,984		-	4,760,623		-	5,141,473		-	5,552,791		-	5,997,014		-	3,779,136
Land per acre	48,600		-	52,488		-	52,488		-	52,488		-	52,488		-	-
Indoor Rec Center	7,151,348		-	7,723,456		-	8,341,333		-	9,008,639		-	9,729,330		-	5,676,971
Indoor Soccer Field	17,934,076		-	19,368,802		-	20,918,306		-	22,591,771		-	24,399,112		-	-
Indoor Tennis Court	2,011,772		-	2,172,713		-	2,346,530		-	2,534,253		-	2,736,993		-	-
Indoor Pool	12,035,083		-	12,997,889		-	14,037,720		-	15,160,738		-	16,373,597		-	-
TOTAL			-			1,669,163			-			-			-	17,844,153
																17,844,153

	L.F.	Mile
5280	1056	0.2
	1320	0.25
	1760	0.33
	2640	0.5
	3521.76	0.667

Table F-15. Outdoor Recreation Priority Ranking for District 2

Action	Priority Rank	Desired Completion (years)	Opinion of Probable Cost per Unit	Funding Sources
Acquisition Neighborhood Park	1	1–3	$45,000 / acre in addition to PDO	Bonds, Grants, Land Donation
Trail	2	1–3	$30 / lf	Bonds, Grants, Land Donation
Picnic Shelter (20' x 20')	3	1–3	$13,997	Bonds, Grants
Playground	4	1–3	$204,120	Bonds. Grants
Open Space (1 acre)	5	1–3	Included in land cost	Bonds. Grants
Flower Garden	6	1–3	$12 / sf	Bonds, Grants, Operating Budget
Basketball Court (94' x 50')	7	1–3	$58,320	Bonds, Grants
Practice Field (backstop and infield only)	8	1–3	$52,488	Bonds, Grants
Sprayground	9	1–3	$408,240	Bonds, Grants
Trail	10	4–6	$37 / lf	Bonds, Grants
Large Playground	11	4–6	$477,532	Bonds, Grants
Picnic Shelter (20' x 20')	12	4–6	$17,632	Bonds, Grants
Open Space (1 acre)	13	4–6	Included in land cost	Bonds, Grants
Baseball Field (300' fence)	14	4–6	$367,332	Bonds, Grants, League Fundraising
Basketball Court (94' x 50')	15	4–6	$73,466	Bonds, Grants
Swimming Pool	16	4–6	$4,407,984	Bonds, Grants
Soccer Field (300' x 180')	17	4–6	$117,546	Bonds, Grants, League Fundraising
Tennis Court	18	4–6	$80,813	Bonds, Grants
Volleyball Court (sand court)	19	4–6	$36,733	Bonds, Grants
Acquisition Neighborhood Park	20	7–10	$52,488 / acre in addition to PDO	Bonds, Grants, Land Donation
Trail	21	7–10	$51 / lf	Bonds, Grants
Playground	22	7–10	$349,826	Bonds, Grants
Picnic Shelter (20' x 20')	23	7–10	$23,988	Bonds, Grants
Open Space (1 acre)	24	7–10	Included in land cost	Bonds, Grants
Flower Garden	25	7–10	$20 / sf	Bonds, Grants, Operating Budget
Basketball Court	26	7–10	$99,950	Bonds, Grants
Sprayground	27	7–10	$699,652	Bonds, Grants

RECREATION ALTERNATIVES FORMULATION

Among the Chacon Creek Recreation Alternatives, recreation amenities vary little, typically in location and total area/per amenity size adjustments, rerouting of the circulation system, and total acreage. The multiuse trail system is part of the ecosystem restoration component in the NER plan. The Recommended Plan combines the NED and NER plans and is not anticipated to alter the proposed recreation aspects.

More design efforts are needed at the sponsor level to define the "character and amenities" in the park and the O&M program and plans. USACE recommended that the Parks Department consider using their time and effort in this area toward creating a *Design Guidelines Book* for communication and for advanced design information that will be needed during the PED stage. Actual location of all features will be determined during the PED Phase if the project is authorized. Because buildings and fencing currently occupy the site, *exact siting in the field is not doable at this time*. Existing trees should be identified and preserved.

Cost estimates for this feasibility phase are based upon best available information obtained from coordinated planning activities with the city, and these have the potential to change in location, type, size, and quantities. Future design and all construction activities for park and ecosystem restoration will include the City's Parks and Recreation designated representatives.

Multi-use Trail System

Recreation features of the Multi-use Trail System will be limited to those amenities defined for ecosystem areas to qualify for Federal cost-share. Betterments are 100% sponsor responsibility and need to be compatible with the partnership goals, objectives, and legal authorities. *The Multi-use Trail System as shown in project maps are rerouted from the original proposal to increase distance away from the stream to:*

- *Permit more area for the stream to make natural meander changes*
- *Protect the investment in the trail*
- *Reduce the need for new bridges and/or low water crossings*

Pedestrian Bridges and Low Water Crossings

There were approximately 13 stream crossings proposed in the original VDS conceptual trail plan; *this quantity has been reduced*. *As of the date of this report, several creek crossings are still planned and will be either low water crossings or pedestrian bridges*, which ever is determined most feasible for the hydraulic and environmental constraints, and maintenance over time. *It is estimated that five new pedestrian bridges and two low water crossings will be needed for trail linkage in addition to an underpass trail linkage along the existing bridge on State Highway 359 slightly downstream of the proposed park*. A pedestrian bridge already exists near this area and it is undetermined if it will remain. Refer to the cost estimation information for total planned length and costs proposed for the various configurations.

Also at the time of writing this report, no in-field or H&H investigations on stream crossings have been obtained. The pedestrian bridges will introduce new hydraulic constraints that could, if not properly designed, greatly impact the stream and increase risk of lost investment. Low water crossings are preferred, but may not be feasible with the existing land form. Final routing should also take into consideration the reduction of impacts to the ecosystem restoration project and benefits derived from these efforts. More could be done in regards to reducing the impact on the stream, riparian area and wildlife species. ***Additional design efforts will be addressed in the Preconstruction Engineering Design (PED) Phase with in-field investigation and trail routing.***

Trailheads

Various trailheads are desired along the trail to provide parking, restrooms, and some picnicking opportunities. *These trailheads are currently not planned for the project, because little time and effort was given to define the locations where these will occur*. USACE can only participate on trailheads planned for project lands. ***If the opportunity occurs during PED to include trailheads, cost-share adjustments might be needed in the project authorities***. As locations become defined, all trailheads should be shown on the maps to evaluate other linkage possibilities.

Cost Estimation for Trail System

Currently, insufficient information has been developed to assess the cost of the trail, including routing, hydrology and hydraulic considerations and limitations, Ecosystem Authority restrictions, and costs for trailhead locations and amenities. Trailheads must be inside project lands for cost-share consideration. Currently planned is a multi-use trail with a minimum 8-foot-wide concrete path with one-foot shoulders for a total width of 10 feet. The Transportation Department's specifications for Hike and Bike trail will be used to create opportunities for the City to partner with TXDOT. *If such partnership occurs, cost-share planned by USACE for those areas will be removed from the plan*.

Trail Design Recommendations

It is recommended that the final trail alignment be pushed further from the creek. *Alignment should be based upon a fluvial geomorphological evaluation of the predicted future stream movement and existing grade and right-of-way space. In-field alignment is needed.* Nature trails could be added to take the public to specific sites along the creek and link to the Multi-use Trail System. By placing the main trail further from the creek and limiting grade changes, the "recreational experience" might be lessened, but the maintainability of the trail will be enhanced, and concerns regarding wildlife habitat and wildlife activity near the creek will be less impacted by trail-related disturbance.

Other Crime Prevention Potential

Laredo is an important border control city, which requires cooperation/coordination with the Border Patrols to police the area. Planning to include a heli-pad in the proposed park area was suggested for Border Patrol Emergency Transport by helicopter, with the concept of multi-use of this feature for a stage and amphitheatre with portable backdrops for festivals. Design would need to consider potential conflicts with the proposed activity surrounding this area and find a more suitable place in the park if needed. *At this time, no features were planned for this purpose, but could be added in the PED stage. Open field areas might be suitable for this purpose*.

FLOOD RISK MANAGEMENT PARK ALTERNATIVES INVESTIGATED

As shown in **Error! Reference source not found.**, subareas were defined to delineate the lands currently owned by the City as part of an existing park and easement, and the various floodplain lands being considered for flood risk management buyout. The community garden area adjacent to Subarea 2 is part of Subarea 1 and is within the 10-year buyout plan.

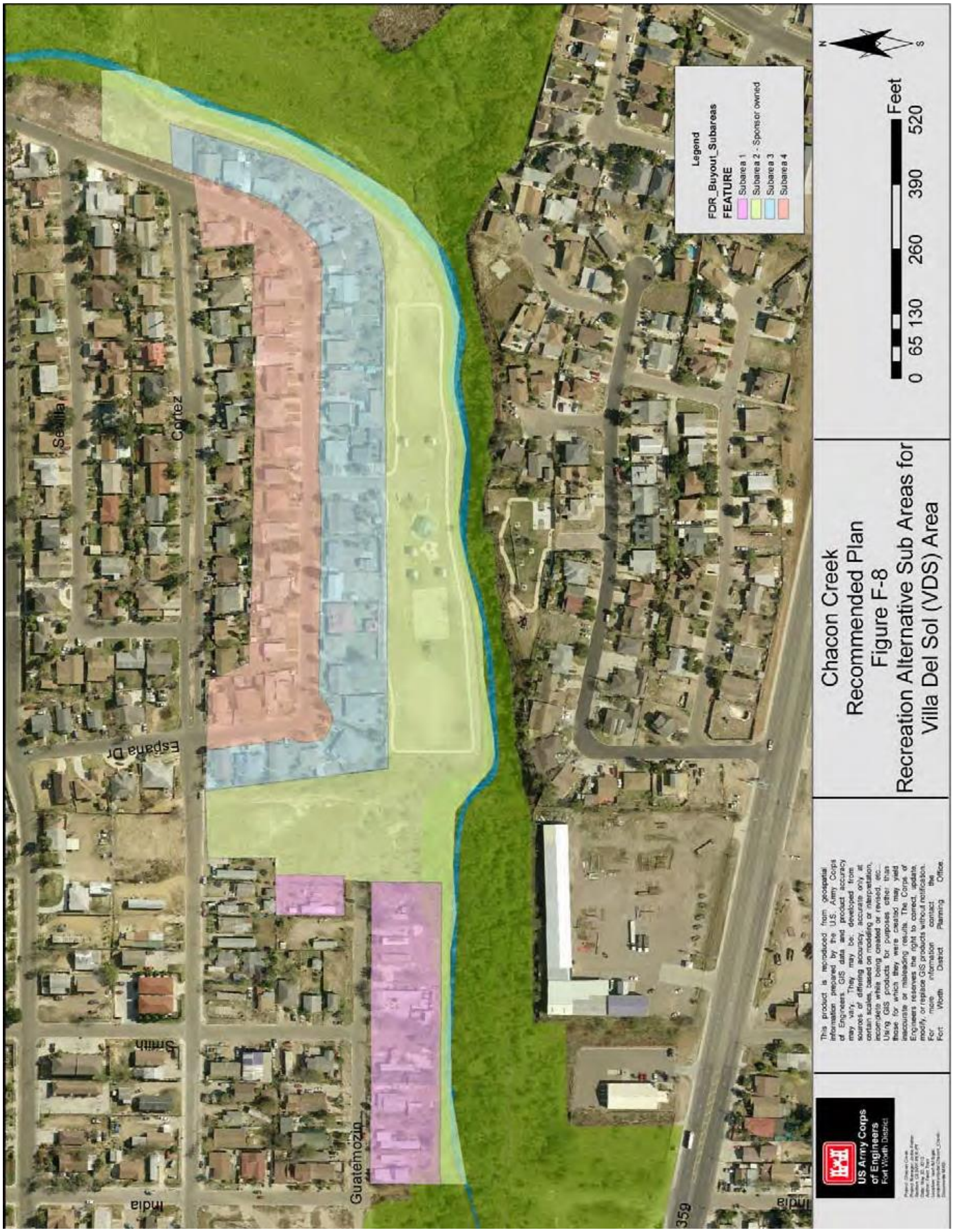


Figure F-8 Recreation Subareas for Villa Del Sol Area

(Image source: USACE, 2010)

Villa Del Sol “VDS Plan” Plan

The Villa Del Sol VDS Plan (shown in **Error! Reference source not found.**) is the sponsor’s preferred alternative for the buyout area, which incorporates the city’s land redesigned to become one larger park facility housing specialty and metro-park capabilities. The plan maximizes the open space and the use of such space for a higher quality recreational experience. *It could support practice fields, sports fields (100 percent sponsor cost), festivals, and special events, all of which have existing demand within the city and community*. This proposed park alternative is estimated to be 18.7 acres, which includes Subarea 2 (sponsor-owned park) which contains approximately eight acres. *Two new pedestrian bridge*s are planned in relation to the *NER multi-use trail* in this area and will link trails leading to community facilities east of the creek.

The sponsor-owned area (Subarea 2) as it currently exists contains land that is both existing parkland and utility easement land. *USACE proposed to consider relocating existing park features higher in the floodplain and providing room for an ecosystem restoration buffer zone (minimum 50 feet).* USACE could possibly justify in flood risk management cost-share the demolition costs of those features to be relocated or replaced in higher elevation areas. *Such relocation would create the potential for the city to consider the new modern facilities in demand and achieve lower operations and maintenance (O&M) costs for future generations*.

As shown in the Figure 9, *a proposed disc golf area, dog parks, and a community garden could partially meet the city’s demand for these facilities*. The area currently proposed for the 18-hole disc golf course has limited vegetation and would need *landscaping to add trees and shrubs*. *Consideration could be given to placing this amenity in the existing tree area that should remain following demolition of buyout parcels. Lower areas might be able to be designed to accommodate other planned open space recreation.* ***These considerations will be evaluated in the PED and final design phases.***

These lands currently do not qualify as flood risk management buyout lands, and any recreation measures implemented on these areas is currently at *100-percent sponsor cost.* It is desirable to incorporate all of Subarea 2 into the USACE supportable cost-share plan if possible; this incorporation will need approval from USACE Headquarters. *The VDS Plan assumes that incorporation of these lands and redesign of Subarea 2 will take place*.

Table F-16. Villa Del Sol (VDS) Plan Amenities

Subarea	Amenities Considered
1, 2, 3, 4	Parking and Access Roads (includes all associated amenities)
2	Amphitheater
1, 2	Part of Multi-use Open Space, possible Frisbee Golf (18-hole)
2, 3	Game Courts
2	Individual Picnic Sites (8)
4	Metro Bus Shelter/Trailhead
1	Part of Multi-use Open Space, possible Community Garden and Shed (Some not cost-shared, such as fence)
3, 4	Part of Multi-use Open Space, possible Dog Parks (fence not cost-shared)
3, 4	Large Group Picnic Shelter (rentable, income generation for maintenance)
3	Small Group Picnic Shelters (2)
1, 2, 3, 4	Multi-use Open Space (possible practice fields, soccer fields, festival and concert grounds (limited cost share)
3	Playground – large, multi-age themes
3	Playground – small, secondary
3, 4	Comfort Stations (2 Restrooms) may also be designed with concessions, group picnic with restrooms
1, 2	Tree Buffer (50 feet)
	Circulation System (5-8’ wide concrete paths)
NER	Two Pedestrian Bridges (refer to the NER Multi-use trail plan) – linkage to trails planned to community center in eastern non-project lands

Figure F-9. Villa Del Sol (VDS) Plan

(Image source: USACE, 2010)

Partial 25-Year Floodplain Evacuation with Recreation

The Partial 25-Year Floodplain Evacuation with Recreation (shown in **Error! Reference source not found.**0) in Reach 2 was developed in case the USACE cannot include the sponsor-owned area in the project, no additional recreation amenities can be planned for this subarea, and USACE can justify additional buyout lands. In that case, it would be the city's choice and 100% cost to perform any redesign in the Subarea 2. It is assumed that all of Subarea 2 will eventually become multi-use open space with only existing pathways kept. No cost-share assistance is available for landscape revegetation and enhancement or recreation amenities for Subarea 2. This plan, which has the larger acreage with Subarea 4 incorporated, is very close to the VDS Plan, but has a reduction in parking, redistribution of picnic facilities, and less Multi-use Open Space to accommodate sport and practice fields.

The significant loss of multi-use open space in Subareas 3 and 4 resulting from redistribution of desired amenities and the reduction of parking produce significantly lower benefits obtained from this plan. The sponsor is left with the burden of all costs for improvements to Subarea 2, which likely reduces the desirability of such improvement. The open field in Subarea 2 is currently used for soccer practices and games and is lighted, and there is some reduction of benefits for wildlife along the creek because of this lighting. However, this is localized and less of a concern than trail lighting considerations. *Lighting moved to higher ground may be less intrusive on the ecosystem objectives, but could affect local residents living adjacent to the park more*. Table F- lists the recreation land use planned for the various amenities on a subarea basis.

Table F-17. Partial 25-Year Floodplain Evacuation with Recreation Amenities

Subarea	Amenities Considered
1, 3, 4	Parking and Access Roads including all associated amenities (Subarea 2 100% sponsor cost)
1	Amphitheater
2	Subarea 2, if multi-use conversion 100% sponsor; possible Frisbee Golf (18-hole)
3	Game Courts
1, 3, 4	Picnic Sites (15) including all associated amenities (Subarea 2 100% sponsor cost)
4	Metro Bus Shelter/Trailhead
1	Multi-use Open Space, possible Community Garden and Shed
1, 3, 4	Multi-use Open Space, possible festival area, concert space, dog parks
3, 4	Large Group Picnic Shelter and Basketball Court
3	Small Group Picnic Shelters (2)
4	Playgrounds – large, multi-age themes, small, secondary
3, 4	Comfort Stations (Restrooms 2) group picnic with restrooms
1, 2	Tree Buffer (50 feet min., Ecosystem Restoration cost-share)
1, 2, 3, 4	Circulation System (5–8' wide concrete paths)
2	Maintenance Road/Multi-use Trail (within park only, 10-foot-wide concrete, 2 2-foot shoulders)
NER	Two Pedestrian Bridges and Trail (refer to the NER Multiuse trail plan) - linkage to trails planned to community center in eastern non-project lands

Figure F-10 Partial 25 Year Floodplain Evacuation with Recreation

(Image source: USACE, 2010)

10-Year Floodplain Evacuation with Recreation

The 10-Year Floodplain Evacuation with Recreation (shown in F-11) in Reach 2 is the least desired footprint according to the city's recreation goals. Subarea 2 is the city-owned property as described previously. *The main difference between this plan and Alternative 1 is the reduction of land base (Subarea 4) to support the number of multi-use fields and parking areas.* It *assumes that all new recreation amenities desired and planned will go on the buyout parcels and the city might or might not redesign Subarea 2*. Subarea 2 currently contains a basketball court, approximately six picnic shelters, and a playground. The existing playground surface is a high-maintenance requirement and washes away with flooding. The area also has parking and an open field used for either practice or soccer games and is lighted for these activities. New walks have been added within the past few years and could be reincorporated into the new design circulation and multi-use trail linkages. The parking area and boundary have fencing and gate control features.

Table F- lists the various recreation land uses for 10-Year Floodplain Evacuation with Recreation. *This plan differs from the original concept plan prepared for the VDS area in the change from a multi-use trail to using existing walks. Relocated and/or new picnic sites, basketball court, and playground show a different distribution than the VDS Plan.* These would need to be removed from Subarea 2 to accommodate a proposed disc golf area and revegetation in this subarea (at 100% sponsor cost).

Table F-18. 10-Year Floodplain Evacuation with Recreation Amenities

Subarea	Amenities Considered
1, 2, 3, 4	Parking and Access Roads (includes all associated amenities)
1	Amphitheater
1, 3	Multi-use Open Space, possible Frisbee Golf (18-hole), *Subarea 2 if redesigned*
3	Game Courts
1, 3	Picnic Sites (11)
4	Metro Bus Shelter
1	Multi-use Open Space, Community Garden and Shed
3	Multi-use Open Space, possible Dog Parks, practice fields
3	Large Group Picnic Shelter and Basketball Court
3	Small Group Picnic Shelters (2)
1, 2, 3	Multi-use Open Space (possible practice or sports fields, festival, concert usage, dog parks, existing park playground, shelters, basketball court, community garden, and shed
3	Playground – large, multi-age themes
3	Playground – small, secondary
3, 4	Comfort Stations (2 Restrooms) - may also be designed with concessions, group picnic with restrooms
1, 2	Tree Buffer (50 feet)
1, 3	Circulation System (5–8’ wide concrete paths)
NER	Two Pedestrian Bridges and Trail (refer to the NER Multiuse trail plan) - linkage to trails planned to community center in eastern non-project lands

Figure 11. 10-Year Floodplain Evacuation Plan

(Image source: USACE, 2010)

Recommended Plan – Revised Villa Del Sol "VDS Plan" plus Areas A and B

The Revised Villa Del Sol "VDS" Plan (shown in Figure F-12) was modified based upon comments and review to include additional areas within the 10-year floodplain, but not attached to the Villa Del Sol Park. This plan incorporates the city-owned land redesigned to become one larger park facility housing specialty and metro-park capabilities as described in the VDS Plan for Alternative 1. In addition it creates two additional small recreational areas downstream, described as Area A and Area B (Figures F-13 and F-14). The VDS plan maximizes open space and the use of such space for a higher quality recreational experience, and supports practice fields, sports fields (100 percent sponsor cost), festivals, and special events. All of which proposed features have existing demand within the city and community. The Villa Del Sol proposed park area is estimated to be 18.7 acres, which includes Subarea 2 (sponsor-owned park area, approximately eight acres). Two new pedestrian bridges are planned in relation to the multi-use trail in this area to link trails leading to community facilities east of the creek and to reduce need to drive to the park for those residents on the east side.

As discussed in the original Villa Del Sol Plan, the sponsor-owned area (Subarea 2), as it currently exists, contains land that is both existing park land and utility easement land. USACE proposed relocating existing park features higher in the floodplain and providing room for an ecosystem restoration buffer zone (minimum 50 feet). USACE could possibly justify as part of the flood risk management authority, the cost-share of demolition of those features to be relocated or replaced in higher elevation areas. Such relocation would create the potential for the city to consider the new modern facilities in demand and achieve lower operations and maintenance (O&M) costs for future generations.

As shown in the Figure F-12, a proposed disk golf area, dog parks, and a community garden would partially meet the city's demand for these facilities. The area currently proposed for the 18-hole disk golf course has limited vegetation and would need landscaping to add trees and shrubs and time to establish prior to becoming a desirable disk golf course. Consideration could be given to placing this facility in the existing tree area that should remain following demolition of buyout parcels. Lower areas might be able to be designed to accommodate other planned open space recreation. **These considerations will be evaluated in the PED phase**.

These sponsor-owned lands currently do not qualify as flood risk management buyout lands, and any recreation measures implemented on these areas is currently at 100 percent sponsor cost. It is desirable to incorporate all of Subarea 2 into the USACE supportable cost-share plan if possible; this incorporation will need approval from USACE Headquarters. The VDS Plan area of the Recommended Plan assumes that incorporation of these lands and redesign of Subarea 2 will take place.

In addition to Villa Del Sol Park, the area designated as Area A and Area B were added to the Recommended Plan to maximize economic potential and create trailheads and small park areas from lands still remaining in the 10-year floodplain, but were not adjacent to the Villa Del Sol Park. Area A is 1.61 acres in size and contains a parking lot, four picnic tables and 1.43 acres of open space. This site is a proposed as a trailhead and portion of the proposed trail/maintenance road will run through the site. This park is located adjacent to State Highway 359 and India Street. Proximity to the state highway reduced the city's preference for additional recreational use of this park. Some future threat of encroachment may be a potential should the state highway need to be widened, but this action should only affect areas designated as open space.

Area B contains eight picnic tables, a playground, restroom, walk, parking lot with median and open space and it also has portions of the multi-use trail/maintenance road. Total acreage is 1.76. The park is both a neighborhood park and trailhead. A boardwalk is planned to connect to the park to the trail system to the east and the proposed wetland interpretive area. This park is located at Wooster Street and India Street.

Table F-19. Recommended Plan – Villa Del Sol (VDS) plus Areas A and B Amenities

Subarea	Amenities Considered
1, 2, 3, 4	Parking and Access Roads (includes all associated amenities)
2	Amphitheater
1, 2	Part of Multiuse Open Space, possible Frisbee Golf (18-hole)
2, 3	Game Courts
2	Individual Picnic Sites (8)
4	Metro Bus Shelter/Trailhead
1	Part of Multiuse Open Space, possible Community Garden and Shed (Some not cost-shared, such as fence)
3, 4	Part of Multiuse Open Space, possible Dog Parks (fence not cost-shared)
3, 4	Large Group Picnic Shelter (rentable, income generation for maintenance)
3	Small Group Picnic Shelters (2)
1, 2, 3, 4	Multiuse Open Space (possible practice fields, soccer fields, festival and concert grounds
3	Playground – large, multi-age themes
3	Playground – small, secondary
3, 4	Comfort Stations (2 Restrooms) may also be designed with concessions, group picnic with restrooms
1, 2	Tree Buffer (50 feet)
	Circulation System (5-8' wide concrete paths)
NER	Two Pedestrian Bridges (refer to the NER Multiuse trail plan) – linkage to trails planned to community center in eastern non-project lands
Area A	**Amenities Considered**
	Parking and Access Roads off of India Street
	Individual Picnic Sites (4)
	Multiuse Open Space
	Path to linkage with trail

Area B	Amenities Considered
	Parking and Access Roads from India Street and Median
	Multiuse Open Space
	Playscape
	Restroom
	Boardwalk Trail linkage and Concrete Pathways

Figure 12. Recommended Plan, Villa Del Sol (VDS) Area

(Image source: USACE, 2010)

Figure 13. Recommended Plan Area A

(Image source: USACE, 2010)

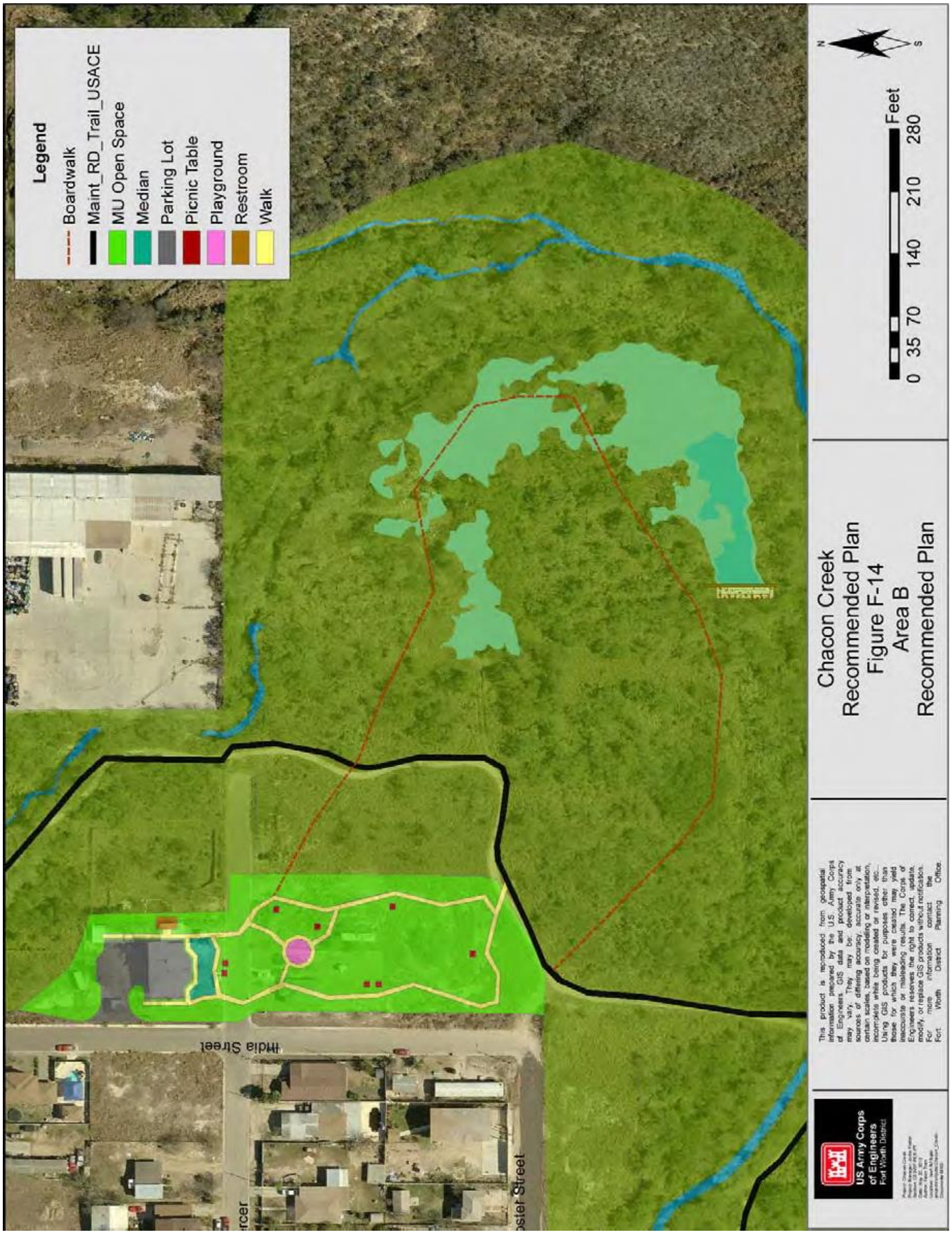


Figure F-14. Recommended Plan Area B

(Image source: USACE, 2010)

SUMMARY AND RECOMMENDATIONS

As described in the regional recreation section, there are numerous passive outdoor recreational opportunities in the region provided one is capable of driving to them. However, within the City of Laredo, outdoor recreation, both passive and active are currently in short supply and opportunity exists within the flood risk management and ecosystem restoration authorities to improve community recreation opportunities, address significant shortfalls, reduce dependency and need for automobiles, increase the social interaction and provide opportunities for urban community gardens and education to increase the appreciation of water quality, water quantity, ecosystem functions and wildlife habitat and species needs.

With appreciation comes a willingness of the taxpayer base and visitor to invest to protect and maintain these amenitites. Without appreciation, operation and maintenance costs will not be supported and undesirable human behaviors will infiltrate the “abandoned” riparian corridor. The riparian improvements will be viewed as a wasteland that will have to be maintained by the taxpayer base. Recreation is one method to bring both economic and social benefits to public owned land to offset property taxes lost as land transistions from privately owned to publically owned land. It is also the city’s investment to increase the overall quality of life for local residents.

Because of the opportunity to meet community needs and desires for recreation and improved riparian function, the Chacon Creek project was originally conceived by the city with the assistance of private contractors from the urban planning, architecture and landscape architectural disciplines. *The city’s citizens were involved in the public conceptual process and have “bought into” the city’s plan for improvements.* USACE and other federal support was recruited to assist the City of Laredo in building their Vision. *Their vision includes as a corner stone to its success both passive and active recreation opportunities.*

Chacon Creek is just the first is a series of riparian corridor improvement projects that the City of Laredo wants to create to meet existing and future growth requirements and to steer the city toward a more sustainable, and higher quality of life future. As climate change and population shifts continues there will be a growing need for locally grown produce and easily obtainable recreational opportunities.

It is most beneficial to the sponsor and the public at large to reduce the flood risk management maintenance currently needed for existing public lands in the Villa Del Sol Subarea 2 and to construct a larger park that can accommodate the widest array of possible amenities. The community garden is a desirable amenity and planned for 12 families. However, deer-proof fencing will be needed as well as access control to reduce vandalism/produce theft by non-participating individuals. (There is potential of partnerships with a newly created non-profit foundation “Sustainable Gardens,” which is being considered in Austin and might also have potential for Laredo and other communities.) Dog parks also require fencing. The fences are subject to flood damage and have a maintenance cost associated with them. Various other amenities, such as drinking fountains, signage, benches, are listed in the cost estimation sheets but are not shown in the conceptual maps or amenity tables.

Soccer and field sports are in demand, and some consideration needs to be given to accommodating these activities to the highest level possible, because it is difficult for most cities to acquire block acreage suitable for their inclusion into the recreational system. Lighting design should limit light pollution as much as feasible and be hooded; consider impact on the remaining community in the area as well as neighboring ecosystem areas. Fertilization, pest control and irrigation concerns should be adequately addressed to limit storm water pollution concerns for the creek. *Use of bioswales and holding ponds may be appropriate stormwater protection features that would be added during the PED advanced design stage. Some or all of these features may be required to obtain state water quality certification.*

Community impact could also be a consideration regarding the large parking areas planned. Ideally, these parking areas should be reduced and more land made available for other activities. However, festivals, concerts, practice fields, and the wide array of amenities will attract a larger population and the immediate community. Reducing parking (quantity) could be used as a control mechanism for carrying capacity considerations. Reducing impermeable surfaces and incorporating rain harvesting strategies would increase sustainability and reduce stormwater drainage issues. Gates should be installed at all access points to provide more control of the area and to provide capabilities to close the park during flooding events.

The plans do not show existing trees, but these trees need to be preserved provided they are not of the invasive species genre. The climate of Laredo will make revegetation to a forested or more forested state difficult and will most likely require irrigation. Salts from irrigation and weeds that also are stimulated by irrigation will increase maintenance costs, while trees and increased amenitites reduce the ability to mow the site.

It is recommended that if a disc golf course is planned, to place this course within the existing trees and to use the Subarea 2 as practice field and or soccer fields. Some non-structural flood risk measures could be considered to protect Subarea 2, such as small flood walls, berms, or fill to raise and level the ground in Subarea 2. Closing and demolition of the existing roads will reduce drainage flow into Subarea 2 as well. It is USACE-SWF’s recommendation to incorporate Subarea 2 into the project and redesign for the maximum recreational experience and benefit.

Cost-share is limited to traditional features, and betterments, though allowed, will be at 100% sponsor cost. Costshare for approved recreation features under the USACE authorities is 50/50 for basic amenity levels. Betterments and enhancements to these basic levels is 100% sponsor cost as is non-approved recreation amenities such as sport fields and sport courts. There are other partners that may assist the city to create these amenities and their needs/desires should be included in the design to enhance partnership capabilities. There is a trend to utilize structures such as building to produce solar or wind energy and opportunities such as these should be fully exploited during the design to provide energy and/or revenue sources for the city to maintain their facilities. Since the city has already began trail building efforts in some areas of the Chacon Creek drainage, funding sources should be ascertained to prevent conflicts with the federal partners. The trail system should be designed to meet the TxDOT alternative transportation requirements currently being used by the city for other reaches of the trail to ensure conformity and minimum access requirements for emergency vehicles. It is desirable to route trails farther away from the eroding creek banks, to ascertain future meandering potentials prior to design and to design with those meander alignments in mind. It is also desirable to reduce and avoid where possible additional pedestrian and other bridges that would create new hydraulic impacts of the stream system. Nature trail spurs would be desirable to take individuals closer to the creek for observation of wildlife and nature educational opportunities should be included in the design of the overall trail system.

REFERENCE:

USACE. 2010. Draft Feasibility Report and Environmental Assessment, Chacon Creek, Laredo, Texas. U.S. Army Corps of Engineers Fort Worth District. Approx. 142 pp.

APPENDIX G

ENGINEERING

APPENDIX G.1

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC ANALYSES

INTRODUCTION

A hydrologic and hydraulic analysis was performed for Chacon Creek. The U.S. Army Corps of Engineers, Fort Worth District (USACE) Hydrology and Hydraulics Section, Carter and Burgess, Inc., and Brown & Root, Inc. each contributed significant technical efforts as part of the overall investigation. The analysis consisted of the development of an Existing Conditions hydrologic and hydraulic model for Chacon Creek and the development of structural and non-structural flood protection alternatives for selected flood damage reaches along Chacon Creek.

Chacon Creek Existing Conditions

Chacon Creek is located in the Rio Grande Basin in deep Southwest Texas. Chacon Creek originates in south central Webb County and flows southwest. The Chacon Creek watershed has a drainage area of approximately 155 square miles. Located in the eastern half of the city in Webb County, Chacon Creek originates north of Lake Casa Blanca and flows approximately six miles to the south and west emptying into the Rio Grande. For location maps, refer to the main report. The surrounding flat terrain is surfaced by sandy clays that support mesquite, cacti, and grasses. The average channel slope of Chacon Creek from Lake Casa Blanca to the Rio Grande is approximately 14.8 feet-per-mile (approximately 95 feet in elevation difference).

This study was initiated by the City of Laredo to expand a previous flood control master plan into a multi-objective project. The upstream study limit is U.S. Highway 59, and the downstream study limit is the Rio Grande. On the next page, Figure G.1-1 is a typical view of the Chacon Creek channel.

Figure G.1-1. Chacon Creek Study Area

The City of Laredo recognized that the nature of the Chacon Creek watershed (Figure G.1-2) has changed dramatically since the last Federal Emergency Management Agency study was completed in 1982. The floodplain, as shown on the published Flood Insurance Rate Map (FIRM) on the 1982 study, shows the 100-year floodplain averaging 100 feet in width. As the watershed has urbanized, the storm water time of concentration has decreased and the amount of runoff has increased, putting more water into the creek more quickly, thereby increasing peak discharge.

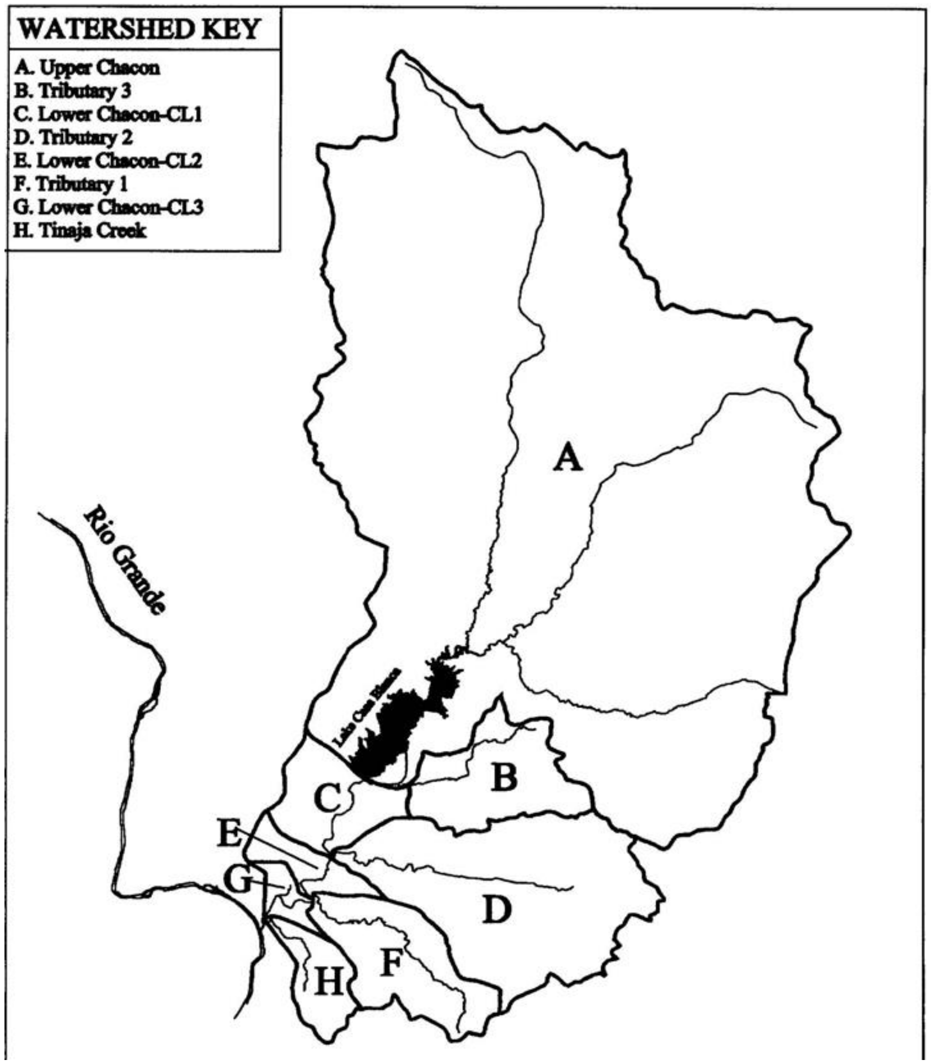


Figure G.1-2. Chacon Creek Watershed

The City of Laredo developed and passed a comprehensive storm water ordinance to regulate development within existing floodplains. Additionally, the City of Laredo retained an engineering consultant to study the potential flood conditions in the creek and make recommendations for alterations to alleviate the flooding. Results from the study *Stormwater Master Drainage Plans for the Chacon Creek Watershed*, November 1999, Brown and Root, Inc. show that the floodplain had changed and that approximately 241 residential homes, 30 small industrial facilities, and three large industrial facilities along the main stem of Chacon Creek are now located within the 100-year floodplain boundary.

Upon completion of the analysis of the existing floodplain, the study was expanded to look at recommendations for mitigation within the 100-year floodplain and thereby remove the dwellings from the floodplain. Two recommendations were proposed for the floodplain mitigation. Both recommendations consisted of channelizing the creek by creating a trapezoidal channel, lined with either grass or concrete, for the entire length of Chacon Creek from the spillway of Lake Casa Blanca to the Rio Grande.

Although the construction of a trapezoidal channel would remove a significant number of structures from the 100-year floodplain, it left a number of issues unaddressed. One issue is the need to keep the channel clean and free of trash. The creek is a tremendous natural resource with economic, recreation, and educational potential; but this potential is masked by a history of dumped materials and debris. Additionally, the proposed improvements did not address other City of Laredo concerns, such as a need for more open space, trails, and parks. Finally, the costs of the proposed improvements were prohibitive. For more information on the description of the project, refer to the *Chacon Creek Master Drainage Plan*, Carter and Burgess, Inc., December 2001.

Lake Casa Blanca Dam

Lake Casa Blanca Dam is owned by Webb County. In June of 1978, a Phase I Inspection Report National Dam Safety Program was prepared by the Texas Department of Water Resources for the Corps of Engineers, Fort Worth District. The report states the following:

> The embankment, service spillway, and emergency spillway are in good working condition. Immediate attention should be given to the following maintenance deficiencies:
>
> - Erosion on the upstream slope below the roadway berm
> - Small holes in the embankment crest
> - Silted-in toe drains
> - Leaking pipe

During the Corps of Engineers site visit in 2006, additional deficiencies were observed. The major deficiency was erosion on the downstream face of the dam embankment along with several tree and plant species. These deficiencies are noted strictly as observations; the Corps of Engineers does not make any recommendations regarding these observations.

Previous Studies of Chacon Creek

The City of Laredo contracted with Brown & Root, Inc. to develop a Flood Protection Plan for the Chacon Creek Watershed. As a part of the Flood Protection Plan, Brown & Root prepared the *Chacon Creek Watershed Flood Insurance Study*, dated March 17, 1997.

A thorough review of the hydrologic and hydraulic models as outlined in the report, *Stormwater Master Drainage Plans for the Chacon Creek Watershed*, November 1999, Brown and Root, Inc., was conducted by Carter and Burgess, Inc. The review indicated a number of inconsistencies in the previous modeling effort. Carter and Burgess, Inc. prepared by a report titled *Final Review – Chacon Creek Master Drainage Study*, January 2002, which outlined the errors and omissions in the previous study. The report was submitted to and approved by the City of Laredo.

Both the existing conditions hydrologic and hydraulic models were corrected based on the findings of the review. The existing conditions 100-year floodplain delineation was prepared and formed the basis by which proposed improvements were to be tested. The revised 100-year floodplain boundary for the entire main stem of Chacon Creek is shown in the Carter and Burgess report.

MODELS

The Chacon Creek model developed for this analysis is based on the Chacon Creek backwater models developed for the 1997 Webb County Flood Insurance Study (FIS). The Chacon Creek 1997 FIS models were based on the Chacon Creek backwater models originally developed by Carter & Burgess and further updated and revised by the U.S. Army Corps of Engineers Fort Worth District for the 2007 Feasibility Scoping Meeting.

The Chacon Creek 1997 FIS backwater models were developed using HEC-RAS (River Analysis System), version 3.0.1. The HEC-RAS software was developed at the Hydrologic Engineering Center (HEC) in Davis, California, which is a division of the Institute for Water Resources of the U.S. Army Corps of Engineers. HEC-RAS computes one-dimensional steady and unsteady low hydraulics calculations. The most recent version of HEC-RAS (4.0) was used to compute water surface profiles.

Origin of Data

The Chacon Creek HEC-RAS model incorporated input data developed from the following sources:

- TxDOT bridge plans
- USGS 7.5-minute quadrangle topographic maps
- City of Laredo 2-foot topography (IBWC LIDAR survey grade) 2006
- Vertical datum NAVD 88
- City of Laredo bridge plans
- Webb County bridge plans
- Field-surveyed cross-sections

The orientation of the input of the cross-section data is downstream left-to-right. The Chacon Creek HEC-RAS model contains a total of 73 cross-sections (including bridges).

Manning’s Coefficients of Roughness

Manning’s *n* values were assigned by visual inspection, photographs taken in the field, and aerial photographs. The majority of the land use that influences the streams in this study consists of developed land, such as residential, commercial, and industrial developments, along with transportation networks. Other land uses that factor into this study consist of undeveloped land, such as pastures and meadows. The majority of the streams are primarily located in natural floodplain conditions, such as undeveloped channels and overbanks. Table G.1-1 lists the ranges of Manning’s *n* values for channels and overbanks that were applied to the HEC-RAS models.

Table G.1-1. Manning's Roughness Coefficients by Stream

Stream	HEC-RAS *n* Value Ranges	
	Channel	Overbank
Chacon Creek	0.035 - 0.080	0.04 - 0.08
Tributary 3	0.025 - 0.085	0.04 - 0.09
Tributary 1 (Tex Mex Creek)	0.025 - 0.085	0.04 - 0.09
Tributary 2	0.025 - 0.085	0.04 - 0.09
Tinaja Creek	0.025 - 0.085	0.04 - 0.09

Limits of Model

The Chacon Creek Model limits extend from the Chacon Creek/Rio Grande River confluence in Webb County at the downstream limit, to river station 34946 (5.94 miles), which is the emergency spillway of Lake Casa Blanca Dam at the upstream end.

Stream Gages

There are no known existing stream gages on Chacon Creek.

Structures

Table G.1-2 indicates the bridge structures that cross Chacon Creek and corresponding creek stations.

Table G.1-2. Bridge Structures

Bridge	Station
Bob Bullock Hwy. (Loop 20)	28286
Hwy. 59	26562.5
Clark Blvd.	20866
Tex Mex Railway	17854
Hwy. 359	12063
Hwy. 83	6276.5
Meadow Ave.	1184

HYDROLOGIC ANALYSIS

The Chacon Creek hydrologic analysis to compute peak discharges for the watershed were determined using the HEC-1 program for the 10-, 50-, 100-, and 500-year storms was completed by Brown and Root, Inc, under contract by the City of Laredo. Carter and Burgess reviewed the original work completed by Brown and Root which was later updated using HEC-HMS in December 2005. This data, submitted as work-in-kind for this planning study, was used by the Corps of Engineers to develop the 2-, 5-, 25-, and 250-year peak discharges.

The Chacon Creek watershed has an approximate drainage area of 155 square miles and discharges into the Rio Grande. For this study, the watershed was divided into eight subbasins. The sizes of the subbasins ranged from 1 to 117 square miles. The subdivision was necessary to obtain the information needed in terms of level of detail and location as dictated by the objectives of the study. These peak discharges were used for existing conditions in the Chacon Creek HEC-2 hydraulic model.

For the purpose of these detailed hydrologic analyses, flood frequency data was developed using the rainfall data from TP-40 “Technical Paper No. 40, Rainfall Frequency Atlas of the United States,” published by the National Weather Service. Peak discharge-frequency relationships were determined by performing hydrologic analyses for floods of the selected recurrence intervals for each sub-basin studied in the watershed. The USACE HEC-1 program was used and then upgraded to HEC-HMS to simulate the precipitation-runoff process and compute flood hydrographs at appropriate locations in the watershed.

The peak discharges (Q) for Chacon Creek and its tributaries were calculated using the methodology developed by the Soil Conservation Service (SCS). The SCS method of estimating direct runoff from the storm rainfall is based on procedures developed by SCS hydrologists over the last five decades. The hydrologic parameters used to determine peak flows included rainfall data, watershed data, and soil properties. Soils in the Chacon Creek study area were divided into three groups based on the minimum rate of infiltration of each soil subject to various saturation levels. The physical parameters of each soil type and group classification were determined following a field reconnaissance of the watershed and using the Soil Survey of Webb County, Texas, published by the Department of Agriculture in October 1985. On the next page, Figure G.1-3 is the SCS Webb County Soil Map.

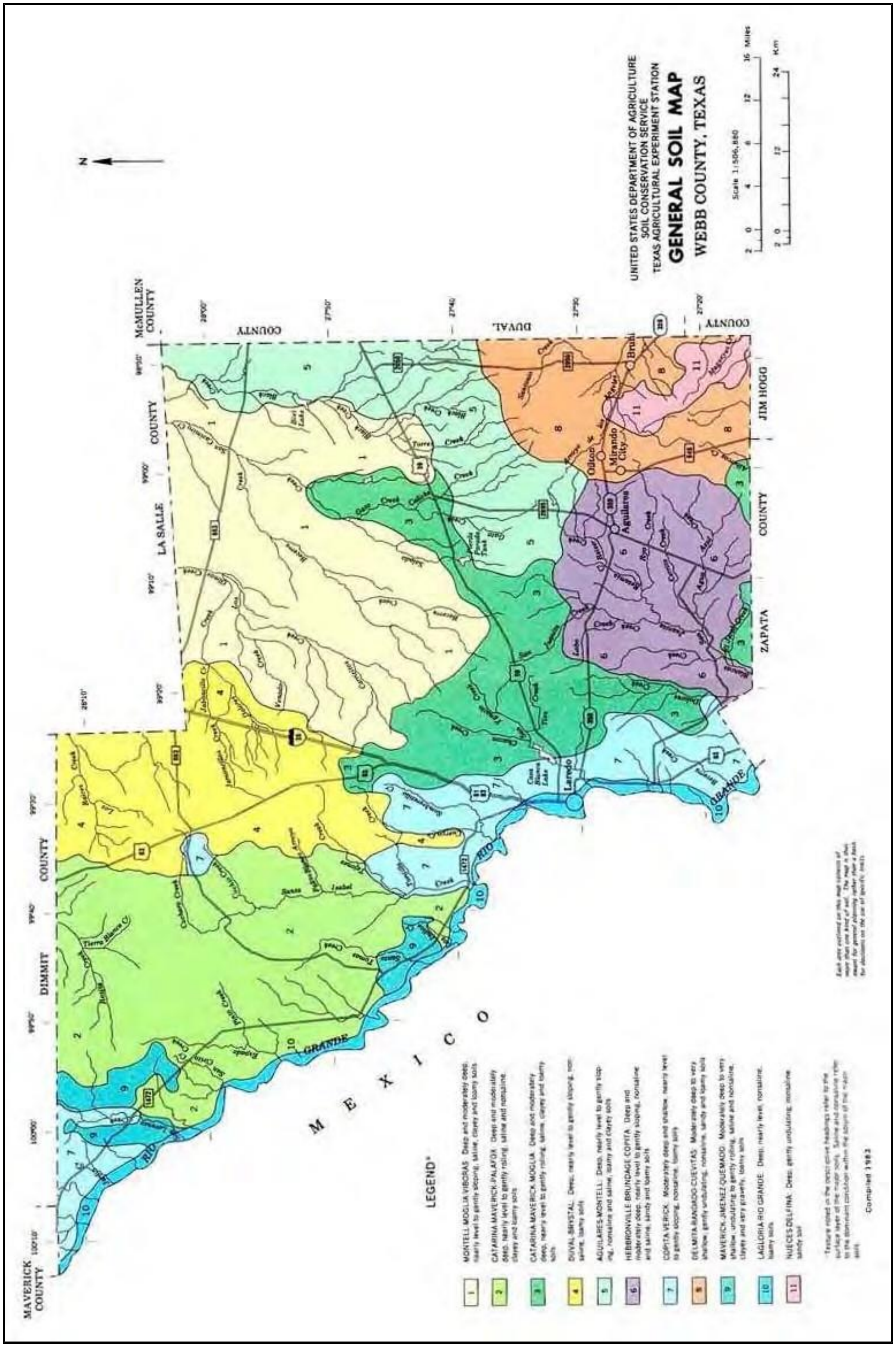


Figure G.1-3. Webb County Soil Map

Each hydrologic basin in the watershed was divided into the percentage of contributing soil group classification and land use cover. A composite SCS curve number was determined. This curve number described the physical parameters of each hydrologic subbasin for development conditions existing in January 1994 (the date of the aerial orthophotos from the City of Laredo and Webb County). The additional parameters were determined from the available aerial photographs and the digital terrain model (DTM) of the drainage basins.

The SCS curve numbers were used in the computation of the initial and uniform loss rate parameters for each subbasin in the HEC-1 input data set. These loss parameters account for rainfall losses due to surface interception, depression storage and infiltration. The loss rates for the existing conditions were calculated using the SCS soil loss methodology and were consistent with the previous Flood Insurance Study. The rainfall excess for each subbasin was transformed into surface runoff using the Snyder Unit Hydrograph routine in the United States Army Corps of Engineers HEC-1 program. The SCS equation was used to estimate the watershed lag time (TL) for each subbasin.

The Upper Chacon Creek watershed includes the Tios and the San Ygnacio Creeks. The approximate drainage areas of these two basins are 22.11 and 34.21 square miles respectively. The runoff from this hydrologic basin drains into Lake Casa Blanca. This basin falls under The SCS hydrologic soil Group C and has an SCS curve number of 79. Approximately 94 percent of this basin area is undeveloped. There has been no significant urbanization in the basin between 1981 and 1994. The updated 100-year peak discharge for this basin is 36,918 cfs, as compared to a peak discharge of 33,821 cfs in the 1981 FIS HEC-1 Model. This represents a 10 percent increase in peak discharge between 1981 and this study.

In this study, the peak discharges for all the hydrologic basins in the Chacon Creek watershed, downstream from Lake Casa Blanca dam were determined using the HEC-1 program with 6-hour rainfall depths taken from the U.S. Weather Bureau Technical Paper TP-40. The basins were subdivided to delineate the watershed and to accurately model the rainfall runoff process. Due to this subdivision and the increased urbanization between 1981 and January 1994, the unit hydrograph parameters were recalculated based on the SCS methodology.

The parameter calibration option of the HEC-1 program was not used to estimate the unit hydrograph parameters because of the absence of gauged basins in the region. An additional step (the use of regional regression equations suggested by FEMA) was incorporated in an attempt to verify tabulated flows generated in these studies.

Rainfall depths used in the computation of runoff from each subbasin were modified using depth-area curves developed by the SCS. A precipitation hyetograph was used as input in the HEC-1 model for all runoff calculations. The time distribution of rainfall was based on the pattern that was used in the 1981 Flood Insurance Study. The time distribution of rainfall in this pattern is such that the maximum one-hour rainfall depth is contained within the maximum six-hour rainfall depth. Because all of the critical storm depths are contained within the storm distributions, the distributions were appropriate for designs on both small and large watersheds.

The HEC-1 model for the Chacon Creek watershed was developed to analyze the effects of increased urbanization and other changes in runoff response associated with items such as channelization or changes to the watershed in general. The components of this model include subbasin runoff, reservoir routing, channel routing, and hydrograph combination.

Table G.1-3 lists the Chacon Creek future without-project peak discharges for the 2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year flood events.

Table G.1-3. Chacon Creek Future Without-Project Peak Discharges

Discharge Point	Station	Drainage Area (sq mi)	ACE Flood (cfs)							
			50%	20%	10%	4%	2%	1%	0.4%	0.2%
CU	34946	116.90	8540	10994	13309	17133	20741	25610	31598	37041
WNOD1, C	33425	122.86	8540	10994	13309	17133	20741	25610	31598	37041
NODE1, CO	32760	126.92	8539	10992	13305	17127	20731	25596	31582	37023
NODE2, CO1	16868	142.90	8537	10990	13304	17126	20732	25597	31586	37030
NODE3, CO	16343	144.78	8538	10991	13304	17126	20730	25594	31582	37025
NODE3,C1	9730	150.98	8538	10991	13304	17126	20730	25594	31582	37025
NODE4	1208	154.48	8538	10990	13303	17124	20728	25592	31579	37022

Tributaries

The Tributary 3 and 3A channels have a total drainage area of approximately 5.96 square miles. These tributaries drain into Chacon Creek just downstream of the Lake Casa Blanca Spillway (Node 1). For the HEC-1 model that was developed by Brown and Root, Tributary 3 was divided into five subbasins. The size of these subbasins varied from 0.67 square miles to 2.1 square miles. Tributary 3 and 3A fall under the SCS hydrologic soil Group C. The SCS curve numbers for these subbasins range from 79 to 82, and approximately 95 percent of this basin area is undeveloped. From the HEC-1 model, the 100-year peak discharge for Tributary 3 channel at the confluence of Chacon Creek is 6,340 cfs.

The Tex Mex Creek (formally known as Tributary 1) channel has a total drainage area of approximately 15.98 square miles. This tributary drains to Chacon Creek just south of the Texas Mexican International Railway Bridge (Node 2). For the HEC-1 model that was developed by Brown and Root, Tributary 1 was divided into eight subbasins. The size of these subbasins varies from 1.37 to 3.74 square miles. TexMex Creek falls under the SCS hydrologic soil Group B, and the SCS curve numbers for these basins range from 69 to 72. Approximately 80 percent of this basin area is undeveloped. From the HEC-1 model, the 100-year peak discharge for Tex Mex Creek is 12,868 cfs.

The Tributary 2 channel has a total drainage area of approximately 6.20 square miles. The Tributary 2 channel joins Chacon Creek just south of U.S. Highway 359 (Node 3). For the HEC-1 model that was developed by Brown and Root, the Tributary 2 basin was divided into five subbasins. The size of these basins varies from 1.0 to 1.54 square miles. Tributary 2 falls under the SCS hydrologic soil Group B, and the SCS curve numbers for these basins range from 69 to 78. Approximately 87 percent of this basin area is undeveloped. For this study, a high percentage of the basin has been urbanized and is continuing to be developed today. A major portion of this development is residential.

One regional detention pond has been constructed in this basin for flood mitigation. This detention pond is located in the Los Presidentes area and is designed to handle a peak discharge of 239 cfs. The storage from the detention basin was incorporated in the HEC-1 model when computing the runoff for the Tributary 2 channel. From the HEC-1 model, the 100-year peak discharge for Tributary 2 at the confluence with Chacon Creek is 7,440 cfs.

The Tinaja Creek channel has a total drainage area of approximately 2.50 square miles. Tinaja Creek drains into Chacon Creek at Meadow Avenue (Node 4). For the HEC-1 model developed by Brown and Root, Tinaja Creek was divided into three basins. The sizes of these subbasins vary from 0.64 to 1.12 square miles. The Tinaja Creek basin falls under the SCS hydrologic soil Group B, and the SCS curve numbers for these basins range from 74 to 85. Approximately 52 percent of this basin area is undeveloped. The Tinaja Creek channel was studied in detail during the 1981 FIS.

For this study area, approximately 48 percent of this basin has been urbanized. A major portion of this urbanization is residential. Two new regional detention facilities have been constructed in this basin to mitigate the existing flooding problems. The first detention basin was constructed in 1988 and is located south of Chacota Street, adjacent to the Zachery Elementary School. The second detention basin was constructed in 1996 and is located east of Ejido Street. Approximately 1,600 linear feet of earthen channel located between Louisiana Street and Pine Street has been concrete lined to improve the hydraulic capacity and conveyance of the channel. The design storage within the two detention basins was incorporated into the HEC-1 model. From this study, it has been determined that the construction of two detention basins has reduced the 100-year peak discharge for the Tinaja watershed by 638 cfs. The 100-year peak discharge for Tinaja Creek subbasin at the confluence of Chacon Creek is 3,075 cfs.

HYDRAULIC ANALYSIS

Hydraulic backwater models (HEC-2) were built for Chacon Creek and tributaries, which incorporated flow data from hydrologic models initially developed by Brown and Root. Carter and Burgess then adjusted and updated these models for the 10-, 50-, 100-, and 500-year discharges using the Corps of Engineers River Analysis System (HEC-RAS), version 3.1.2, to complete water surface profiles for the studied creek. Then in 2008, the Corps used HEC-RAS version 3.1.3 to develop flood reduction alternatives for the Villa Del Sol subdivision by computing several water surface profiles.

Hydraulic models for the Chacon Creek and its tributaries were developed using new cross-sectional data obtained from the Digital Terrain Model (DTM). A DTM was developed for the entire watershed with two-foot interval contours by Tobin International, Ltd. using aerial photogrammetry and Global Positioning System (GPS) technology.

Field surveys of bridge/culvert structures and intermediate cross sections were completed and provided by the City of Laredo and their contractors. There are seven bridges/culvert crossings, which were surveyed and the data was placed into HEC-RAS for the Chacon Creek model. Copies of field notes for each structure can be obtained from the City of Laredo.

As stated previously, the water surface elevation profiles for the various frequency storms (2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year) for the studied streams were computed using the HEC-RAS program, version 3.1.3. Cross-sections were taken froms two-foot contours developed from the DTMs. Bridge crossings were modeled using the field surveys and notes provided by the City of Laredo and their contractors.

The downstream boundary condition for Chacon Creek was computed using the normal depth method. The discharge change locations in HEC-RAS were placed at the junction of Chacon Creek and its tributaries, which is described in the HEC-HMS model. This change in discharge is described by river station in the steady flow data section of HEC-RAS.

Tributaries

All HEC-RAS models for the four tributaries (Tributary 2, Tributary 3, Tributary 1, and Tinaja Creek) provided to the Corps by Carter and Burgess were adequate in representing existing conditions. The four tributaries, which flow into Chacon Creek below Lake CasaBlanca Dam, are approximately 10.1 stream miles combined. Three of the four tributaries are primarily natural grass-lined with various plant species that route through the various areas throughout the City of Laredo. Tinaja Creek, the most downstream tributary, consists of a trapezoidal concrete channel. There are several bridge structures/culverts throughout the entire reach of these tributaries. The 100-year floodplain varies in width for each tributary as it joins at the confluence with Chacon Creek. No flood risk management alternatives were studied for the tributaries.

Lake Casa Blanca Dam

Lake Casa Blanca Dam is owned by Webb County. In June of 1978, a Phase I Inspection Report National Dam Safety Program was prepared by the Texas Department of Water Resources for the Corps of Engineers, Fort Worth District. The report states the following:

The embankment, service spillway, and emergency spillway are in good working condition. Immediate attention should be given to the following maintenance deficiencies:

- Erosion on the upstream slope below the roadway berm
- Small holes in the embankment crest
- Silted-in toe drains
- Leaking pipe

During the Corps of Engineers site visit in 2006, additional deficiencies were observed. The major deficiency was erosion on the downstream face of the dam embankment along with several tree and plant species. These deficiencies are noted strictly as observations; the Corps of Engineers does not make any recommendations regarding these observations.

Chacon Creek Analysis

Chacon Creek was a complete restudy with detailed hydraulic methods from the confluence with Rio Grande upstream to Casa Blanca Dam, which is approximately 6.6 stream miles. Chacon Creek is primarily natural grass-lined with various plant species that routes through the urban area of Laredo. Throughout the entire reach are seven bridge structures/culverts. The 100-year floodplain is much wider in the upstream end and narrows considerably toward the confluence with the Rio Grande. Existing conditions water surface profiles were computed for the 2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year flood events. Flood event discharges for these flood events were developed in the Chacon Creek Hydrologic Analysis and incorporated in the Chacon Creek model.

Villa Del Sol Subdivision Analysis

The damage areas of structures are defined as a housing development called Villa Del Sol, as shown in Figures 14–17 of the main report. Several homes experience flooding due to the 100-year floodplain of Chacon Creek. The limits of flooding consist of areas along the Chacon Creek from just downstream of the Tex Mex Railway downstream to State Highway 359.

ALTERNATIVES ANALYSIS

The modeling approach used to develop the following alternatives were derived by attepting to provide the largest storage increase while lowering the water surface elevations for all 8 frequencies in the Villa Del Sol subdivision area. In this specific reach, 10 cross sections were added every 100 feet with an average width of 200 feet while not disturbing the invert of the natural channel.

The following structural alternatives were developed to help reduce the 100-year water surface elevation as well as restore the ecosystem of the low flow region of the creek.

Small Channel Alternative

The left bank is to be left untouched as well as the existing channel invert. The new channel design will begin 2.0 feet above the existing invert. At this elevation, a new 50-foot-wide channel cut will begin, for creating habitat. Then a new side slope of 1 on 4 will be cut to an elevation 2.0 feet higher than the habitat bench. This second bench area will average 50 feet in width. Then the 1 on 4 side slope cut will daylight to existing ground.

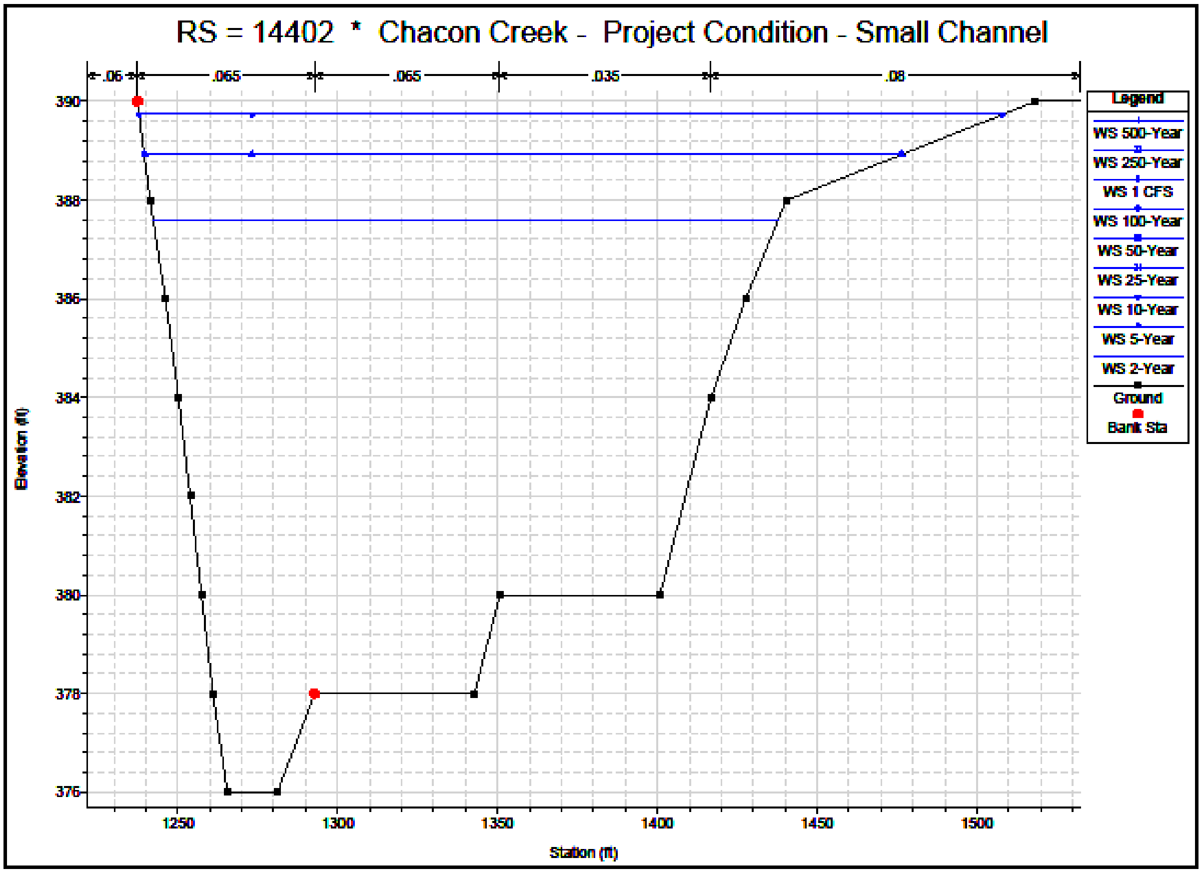


Figure G.1-4. Small Channel Alternative

Medium Channel Alternative

The left bank is to be left untouched as well as the existing channel invert. The new channel design will begin 2.0 feet above the existing invert. At this elevation, a new 50-foot-wide channel cut will begin, for creating habitat. Then a new side slope of 1 on 4 will be cut to an elevation 2.0 feet higher than the habitat bench. This second bench area will average 100 feet in width. Then the 1 on 4 side slope cut will daylight to existing ground.

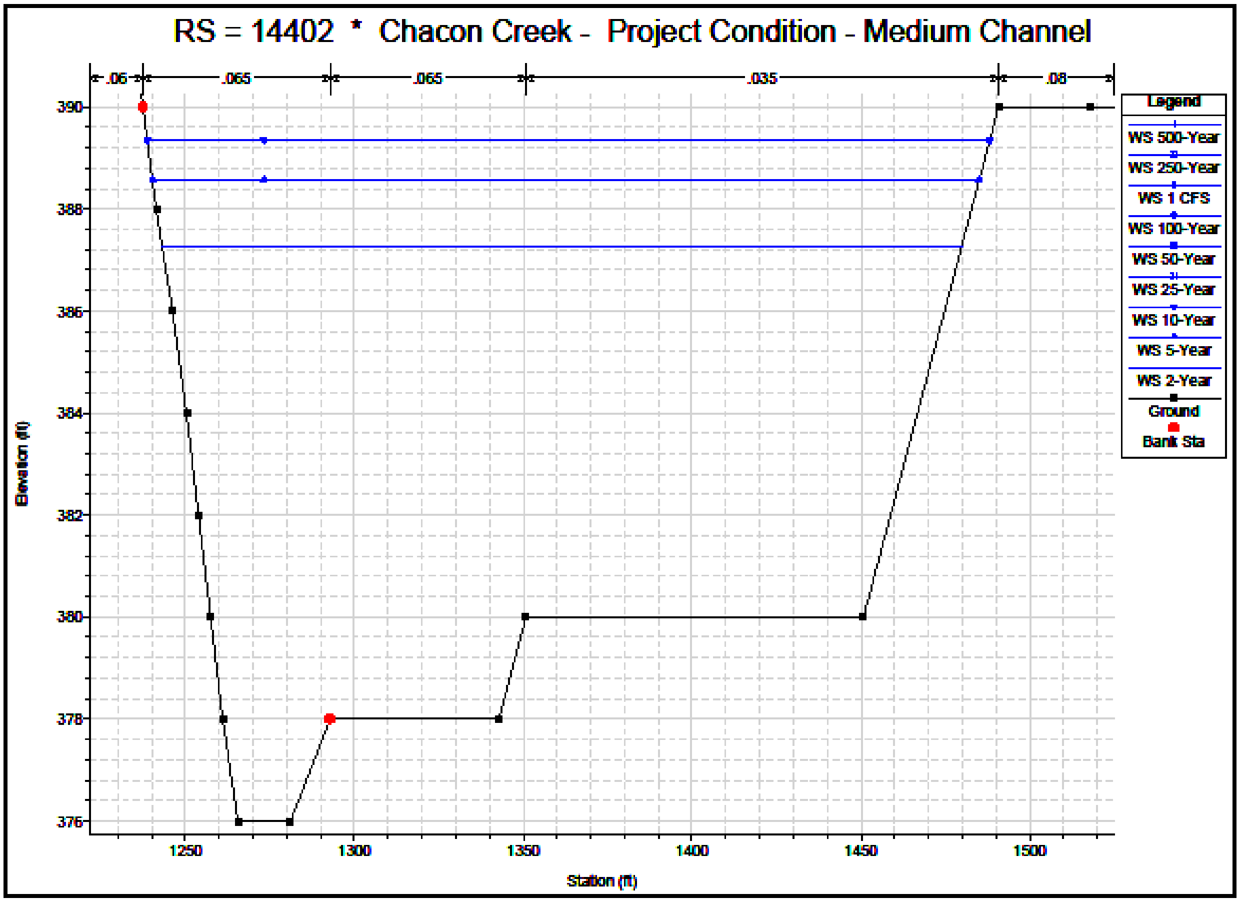


Figure G.1-5. Medium Channel Alternative

Large Channel Alternative

The left bank is to be left untouched as well as the existing channel invert. The new channel design will begin 2.0 feet above the existing invert. At this elevation, a new 50-foot-wide channel cut will begin, for creating habitat. Then a new side slope of 1 on 4 will be cut to an elevation 2.0 feet higher than the habitat bench. This second bench area will average 200+ feet in width. Then the 1 on 4 side slope cut will daylight to existing ground.

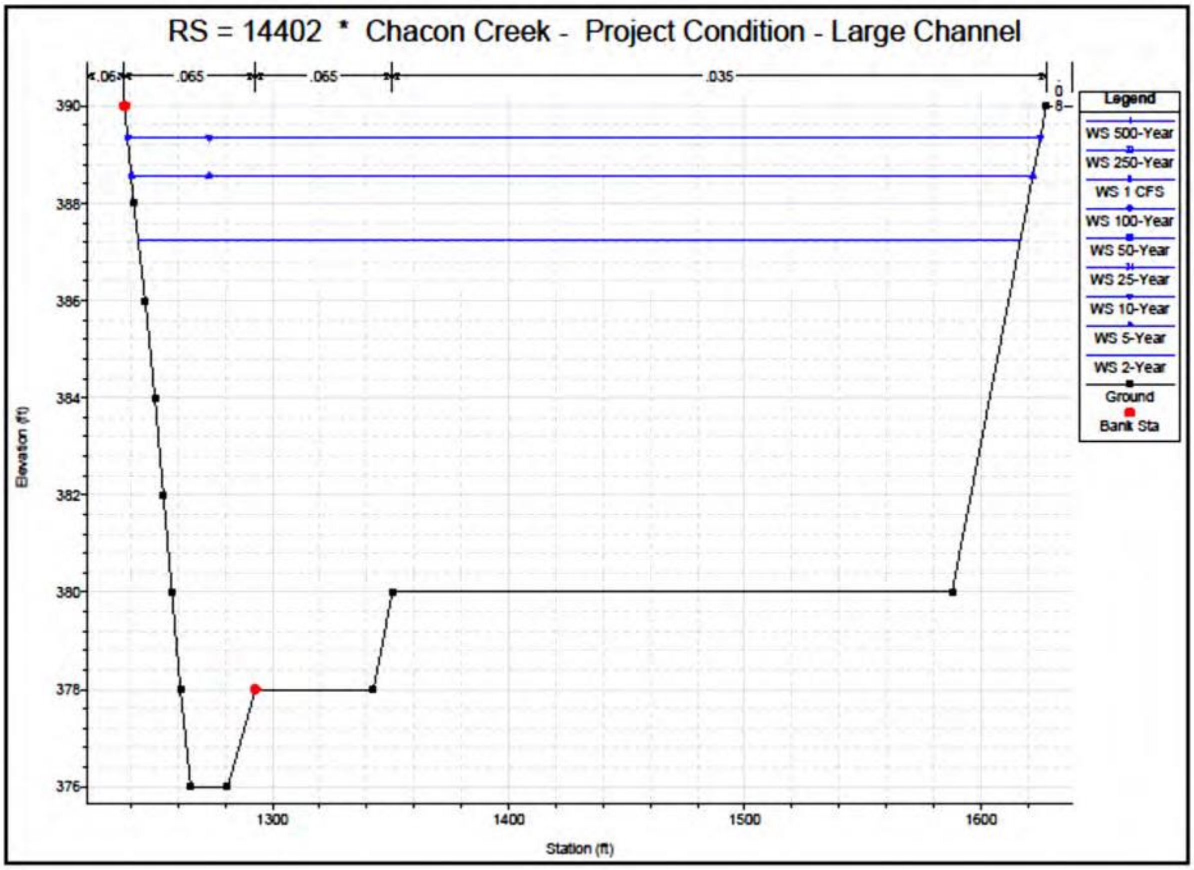


Figure G.1-6. Large Channel Alternative

Industry standard tools, methodology, and best engineering judgment were used to evaluate all data collected, perform analyses, and develop the required discharges and computed water surface elevation profiles. The analyses were used as the baseline for comparison with the future without-project conditions for alternative analysis and plan selection.

Flood Risk Management Comparison

On the next page, Table G-4 indicates the Chacon Creek 25-year (17,126 cfs) and 100-year (25,594 cfs) flood event peak water surface elevations for each of the three alternatives at the Villa Del Sol subdivision.

Table G.1-4. Villa Del Sol Peak Water Surface Elevations (feet)

	Small Channel		Medium Channel		Large Channel	
Creek Station	**25-year**	**100-year**	**25-year**	**100-year**	**25-year**	**100-year**
14402	392.05	394.53	391.99	393.47	391.48	392.84
13959	390.89	393.32	390.29	392.61	390.13	392.40
13571	390.24	392.58	389.90	392.26	389.99	392.29
13210	389.85	392.13	389.71	391.99	389.79	392.07
12848	389.53	391.73	389.46	391.67	389.56	391.76
12408	389.37	391.60	389.35	391.58	389.40	391.64

Figure G.1-7 shows the Chacon Creek water surface profiles for 25- and 100-year flood events for the Villa Del Sol Reach (between the Tex Mex Railway and State Highway 359) for the Small Channel alternative.

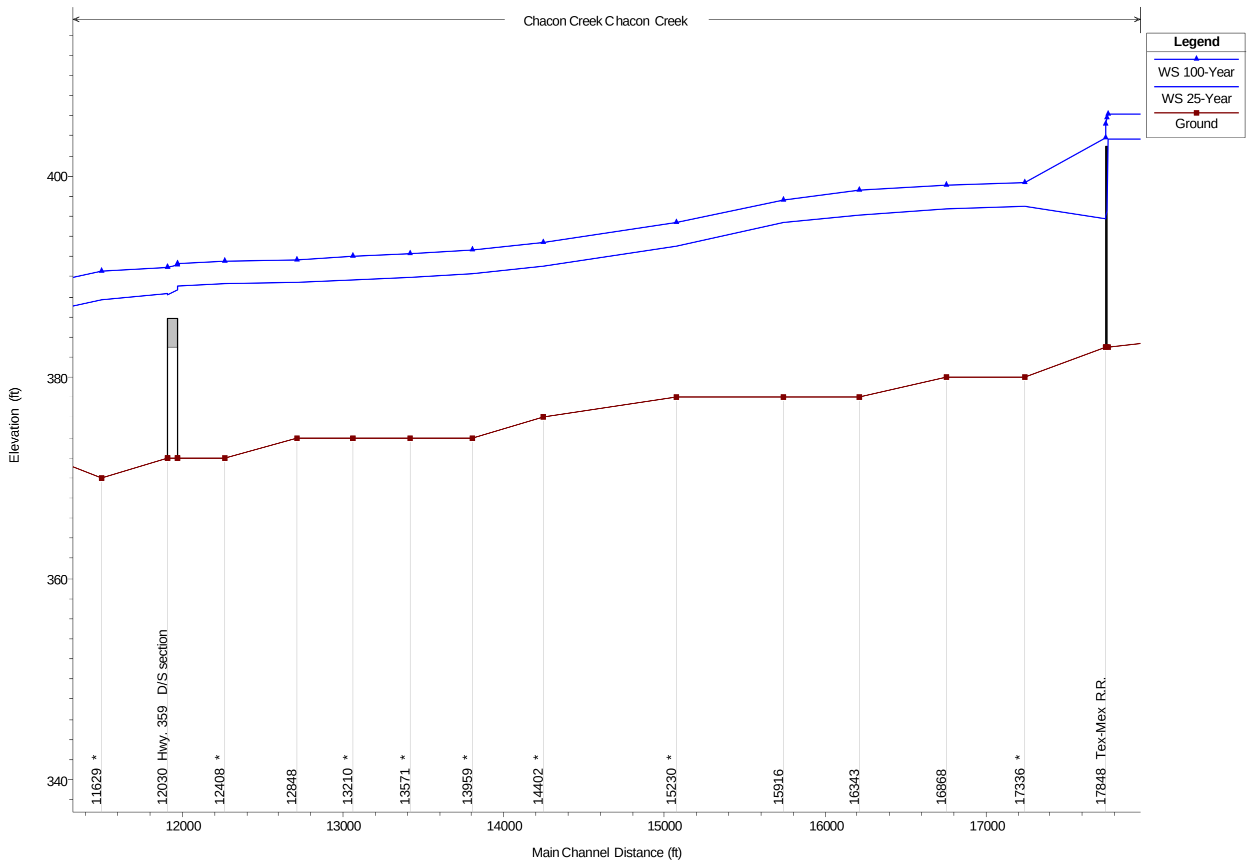


Figure G.1-7. Small Channel Water Surface Profile

Ecosystem Restoration Alternatives

The purpose of this analysis is to develop wetland areas for ecosystem restoration along Chacon Creek in Laredo, Texas. The City of Laredo chose five wetland area locations. The Corps of Engineers designed several sizes of rock weirs, which varied in height and width, to optimize the impoundment of flow in Chacon Creek. The City of Laredo told the Corps that, in addition to the year-round base flow of two cubic feet per second (cfs) in Chacon Creek, an additional two cfs of flow will be available from the County's water treatment facility.

The weir designs and locations were developed to create and enhance the ecosystem along Chacon Creek. The width of each weir was based on two-foot topography for elevations above the estimated base flow elevation. The selection of the height and width of each weir was analyzed for the largest size wetland versus the cost only. For more information, refer to Appendix B "Ecosystem Restoration."

NED Plan

Based on economics for all the alternatives studied, the NED plan is the VDS Plan and the Reach 1 10-year Buyout with Recreation. Refer to the "Recommended Plan" section in the main report.

APPENDIX G.1A

QUALITATIVE CLIMATE CHANGE ANALYSIS

QUALITATIVE CLIMATE CHANGE ANALYSES

INTRODUCTION

Engineering and Construction Bulletin (ECB) No. 2016-25 (USACE 2016), Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects, should be applied to all hydrologic analyses supporting planning and engineering decisions having an extended decision time frame (i.e., not for short-term water management decisions). It provides guidance for incorporating climate change information in hydrologic analyses in accordance with the USACE overarching climate change adaptation policy. This policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of our water resources infrastructure.

Project Description

Chacon Creek is an important natural resource located on the eastern side of Laredo, Texas with a wide range of environmental, economic, recreational, and educational needs and opportunities. Years of neglect including illegal dumping, rapid urbanization, and storm runoff have led to contamination, erosion, and loss of wetland habitats and vegetation. Invasive plant species have seriously degraded the value of riparian and riverine habitats for wildlife, as well as altered soil productivity and increased the potential for fires.

Recurring flood events have historically flooded low lying homes and businesses along the creek. Flood damages associated with the 2007 flood event alone exceeded a million dollars. The flood events have been exacerbated by the explosive growth within the upper portions of the watershed. The city also has a significant shortage of outdoor recreational facilities, both as identified by residents and based on the standards developed by the National Recreation and Park Association.

Feasibility Study and Environmental Assessment for Chacon Creek, Laredo, Texas (Study) was originally conducted by the U.S. Army Corps of Engineers (USACE), Fort Worth District, in cooperation with the City of Laredo, resulting in a Draft Report in 2010. The current report has been updated with any changes that have occurred since the previous draft report, including the addition of the current Climate Change Appendix.

The Study examines an array of alternatives to address each of the challenges to reduce flood threat, restore the aquatic and riparian ecosystems, and provide compatible recreational opportunities. The Tentatively Selected Plan (TSP) is a combined National Economic Development / National Ecosystem Restoration (NED/NER) Plan.

Relevant Current Climate and Climate Change

The study area is located in Laredo, Webb County, Texas, in the northern border of the Rio Grande River. The climate of the project area is semi-arid the average annual temperature is 74 degrees Fahrenheit with hot summers and mild winters. The rural area consists of desert vegetation, experiencing an average of 20 inches of rain per year, majority of rain occurred between May and October but subject to intermittent downpours and flash flooding.

Summary of observed climate trend (temperature, precipitation, and hydrology) in the Rio Grande Region due to climate change are excerpted from “Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Rio Grande Region 13” (USACE 2015) and presented below:

> *Temperature - An increasing trend was observed in mean, minimum, and maximum temperatures, although this trend was less pronounced during the observed fall and winter seasons. Spatial variation, differences in climate and elevation contribute to some variation in results. The consensus view is that recent increases in temperature in the region exceed observations in the historic record beginning in the late 19th century. Temperature increases were greater in areas to the south and at lower elevation.*
>
> *Precipitation - Despite recent drought years, no distinguishable trend in precipitation or frequency of extreme events was identified. In the 20th century, the Southwest has experienced dramatic swings in precipitation due to natural cycles in Atlantic and Pacific sea surface temperatures.*
>
> *Hydrology - An overall decreasing trend is identified based on this region’s streamflow and related snowmelt data with some uncertainty in seasonal trends. Additionally, there is consensus that an earlier onset of snowmelt-driven streamflow has been observed.*

Summary of future projected climate trend (temperature, precipitation, and hydrology) in the Rio Grande Region due to climate change are excerpted from Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Rio Grande Region 13 (USACE 2015) and presented below:

> *Temperature - By the end of the century, temperatures in the Upper Rio Grande are anticipated to increase by about 9°F over twentieth century values under high emissions scenarios, and by close to 5.4°F under the B1 (low emissions) scenarios. There is consensus that temperature increases will be greater in summer and fall. Changes in precipitation are likely to affect net warming across the year because evaporation and condensation processes consume energy that would otherwise go to land surface heating, and also indirectly affect warming through the density and composition of vegetation cover and the persistence of snow cover.*
>
> *Precipitation - precipitation in the Rio Grande Region will remain unchanged, or*

will decline slightly over the 21st century. More precipitation likely will fall as rain, less will fall as snow. Precipitation may become more concentrated in larger precipitation events. Projections for precipitation are limited by uncertainties in factors driving variability due to the natural cycles of the ocean surface temperatures. Additional uncertainties arise with respect to the impacts of the loss of Arctic sea ice, the reductions in Northern Hemisphere snow cover, and the poleward expansion of the subtropical dry zone, all three of which appear to be occurring at a rate faster than predicted by current global circulation models. Seasonal and annual drought is anticipated to be a persistent feature of climate across the Rio Grande Region. Temperature driven increases in evaporation are projected to lead to sustained dryer climate conditions, particularly in winter such that the average climate of the southwest by mid-21st century will resemble that found during a multi-year drought today.

Hydrology - The Rio Grande Region is projected to experience gradual runoff declines during this century (Georgakakos et al., 2014). During the winter months, the region will experience little change to slight decreases in runoff. Conversely, the warm season runoff is projected to decrease substantially. Recent modeling of flows in the Upper Rio Grande by the U.S. Bureau of Reclamation, USACE, and Sandia National Labs projects that native flows in the Rio Grande are likely to decrease by approximately one third by 2100 (U.S. Bureau of Reclamation, 2013). The model simulations consistently project decreasing snowpack, an earlier and smaller spring snowmelt runoff, and an increase in the frequency, intensity, and duration of both droughts and floods. Accelerated warming of high-altitude regions is a result that is not captured by GCMs or downscaled models due to the finer spatial scale, but these findings suggest that current models may even underestimate rates of future snowpack loss.

Observed and Projected Changes to Watershed Hydrology and Assessment

The USACE Climate Hydrology Assessment Tool (http://corpsclimate.us/ptcih.cfm) for public access was used to examine observed and projected trends in watershed hydrology to support the qualitative assessment. The project site is located in Hydrologic Unit Code (HUC) 1308 – Rio Grande-Falcon Region (Figure 1). There is no USGS stream gage adjacent to the project site and one USGS stream gage (USGS 08456300 Las Moras Springs at Brackettville, TX) within HUC 1308 in the USACE Climate Hydrology Assessment Tool. However, this stream gage contains limited annual peak streamflow data (2004 – 2014) to perform observed changes climate hydrology assessment. Instead, three USGS stream gages from adjacent HUC 1211 – Nueces-Southwestern Texta Costal Region (Figure 1) were used to perform the observed changes climate hydrology assessment for the project site.

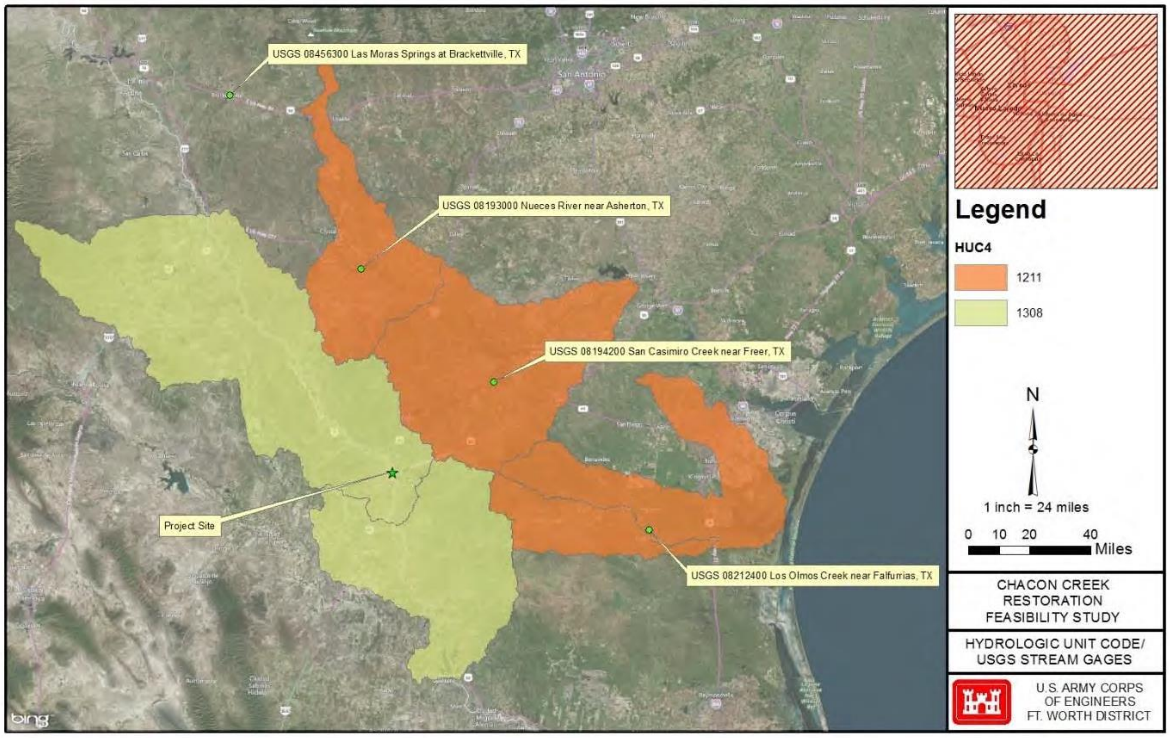


Figure. 1 Project Location and Hydrologic Unit Code (HUC) Regions

Observed Changes

All three gages exhibit a declining trend in annual peak instantaneous streamflow; however, this trend is not statistically significant as indicated by the high p-value. This indicates that overall, there has been no change in flood risk, as measured by the annual maximum flood, over the last period of records (Table 1).

Table.1 Annual Peak Instantaneous Streamflow Trend Analysis for Observed Changes

USGS Gage Name	Period of Record	Trend Equation	p-value
USGS 08193000 Nueces River near Asherton, TX	1940 -2014	Value = -58.7975*Water Year + 122897	0.0784125 > 0.0003 Not Statistically-significant
USGS 08194200 San Casimiro Creek near Freer, TX	1954 -2014	Value = -294.972*Water Year + 593945	0.0274578> 0.0003 Not Statistically significant
USGS 08212400 Los Olmos Creek near Falfurrias, TX	1967 - 1983 1999 - 2014	Value = -18.828*Water Year + 38358.7	0.255054> 0.0003 Not Statistically significant

The Nonstationarity Detection Tool was also used to examine the hydrologic time series at the three gages (http://corpsmapu.usace.army.mil/cm_apex/f?p=257:2:0::NO). No streamflow changes were detected at USGS 08212400 Los Olmos Creek near Falfurrias, TX and but changes were identified in 1986 at USGS 08193000 Nueces River near Asherton, TX and USGS 08194200 San Casimiro Creek near Freer, TX. Over the period of records, these gages show a declining trend in annual peak instantaneous streamflow; however, this trend is not statistically significant. The results of the nonstationarity detection analysis indicate that overall, there has been no statistically significant change in flood risk, as measured by the annual maximum flood, over the period of records.

Projected Changes in Climate

The USACE Climate Hydrology Assessment Tool was used to examine projected trends in watershed hydrology to support the qualitative assessment. As expected for this type of qualitative analysis, there is considerable but consistent spread in the projected annual maximum monthly flows (see Attachment A), the overall projected trend (Table 2) in annual peak instantaneous streamflow increases over time for both HUC 1308 and HUC 1211. This increase is not statistically-significant (p-value > 0.0003) for HUC 1308 but statistically-significant (p-value < 0.0003) for HUC 1211. These findings suggest that there may not be potential for flood risk to increase in the future in the project area, which is resided in HUC 1308, relative to the current time. This result is qualitative only.

Table.2 Annual Peak Instantaneous Streamflow Trend Analysis for Projected Changes

HUC	Projected Period	Trend Equation	p-value
1308 – Rio Grande-Falcon Region	2000 - 2100	Value = 28.3996*Water Year – 35907.5	0.0044573 > 0.0003 Not Statistically significant
1211 – Nueces-Southwestern Texta Costal Region	2000 - 2100	Value = 39.6159*Water Year – 58603.2	0.0001866 < 0.0003 Statistically significant

The NOAA National Environmental Satellite, Data and Information Service (NESDIS) released a report in January 2013 assessing climate trends and scenarios into the next 50–100 years for the Great Plains region (NOAA 2013). The report indicates that there is an upward trend in extreme precipitation event, which is statistically significant at the 95% confidence level. Since 1990, there have been number of years with a high number of extreme events.

Watershed Vulnerability Assessment

The USACE Watershed Vulnerability Assessment Tool was inaccessible while preparing this analysis. Therefore, watershed vulnerability is not assessed (https://maps.crrel.usace.army.mil/projects/rcc/portal.html).

Conclusions and Recommendations

A qualitative climate change analysis was conducted according to Engineering and Construction Bulletin (EBC) no. 2016-25. The literature results support either no distinguishable trend or a declining trend in precipitation or frequency of extreme events, based on historical data. The assessment tools' respective results also indicate that the observed changes in the current data period exhibit a declining trend in annual peak instantaneous streamflow. These tools' projected changes in future periods exhibit an increasing trend in annual peak instantaneous streamflow. However, both the existing data and future projection trends are not statistically significant because they are based on trend lines plotted through data points that have high variance ("p-values).

References

Georgakakos, A., P. Fleming, M. Dettinger, C. Peters-Lidard, Terese (T.C.) Richmond, K. Reckhow, K. White, and D. Yates, 2014: Ch. 3: Water Resources. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 69-112. doi:10.7930/J0G44N6T.

NOAA. 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 4. Climate of the Great Plains U.S. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D.C.

U.S. Bureau of Reclamation, U.S. Army Corps of Engineers (USACE) and Sandia National Laboratories (Sandia), (2013) West-Wide Climate Risk Assessment: Upper Rio Grande Impact Assessment. U.S. Bureau of Reclamation, Upper Colorado Region, Albuquerque Area Office (December 2013), Albuquerque, NM.

USACE. 2015. Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Rio Grande Region 13. Civil Works Technical Report, CWTS-2015-11, USACE, Washington, DC.

USACE. 2016. Engineering and Construction Bulletin 2016-25: Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects.

Attachment A

Climate Change First-order Statistical Analyses

USGS 08456300 Las Moras Springs at Brackettville, TX

Stream Gage Summary of Available Data

Click to hide News Bulletins

- Please see news on new formats
- Full News

USGS 08456300 Las Moras Spgs at Brackettville, TX

Available data for this site SUMMARY OF ALL AVAILABLE DATA GO

Spring Site

DESCRIPTION:

Latitude 29°18'33", Longitude 100°25'13" NAD27
Kinney County, Texas , Hydrologic Unit 13080001
Land surface altitude: 1,105 feet above NGVD29.

AVAILABLE DATA:

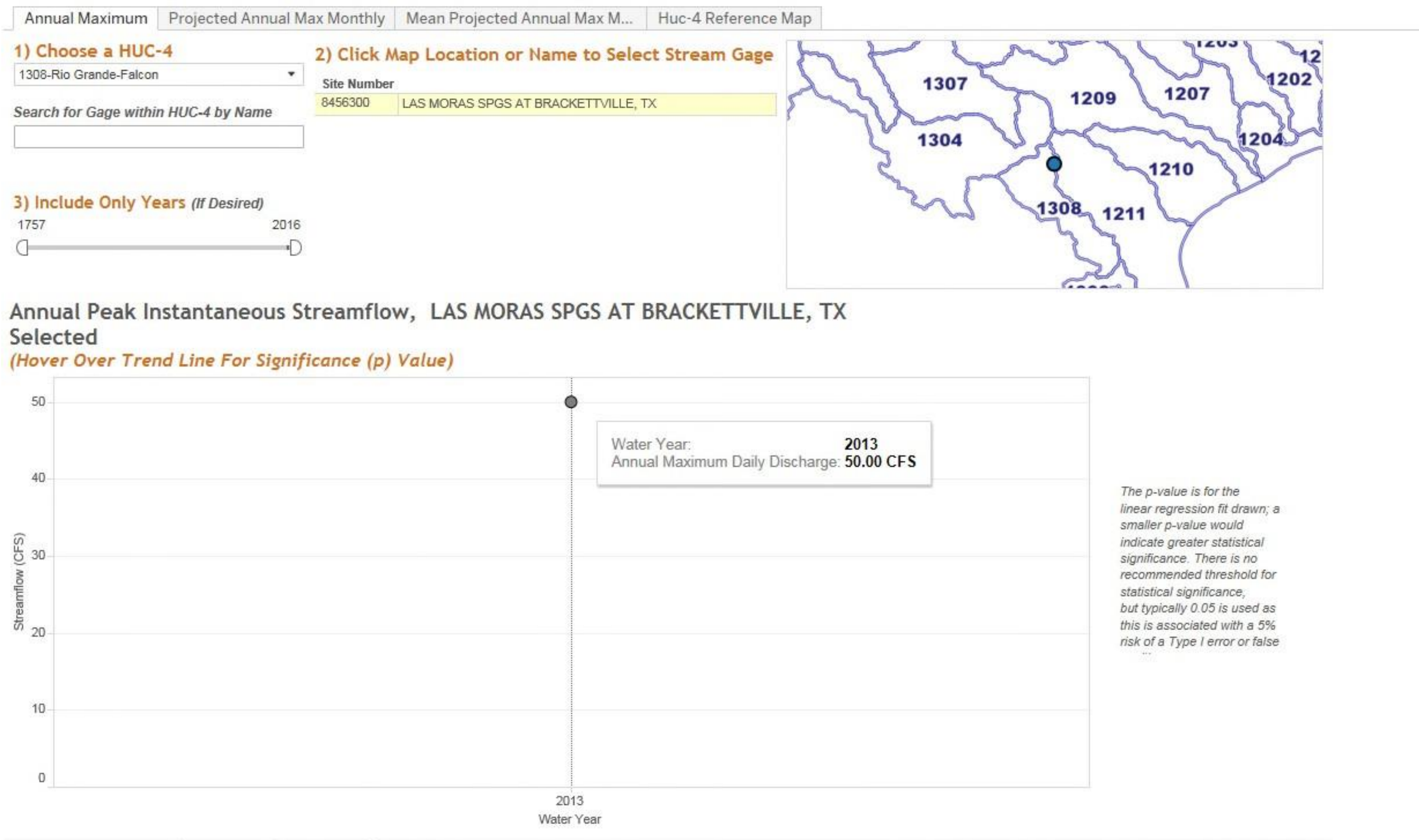
Data Type	Begin Date	End Date	Count
Current / Historical Observations (availability statement)	2003-10-11	2014-08-05	
Daily Data			
Discharge, cubic feet per second	2003-10-03	2014-07-31	10216
Gage height, feet	2003-10-03	2014-08-26	11559
Daily Statistics			
Discharge, cubic feet per second	2003-10-01	2014-08-05	3962
Gage height, feet	2003-10-03	2014-08-26	3853
Monthly Statistics			
Discharge, cubic feet per second	2003-10	2014-08	
Gage height, feet	2003-10	2014-08	
Annual Statistics			
Discharge, cubic feet per second	2004	2014	
Gage height, feet	2004	2014	
Field measurements	1895-12-24	2014-06-12	707
Water-Year Summary	2010	2014	5
Revisions	Unavailable (site:0) (timeseries:0)		

OPERATION:

Record for this site is maintained by the USGS Texas Water Science Center

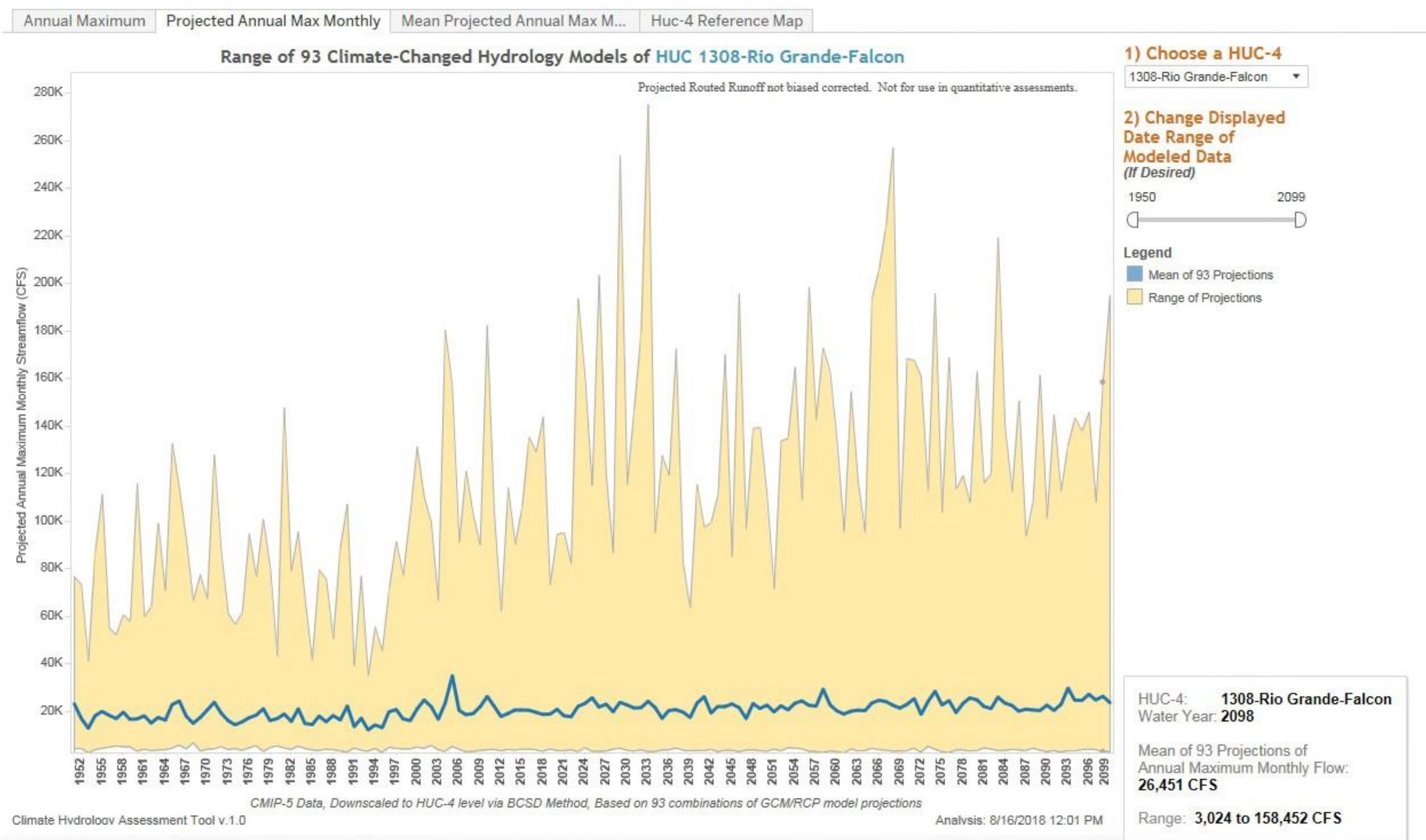
USGS 08456300 Las Moras Springs at Brackettville, TX (Not Applicable for Climate Hydrology Assessment Tool and Nonstationarity Detection Tool)

Climate Hydrology Assessment Tool – Annual Maximum



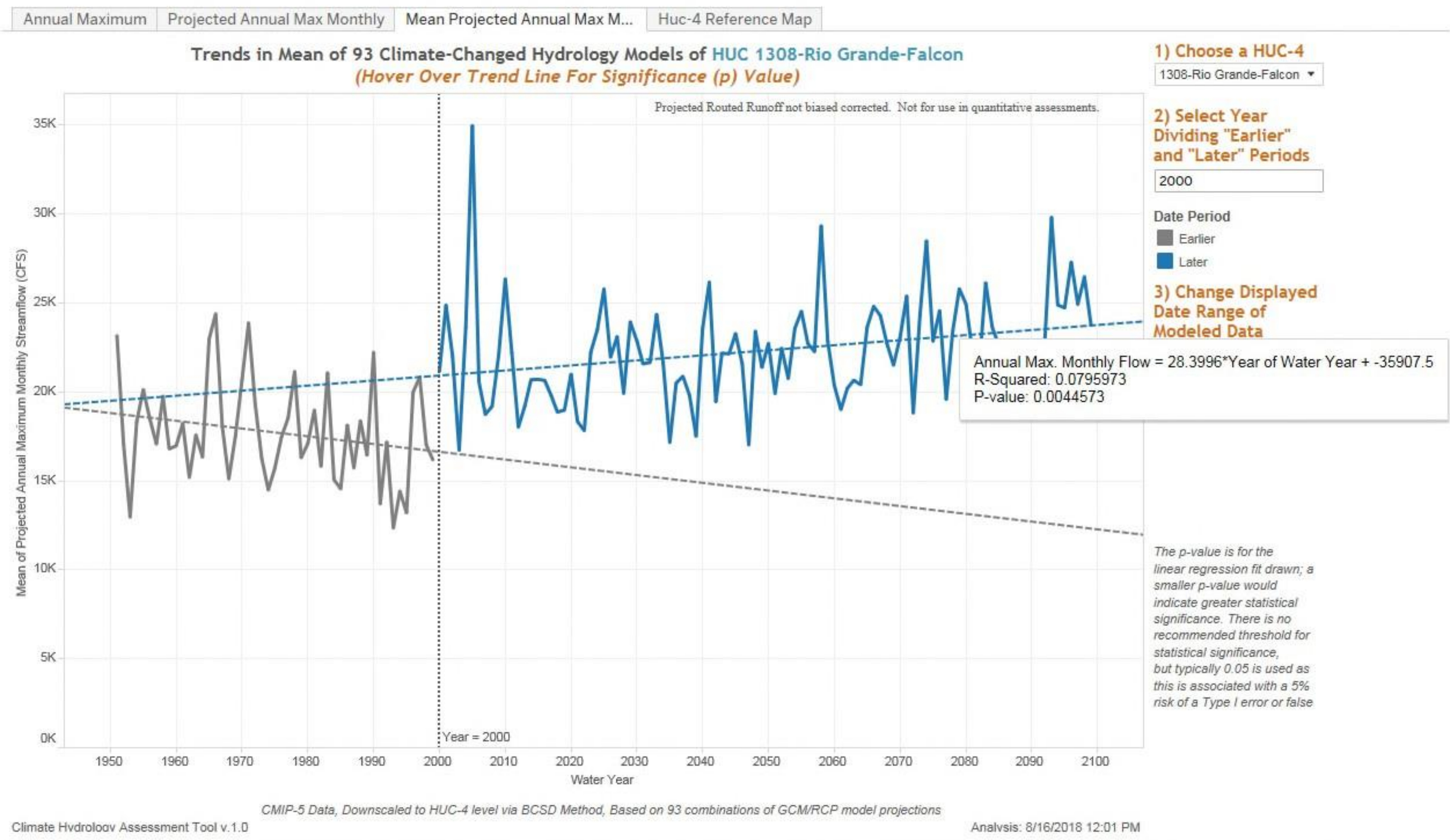
USGS 08456300 Las Moras Springs at Brackettville, TX

Climate Hydrology Assessment Tool – Projected Annual Max Monthly

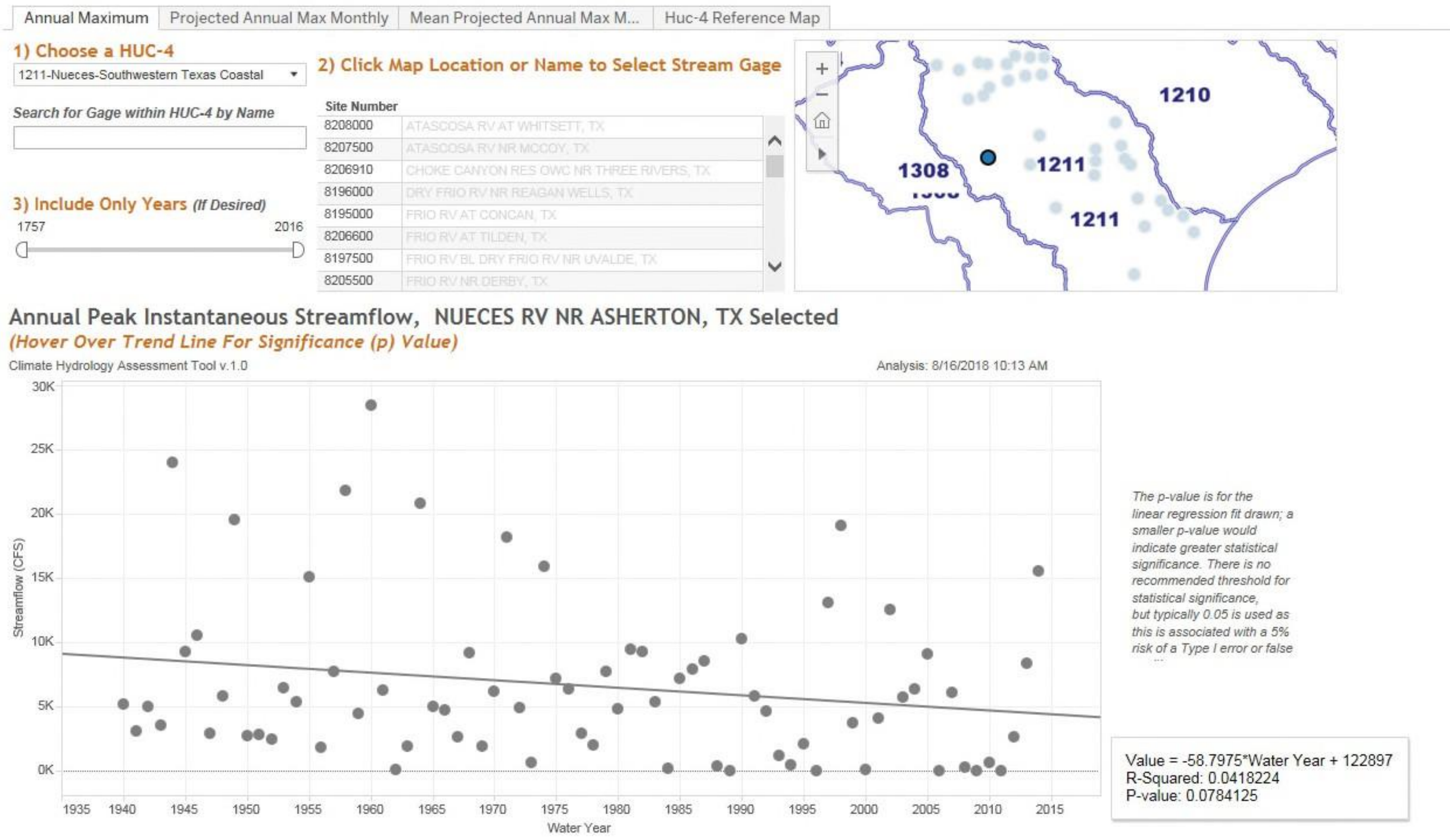


USGS 08456300 Las Moras Springs at Brackettville, TX

Climate Hydrology Assessment Tool – Mean Projected Annual Max Monthly

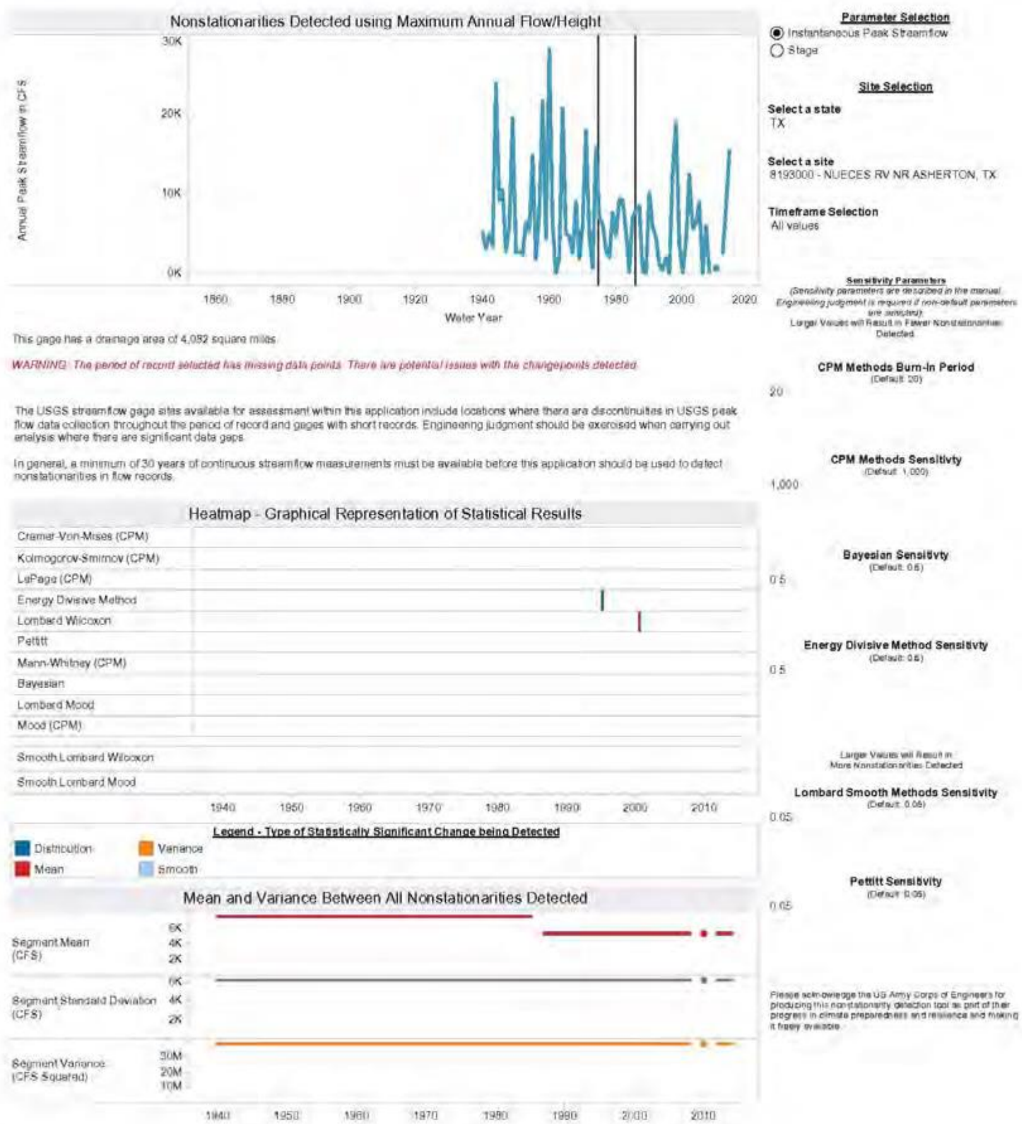


Climate Hydrology Assessment Tool – Annual Maximum

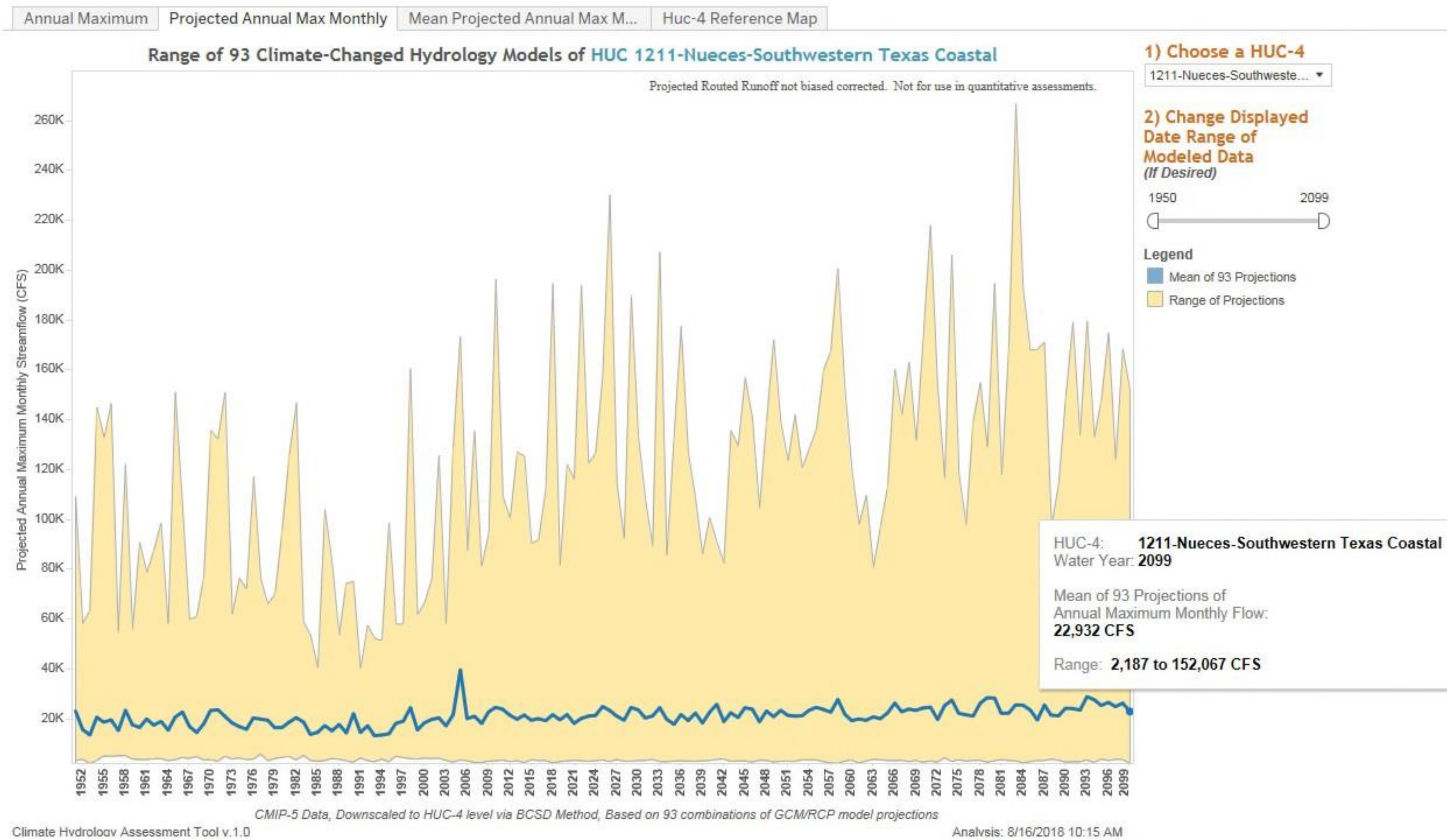


USGS 08193000 Nueces River near Asherton, TX

Nonstationarity Detection Tool – Annual Maximum

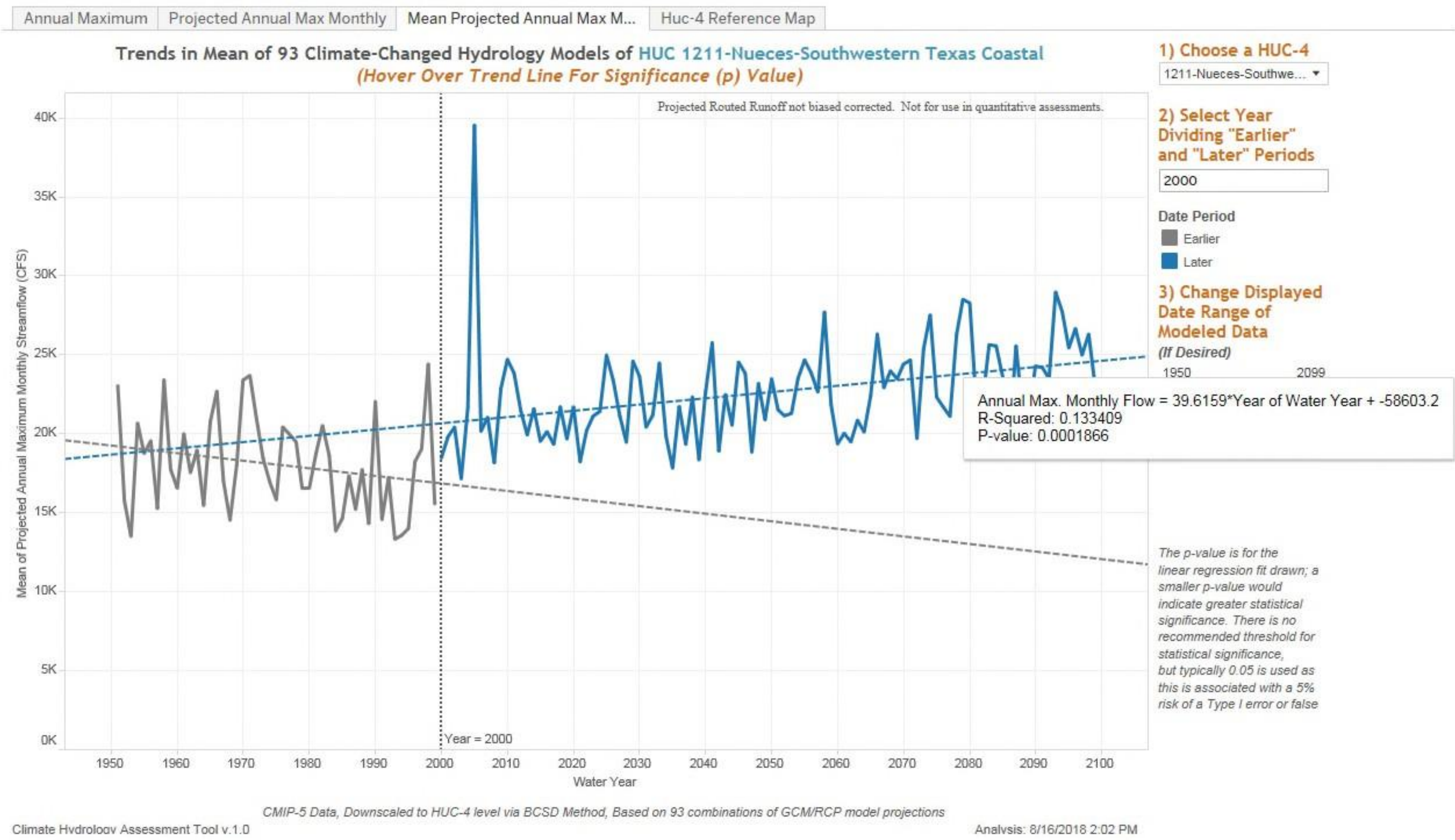


Climate Hydrology Assessment Tool – Projected Annual Max Monthly

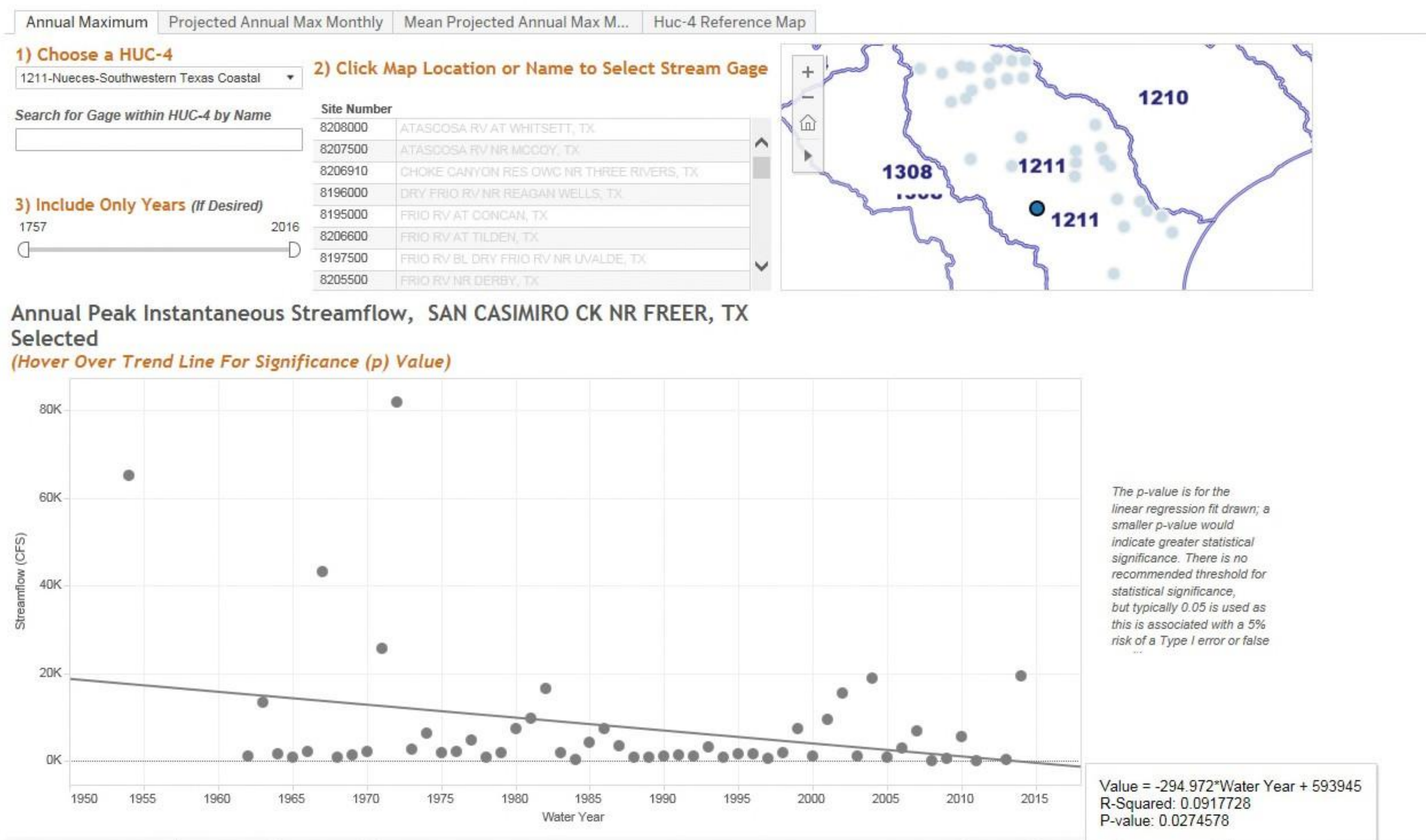


USGS 08193000 Nueces River near Asherton, TX

Climate Hydrology Assessment Tool – Mean Projected Annual Max Monthly

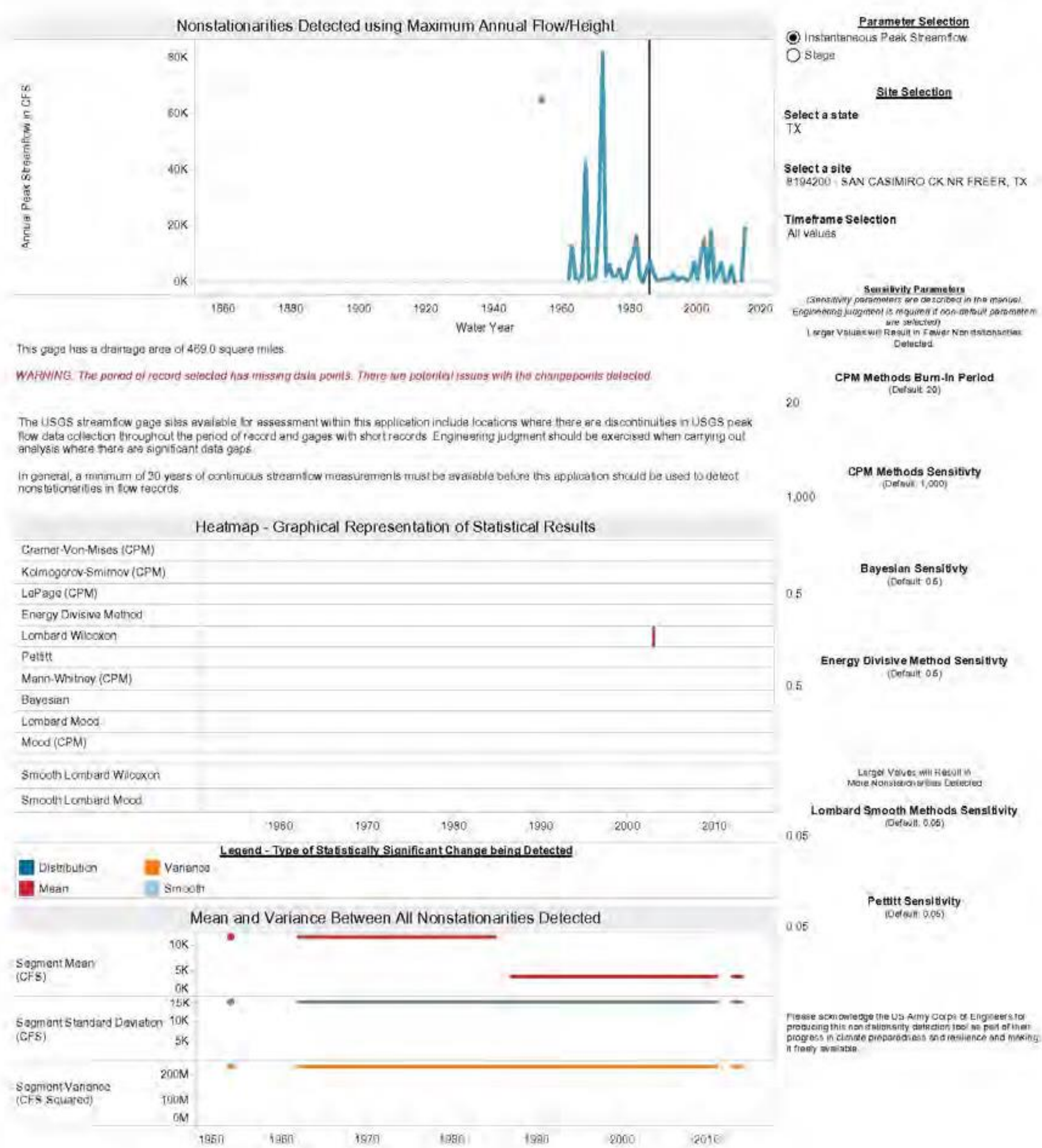


Climate Hydrology Assessment Tool – Annual Maximum

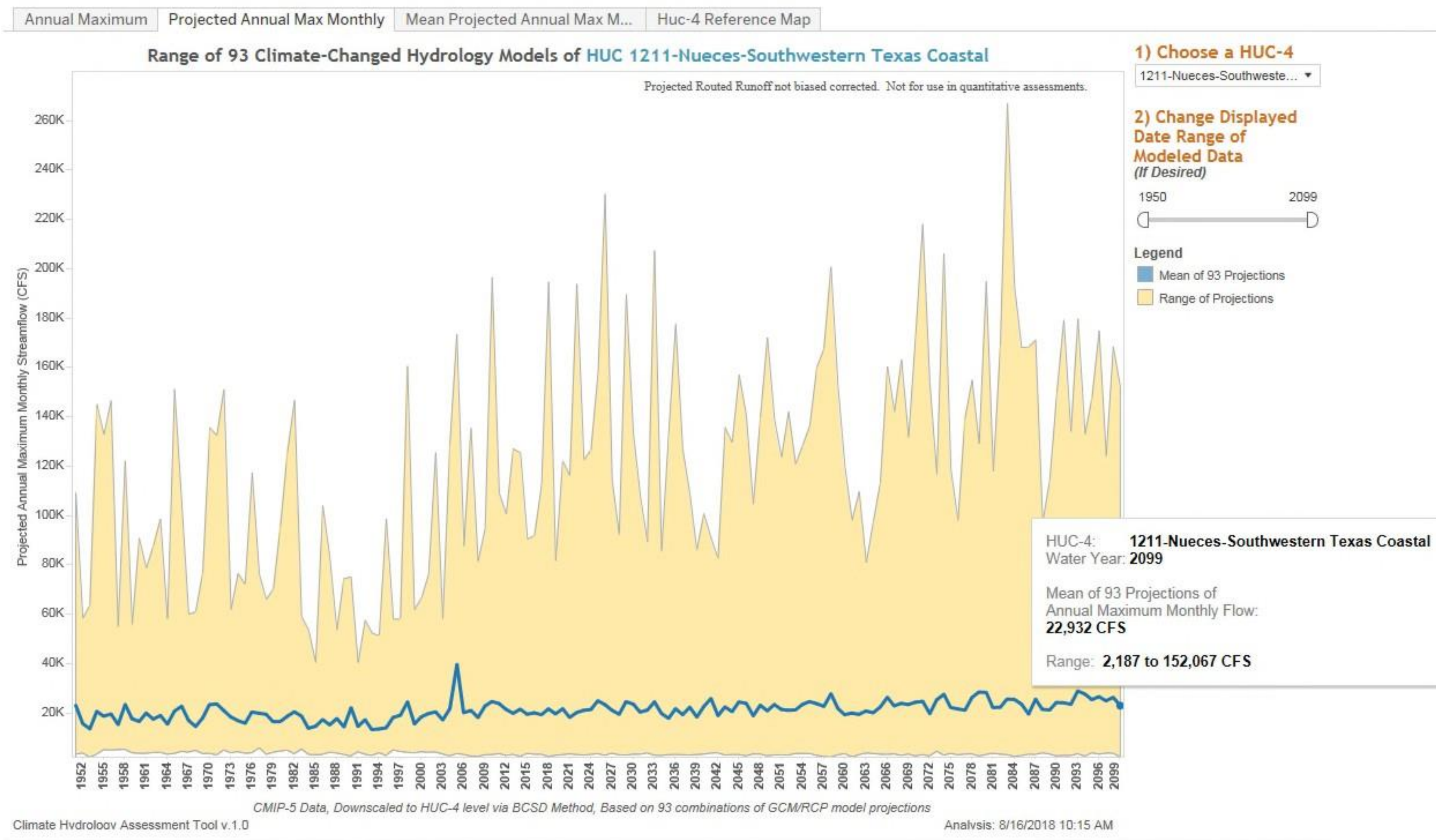


USGS 08194200 San Casimiro Creek near Freer, TX

Nonstationarity Detection Tool – Annual Maximum

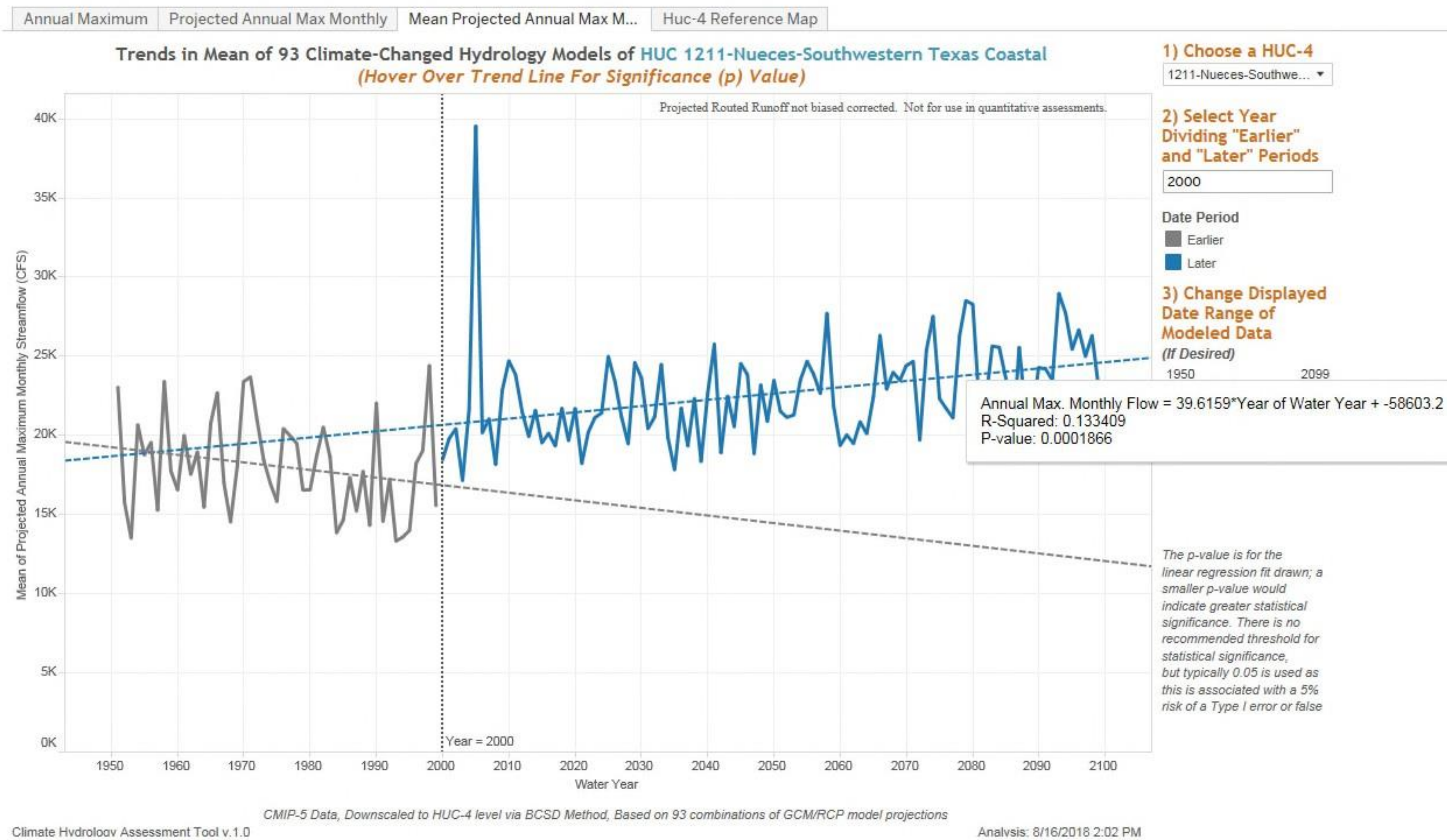


Climate Hydrology Assessment Tool – Projected Annual Max Monthly

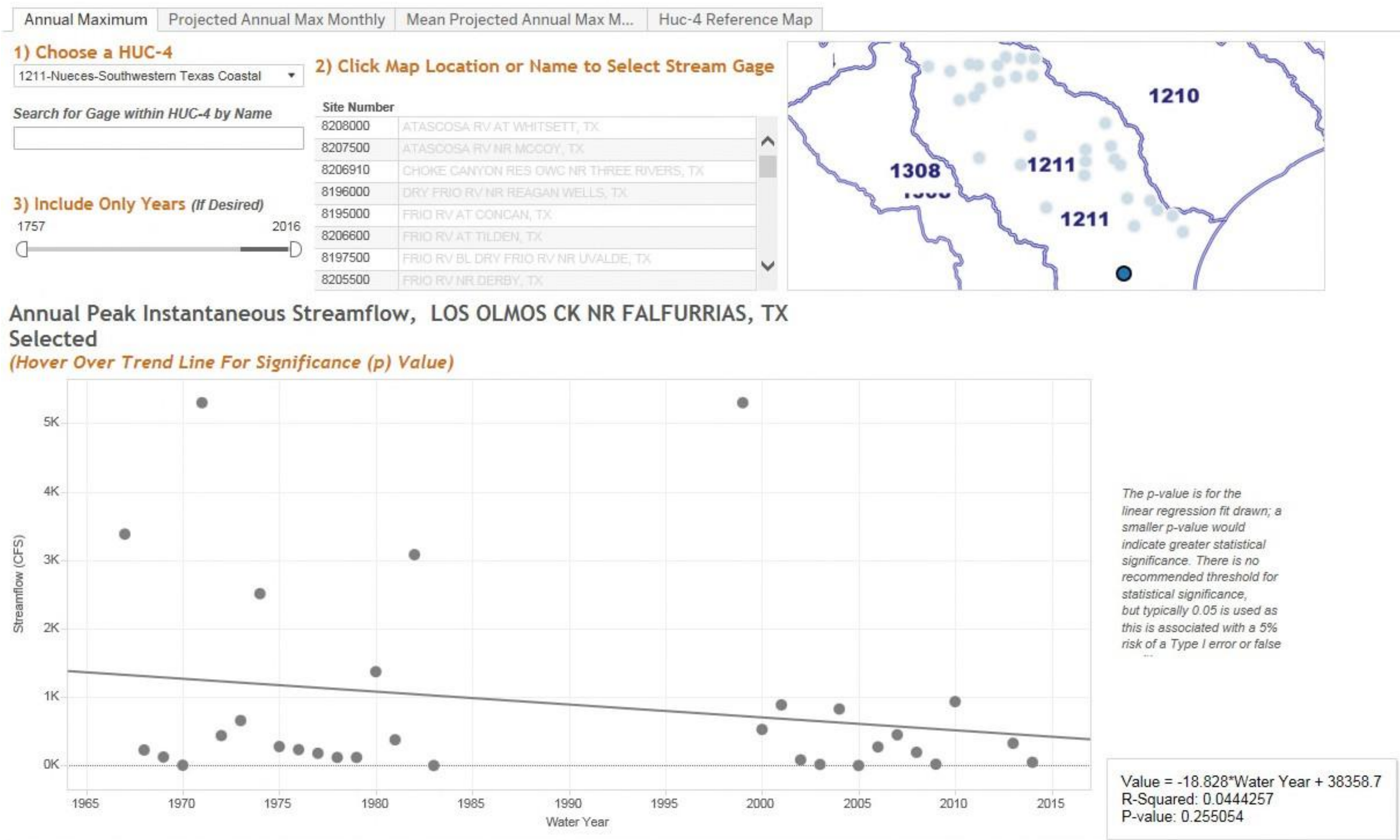


USGS 08194200 San Casimiro Creek near Freer, TX

Climate Hydrology Assessment Tool – Mean Projected Annual Max Monthly

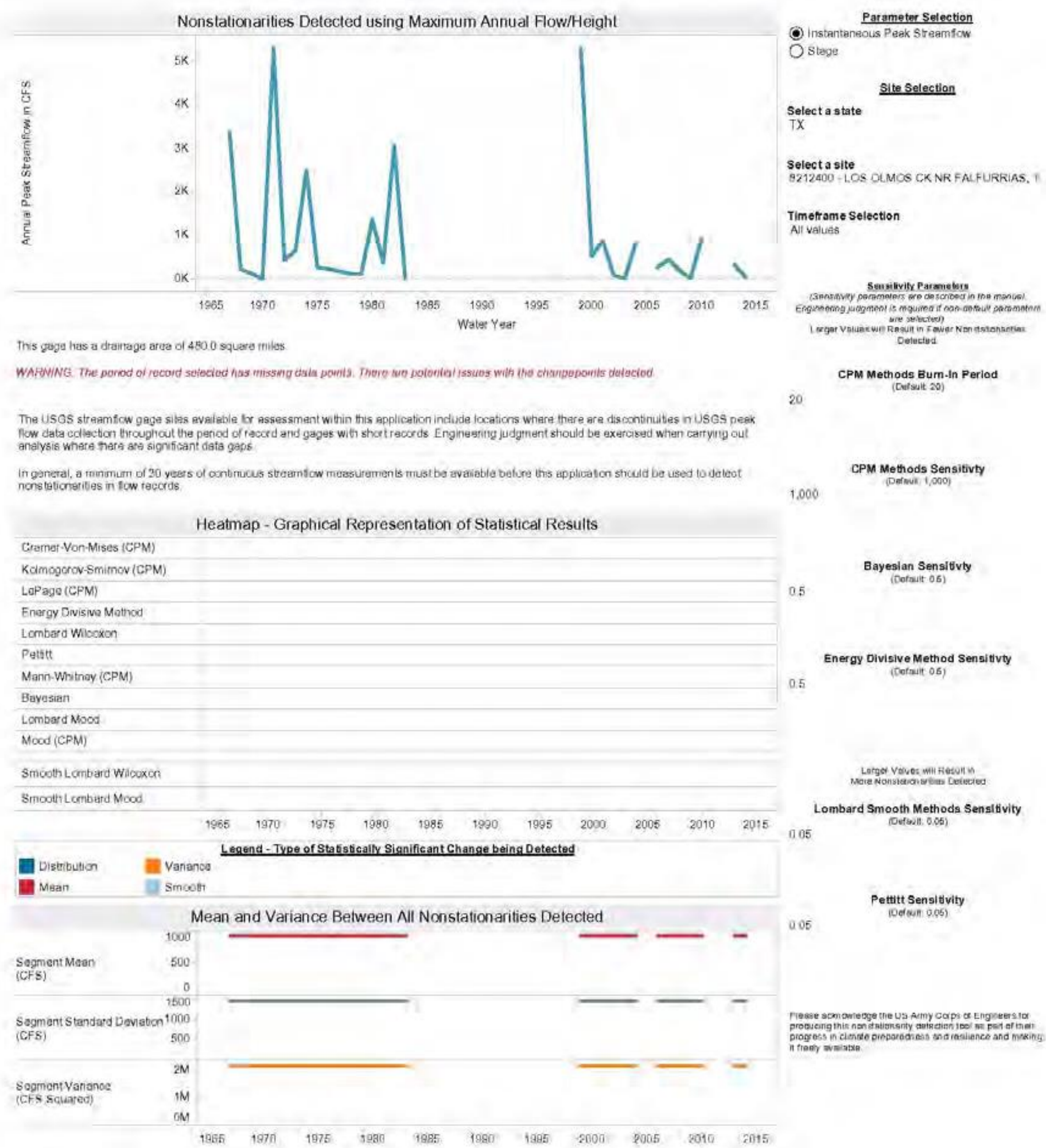


Climate Hydrology Assessment Tool – Annual Maximum

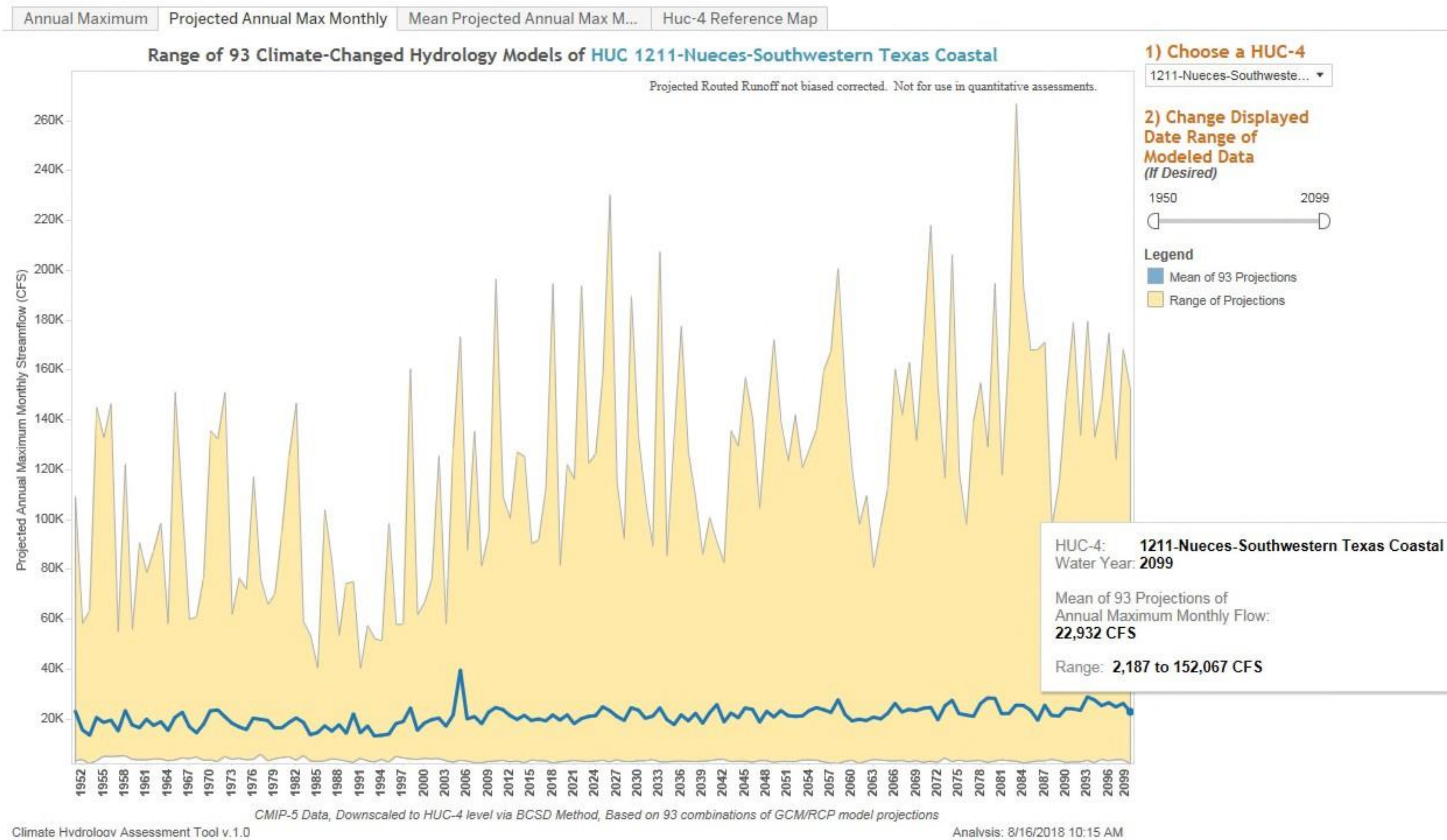


USGS 08212400 Los Olmos Creek near Falfurrias, TX

Nonstationarity Detection Tool – Annual Maximum

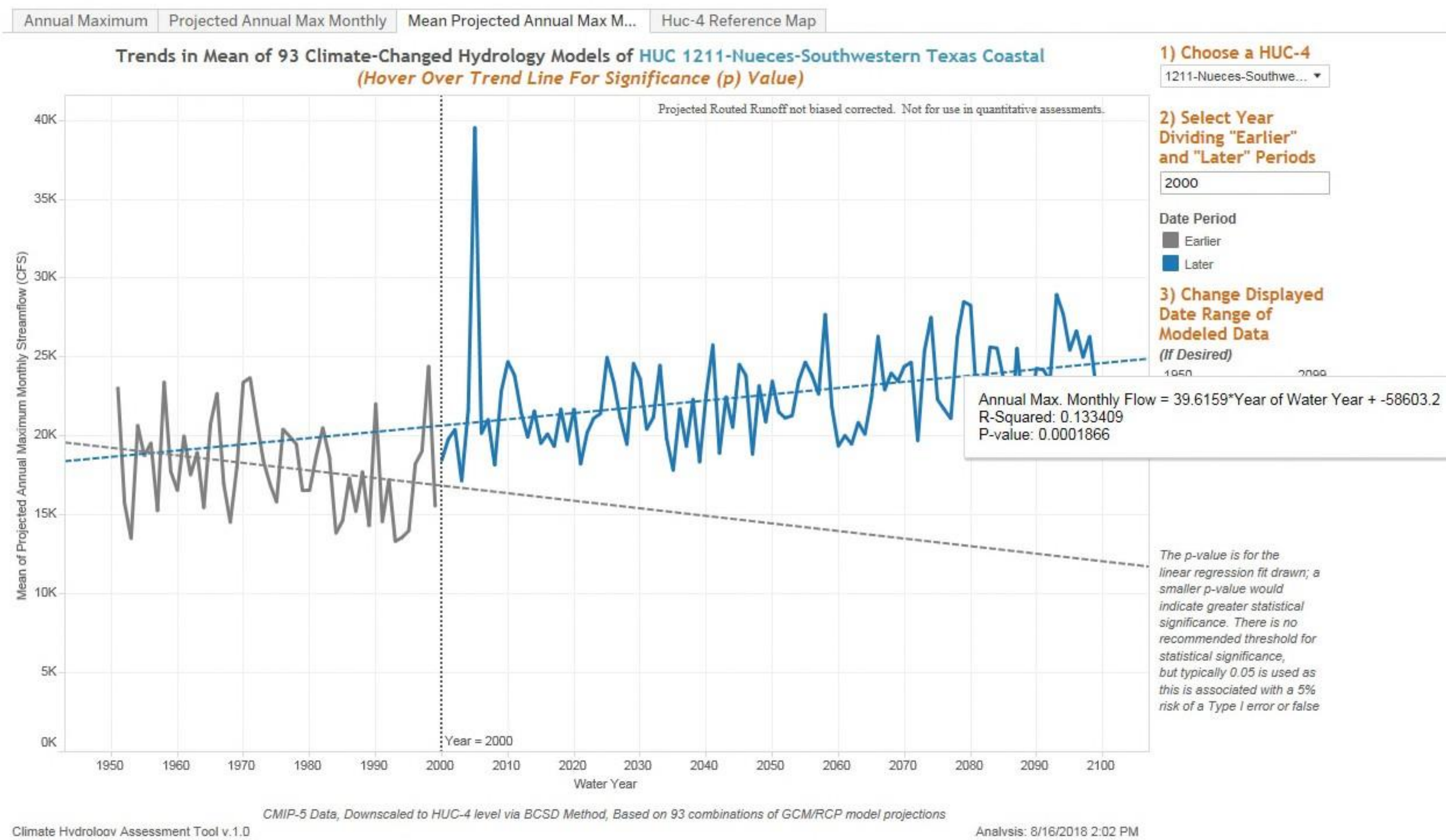


Climate Hydrology Assessment Tool – Projected Annual Max Monthly



USGS 08212400 Los Olmos Creek near Falfurrias, TX

Climate Hydrology Assessment Tool – Mean Projected Annual Max Monthly



CIVIL ENGINEERING

APPENDIX G.2
CIVIL ENGINEERING

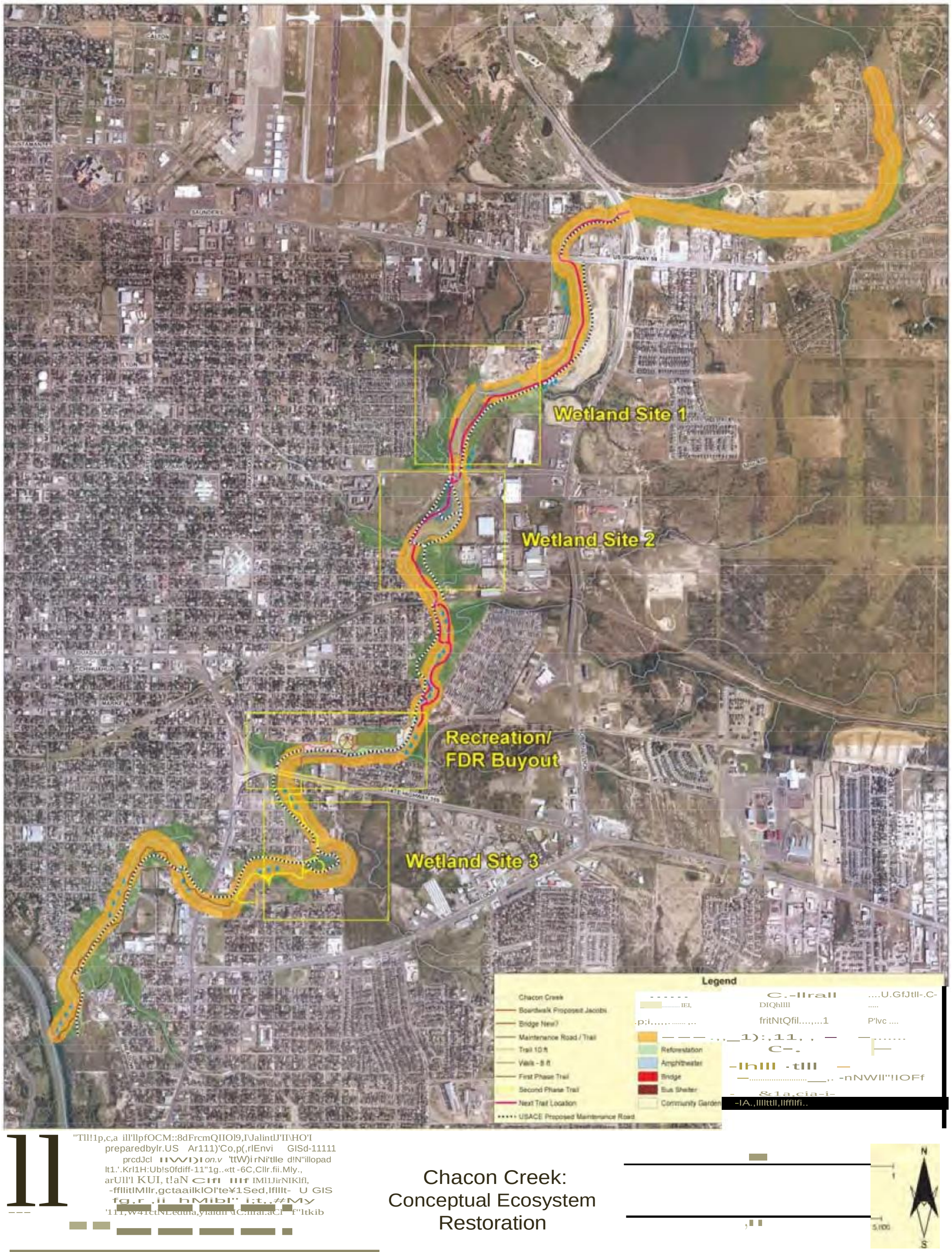
INTRODUCTION

The Chacon Creek Project is located in Laredo, TX and will consist of a buyout, recreation, and an ecosystem restoration plan (See figure below titled Chacon Creek: Conceptual Ecosystem Restoration). Limits of this project extend along Chacon Creek from Casa Blanca Park Road to it's confluence with the Rio Grande River. The buy out/demolition portion of this project encompasses homes that are primarily in the Villa Del Sol and Eastern Division neighborhoods (See Figure 22, (A5) Reach 2 Partial 25-Yr. Event with Recreation). These homes are flooded often with a 25-year or less storm event. Recreation plans included in this project are broken into two categories, flood risk management and ecosystem restoration. The proposed flood risk management portion of the recreation plan entails parks with various park components at three different locations (See Figures 19, 20, and 23 for Recreation Plans). The proposed ecosystem restoration portion of the recreation plan consists of trails, pedestrian bridges, low water crossings, connector paths, and boardwalks along and crossing Chacon Creek, approximately 7 miles in length (See Figure 12, Chacon Creek Proposed Trails). The remaining component of the Chacon Creek Project is the ecosystem restoration plan, which will include reforestation, weir/riffle structures, areas to be cleaned up, and demolition of existing concrete structures (See Figure 33, Chacon Creek Conceptual Ecosystem Restoration).

BUY OUT/DEMOLITION

The selected plan buys out homes along Chacon Creek in the city of Laredo, Texas. The recommended buy out plan consists of acquiring approximately 67 residential parcels within the flood plain (See Figure 22, (A5) Reach 2 Partial 25-Yr. Event with Recreation). The buy out area encompasses approximately 15 acres of land. Most of the buy out/demolition is northwest of Chacon Creek and is bounded by Cortez Street on the north, Chacon Creek on the east and south, and India Avenue on the west. There is one parcel southeast of Chacon Creek that is bounded by Chacon Creek on the north and west, and TX-359 on the south. Seven parcels are bounded by Chacon Creek on the west, TX-359 on the north, North India Avenue on the east, and Chacon Street on the south. The remaining three parcels are bounded by North India Avenue on the west and Chacon Creek on the east. These residences consist of manufactured homes to stick and brick homes. After acquiring the residences, the dwellings will be demolished and removed. Hazardous, toxic, radioactive waste (HTRW) material is anticipated in the dwellings (See Appendix I for HTRW). Some utility lines will be saved if needed for other houses to remain and the proposed recreational facilities. Demolition will include all associated structures, fencing, driveways, etc. from identified residential parcels along with the following roads: Plaza Lane, a segment of South Espana Drive that is south of Cortez Street, the frontage road south of HWY 359, and Mercer Street east of North India Avenue. Demolition areas will be re-established with vegetation.

A demolition plan will be awarded as soon as enough property is acquired for a reasonable contract (See Table #1 below for Buy Out/Residential Demolition Quantities). Houses will be demolished in accordance with the latest HTRW rules and regulations. The contractor will be allowed to salvage the housing units if economical feasible and done in a timely manner. Silt fence and fiber rolls will be used for erosion control until vegetation is established. No houses will be left abandoned for long periods of time after being acquired. Significant trees will be preserved for future recreation areas. Roads will be demolished in accordance with the approved plan and replaced with vegetation. Utility lines in this area will be maintained until the need for the utilities is gone.



(Image source: USACE, 2010)

Table #1: Buy Out/Residential Demolition Quantities		
Items	*Unit Measure*	*Estimated Quantities*
One-Story Home (Including *Associated Structures, Driveways, Sidewalks, Etc.)	Each	51
Two-Story Home (Including *Associated Structures, Driveways, Sidewalks, Etc.)	Each	5
Mobile Home (Including *Associated Structures, Driveways, Sidewalks, Etc.)	Each	10
Roads-Asphalt	Square Feet	59,168
Roads-Concrete	Square Feet	5,490
Utilities per Residence	Each	66
Fence	Linear Feet	11,720

**Note: Associated Structures include, but are not limited to, storage sheds, carports, porches, Etc. Further breakout of items in the table above and erosion control features can be found in the Cost Estimate (Appendix G.5, Cost Estimating).*

RELOCATION PLAN

A comprehensive plan of relocating utilities will be developed before any demolition occurs. Utilities shall consist of water, sewer, electric, communication, and gas lines. One existing storm water pipe exists, but is assumed to not be impacted by demolition and/or the construction of the proposed recreation. The utilities will be removed from above the ground and beneath the ground to three feet deep. Sewer lines below this limit will be flushed and plugged. Residential homes to be bought and demolished are located along the following roads: South Espana Drive, Plaza Lane, Cortez Street, Guatemozin Street, TX-359, North India Avenue, Chacon Street, and Mercer Street. All roads, except for those listed in the Buy Out/Demolition portion of this appendix will remain to service remaining residences.

RECREATION PLAN

A preliminary recreation plan has been developed for Chacon Creek (See Appendix F for Recreation). The cost estimate for the recreational facilities is based on the number of facilities needed within the project area. There are two components of the overall recreation plan, Flood Risk Management and Ecosystem Restoration. The Flood Risk Management portion of the overall recreation plan includes three parks. Villa Del Sol Park will be located south of South Espana Drive. The second park is bounded by Chacon Creek on the west, TX-359 on the north, North India Avenue on the east, and Chacon Street on the south. The remaining park is bounded by North India Avenue on the west and Chacon Creek on the east. The City of Laredo contracted JACOBS Consultancy to produce a concept plan graphic for the proposed Villa Del Sol Park. Table #2 illustrates the proposed features and estimated quantities of Villa Del Sol Park.

Table #2: Flood Risk Management Recreation Quantities-Chacon Creek		
Items	*Unit Measure*	*Estimated Quantities*
Sidewalks:		
Concrete Walks (5' Width)	Linear Feet	6,847
Parking and Drives:		
Parking Lots/Drives (3 Parking Lots)	Square Feet	88,862
Site Furnishings:		
Benches	Each	19

Items	*Unit Measure*	*Estimated Quantities*
Water Fountains	Each	7
Grills	Each	18
Picnic Tables	Each	32
Trash Receptacles	Each	32
Bike Racks	Each	2
<u>Shelter-Group Picnic:</u>		
Pavilion	Each	1
Grand Pavilion	Each	1
Domed Cover with 95’ x 165’ Post	Each	1
<u>Play Equipment-Standard:</u>		
Small Play Area (Includes Play	Each	1
Large Play Area (Includes Play	Each	1
<u>Miscellaneous Structures:</u>		
Shelter-Trail	Each	1
Single Picnic Shelter (10'X16')	Each	19
Comfort Station	Each	2
Storage Building (14’ x 24’)	Each	1
Amphitheater	Each	1
<u>Trees:</u>		
Shade Trees	Each	108
Ornamental Trees	Each	16
<u>Landscape, Irrigation, Turf Establishment,</u>		
Landscape, Irrigation, Turf	Lump Sum	Job
<u>Lighting:</u>		
Security Lighting	Lump Sum	Job
Multi-Use Open Space Lighting	Each	4
Pedestrian Scale Lighting (Parking	Each	20
Parking Lot Lighting	Each	40
<u>Signage and Graphics:</u>		
WayFinding/Signage/Graphics	Lump Sum	Job
<u>Utilities:</u>		
Electrical	Lump Sum	Job
Water	Lump Sum	Job
Sewer	Lump Sum	Job
<u>Demolition:</u>		
Existing Park Features: Playground,	Lump Sum	Job

Note: Items listed in the above table are the main features/quantities. Further breakout of these items and erosion control features can be found in the Cost Estimate (Appendix G.5, Cost Estimating).

Table #3 illustrates the proposed features and estimated quantities of the park south of TX-359, bounded by North India Avenue and Chacon Street.

Table #3: Flood Risk Management Recreation Quantities-Chacon Creek

Items	*Unit Measure*	*Estimated Quantities*
Parking and Drives:		
Parking Lots/Drives (1 Parking Lot)	Square Feet	7,452
Site Furnishings:		
Water Fountains	Each	2
Grills	Each	3
Picnic Tables	Each	6
Trash Receptacles	Each	3
Bike Racks	Each	1
Play Equipment-Standard:		
Small Play Area (Includes Play Components)	Each	1
Trees:		
Shade Trees	Each	20
Landscape, Irrigation, Turf Establishment, Pneumatic Seeding:		
Hydromulch Seeding	Lump Sum	Job
Lighting:		
Parking Lot Lighting	Each	4

Note: Items listed in the above table are the main features/quantities. Further breakout of these items and erosion control features can be found in the Cost Estimate (Appendix G.5, Cost Estimating).

Table #4 illustrates the proposed features and estimated quantities of the park bounded by North India Avenue on the west and Chacon Creek on the east.

Table #4: Flood Risk Management Recreation Quantities-Chacon Creek

Items	*Unit Measure*	*Estimated Quantities*
Sidewalks:		
Concrete Walks (5' Width)	Linear Feet	1,572
Parking and Drives:		
Parking Lots/Drives (1 Parking Lot)	Square Feet	7,452
Site Furnishings:		
Benches	Each	6
Water Fountains	Each	2
Grills	Each	3
Picnic Tables	Each	6
Trash Receptacles	Each	4
Bike Racks	Each	1
Play Equipment-Standard:		
Small Play Area (Includes Play Components)	Each	1

Items	Unit Measure	Estimated Quantities
Miscellaneous Structures:		
Comfort Station	Each	1
Trees:		
Shade Trees	Each	30
Landscape, Irrigation, Turf Establishment, Pneumatic Seeding:		
Hydromulch Seeding	Lump Sum	Job
Lighting:		
Parking Lot Lighting	Each	4
Signage and Graphics:		
WayFinding/Signage/Graphics	Lump Sum	Job

Note: Items listed in the above table are the main features/quantities. Further breakout of these items and erosion control features can be found in the Cost Estimate (Appendix G.5, Cost Estimating).

The Ecosystem Restoration component of the overall recreation plan includes a walk/trail along Chacon Creek with pedestrian bridges and low water crossings. The multi-use trail will be designed for emergency vehicle access. Table #5 illustrates the proposed features and estimated quantities of the Ecosystem Restoration Recreation Plan.

Table #5: Ecosystem Restoration Recreation Quantities-Chacon Creek

Items	Unit Measure	Estimated Quantities
Boardwalks (5' Wide Plasticized Wood)	Linear Feet	2,018
Connector Paths (5' Wide Concrete Sidewalk)	Linear Feet	1,246
Connector Path beneath Bridge	Linear Feet	93
Multi-Use Trail (10' Wide with 2' Shoulders-Concrete and Gravel)	Linear Feet	21,267
Low Water Crossings (10' Wide Concrete)	Each	2
Pedestrian Bridges	Each	5

Note: Items listed in the above table are the main features/quantities. Further breakout of these items and erosion control features can be found in the Cost Estimate (Appendix G.5, Cost Estimating).

ECOSYSTEM RESTORATION PLAN

The ecosystem restoration work will take place along Chacon Creek between Casa Blanca Park Road (northern limit) and the Rio Grande River (southern limit), which is approximately 7 miles of channel. The riparian restoration encompasses 400 acres. Most of the acreage is designated for selective salt cedar removal and the remaining 151 acres is designated for reforestation. Areas designated for reforestation will include buffelgrass clearing, re-vegetation, and irrigation. Reforestation will take place at approximately 32 locations along the right and left descending banks. These areas will be cleared, grubbed, and repeatedly disked with herbicide treatments applied to kill off all invasive plant species. Before new planting occurs, an irrigation system will be installed. The irrigation system will consist of polyvinyl chloride (PVC) pipe and plastic gear driven rotary heads. This system will need water and electricity; therefore, water and electric lines will be run to all reforestation sites from the nearest source. Each reforestation site will also have a water and electric meter.

While construction is underway, erosion control features, such as fiber rolls, silt fence, and stabilized construction accesses will be utilized. These measures shall stay in place until substantial growth has been achieved. Additional ecosystem restoration features include weirs and riffle structures. There are three areas where weirs leading into rock riffle structures will be placed. These structures include concrete footing and stone that will be drilled, anchored, and grouted in place. The stones will be local native stone. Several weir heights were analyzed for alternative ecosystem restoration plans (See Appendix B for Ecosystem Restoration (Environmental)). Table #6 illustrates the various weir heights/widths considered in the alternatives. The rock riffle structure is designed to slope 1V on 5H from the selected weir height to the natural channel bottom elevation.

Table #6: Weir – Riffle Structure Combination Alternatives

Area	*Height (FT)*	*Width (FT)*
	1	110
	2	120
Area #1	3	250
	4	265
	5	275
	6	300
	1	55
	2	150
Area #2	3	190
	4	220
	5	260
	1	45
Area #3	2	55
	3	65

Note: Additional quantities for the weir-riffle structures can be found in the Cost Estimate (Appendix G.5, Cost Estimating).

There are a couple of areas where cleanup and/or demolition is necessary for Ecosystem Restoration. Two concrete structural walls exist within Chacon Creek that will be removed. These structures are in close proximity of each other. One of the structures is the Benavides Park Dam. The location of these dams is approximate 400' west of S Zapata Highway, near the intersection of Mercer Street and North Malinche Avenue. Cleanup will take place along the right descending bank of Chacon Creek in a location that is located between Loop 20 and TX-359. This area is approximately 8 acres and has a significant amount of trash and debris, including a tractor trailer bed that was transported to this location during a flood event by flood waters.

REFERENCE

USACE. 2010. Draft Feasibility Report and Environmental Assessment, Chacon Creek, Laredo, Texas. U.S. Army Corps of Engineers Fort Worth District. Approx. 142 pp.

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STRUCTURAL ENGINEERING

Structural design discussion is included in the Civil Engineering Appendix G.2

GEOTECHNICAL ENGINEERING

APPENDIX G.4

GEOTECHNICAL

1. GENERAL. The geology, physiography, and soil description of existing conditions for the project area for the Chacon Creek GI Watershed Study is provided in this Geotechnical Appendix. Lake Casa Blanca Dam information including description of the dam, specifications, performance history, inspection history, recommendations from the most recent inspection, rehabilitation measures, Webb County maintenance of the dam, and the Hazard Classification of the dam are also provided in this section for the Chacon Creek GI Watershed Study. Lake Casa Blanca Dam is situated upstream of the Chacon Creek Study area. The publications U.S. Army Corps of Engineers, 1978, Casa Blanca Dam, Phase I Inspection Report, and the National Dam Safety Program, Texas Commission on Environmental Quality (TCEQ), 2005, Dam Safety Team Dam Inspection Report along with inquires with Warren Samuelson and Debra Rankin from TCEQ were used to compile the Casa Blanca Dam assessment.

2. GENERAL GEOLOGIC CHARACTERISTICS of the LAREDO AREA.

2.1. Geology and Physiography. The geologic units in Webb County can be characterized as a series of northeast-southwest trending interbedded sand and shale sequences that were deposited in fluvial-deltaic and nearshore marine depositional environments, separated by regional transgressive marine shales. These units were part of a highly destructive, wave-dominated delta system in what is now South Texas during the Eocene (Ricoy and Brown, 1977). The geologic units are Tertiary and Quaternary in age and crop out in northeast-southwest trending belts oriented approximately parallel to the present shoreline of the Gulf of Mexico. These outcrop belts reflect the position of the coast during the geologic time during which deposition occurred (Barnes, 1953). The northwestern part of the county is part of the Rio Grande Embayment, a regional subsurface geologic feature that consists primarily of relatively flat-lying, thick-to-massive sandstones interbedded with thinner shale sequences and few major structural features such as faulting. Most of the sandstone beds were deposited in environments where the primary accumulation of sand has been reworked into barrier bars or strand plains oriented parallel to the depositional strike, with minor accumulations concentrated in dip-trending channels. In areas downdip to the southeast, the geologic units are buried under increasingly thick sequences of Tertiary sediments that are influenced by major structural fault zones and salt diapirs (domes) of the Texas Gulf Coastal Plain and that contain increasing thicknesses of shales (Ewing, 1991). These depositional units have been further modified by subsurface structural elements that developed during the Tertiary period and include the development of syndepositional normal faults (also referred to as "growth faults") and modified by salt tectonism that formed the salt diapirs (Ewing, 1991). The Wilcox fault zone in southeastern Webb County was the first growth-fault system that developed parallel to the present-day coast (Ewing, 1991). The Pescadito Dome in central Webb County is a deep-seated salt diapir that has pushed up and eroded the overlying formations so that the Laredo Formation is exposed at land surface and surrounded by rocks of the Yegua Formation. Another salt diapir, the Moca salt diapir in northeastern Webb County, is associated with the Moca Oil Field. Average regional dips for the Carrizo Sand through the Catahoula Tuff range from 46 to 88 feet per mile (ft/mi), respectively, from northwestern to southeastern Webb County.

The geologic units that form aquifers in Webb County gradually thicken to the southeast toward the Gulf of Mexico along a dip trend. The greatest thickening of the units is in southeastern Webb County in the area influenced by the Wilcox fault zone. The geologic units thicken to the east, and the shale content increases downdip. The increasing shale content is an indication that the sediments downdip were deposited farther out in the basin in a prodelta or nearshore marine environment. The development of the Reklaw Formation, a transgressive marine shale that is equivalent to the base of the Bigford Formation and in Webb County is present only in the subsurface. Farther to the south, the geologic units also become more shaley and dip to the southeast toward the Gulf of Mexico, but the units dip more steeply than the same units to the north. Similar to its configuration in the Reklaw Formation which increases in thickness toward the Gulf of Mexico in southeastern Webb County.

Along the strike sections, most of the formations are relatively uniform in thickness. The thinnest section of formations is in northwestern Webb County. The formations in this area are dominated by sandstones interbedded with shales and lignite. The presence of lignite is an indication that the rocks were deposited in shallow water under reducing conditions in an area such as a lagoon. The formations are at deeper altitudes in the southern part of the county and gradually become thinner and shallower in a northerly direction. Farther down dip in the middle part of the county, the formations are slightly thicker than in the area. The formations in the area are still dominated by sandstones. The formations have greater shale content in the area of the Wilcox fault zone. The subsurface formations are much thicker than their equivalents in the northwestern part of the county, lower in altitude than those units to the northeast, and contain a higher percentage of shale.

This Interior Coastal Plains comprise alternating belts of resistant uncemented sands among weaker shales that erode into long, sandy ridges. At least two major down-to-the coast fault systems trend nearly parallel to the coastline. Chaparral brush and sparse grasses dominate in the area of Laredo. (Source Walter Geology Library at http://www.lib.utexas.edu/geo/physiography.html)

2.2. Overburden. According to the United States Department of Agriculture publication "Soil Survey of Webb County (1985), soils in or adjacent to the study area include the Tela sandy clay loam, Copita fine sandy loam, Verick fine sandy loam, and Lagloria silt loam.

Tela sandy clay loam (SC, CL) typically has a dark grayish brown surface layer, mildly alkaline sandy clay loam about 14 inches thick. The upper part of the subsoil, from 14 to 19 inches, is grayish brown, mildly alkaline sandy clay loam. The middle part of the subsoil, from 19 to 40 inches, is grayish brown, calcareous, moderately alkaline sandy clay loam. The lower part of the subsoil, from 40 to 45 inches, is light brownish gray, calcareous, moderately alkaline sandy clay loam. The underlying layer to a depth of 63 inches is light brownish gray, calcareous, moderately alkaline loam. This soil is well drained, has high available water capacity, slow surface runoff, moderate permeability, and a deep rooting zone. Water erosion is a moderate hazard.

Copita fine sandy loam (SC, SM, CL) typically has a surface layer of brown fine sandy loam about 9 inches thick. The upper part of the subsoil, from 9 to 24 inches, is yellowish brown sandy clay loam. The lower part of the subsoil, from 24 to 37 inches, is light yellowish brown sandy clay loam. The underlying layer to a depth of 60 inches is pale yellow sandstone that is weakly cemented in the upper part and strongly cemented in the lower part. The soil is calcareous and moderately alkaline throughout. This soil is well drained, has low available water capacity, moderate surface runoff, moderate permeability, and a moderately deep rooting zone. Water erosion is a moderate hazard.

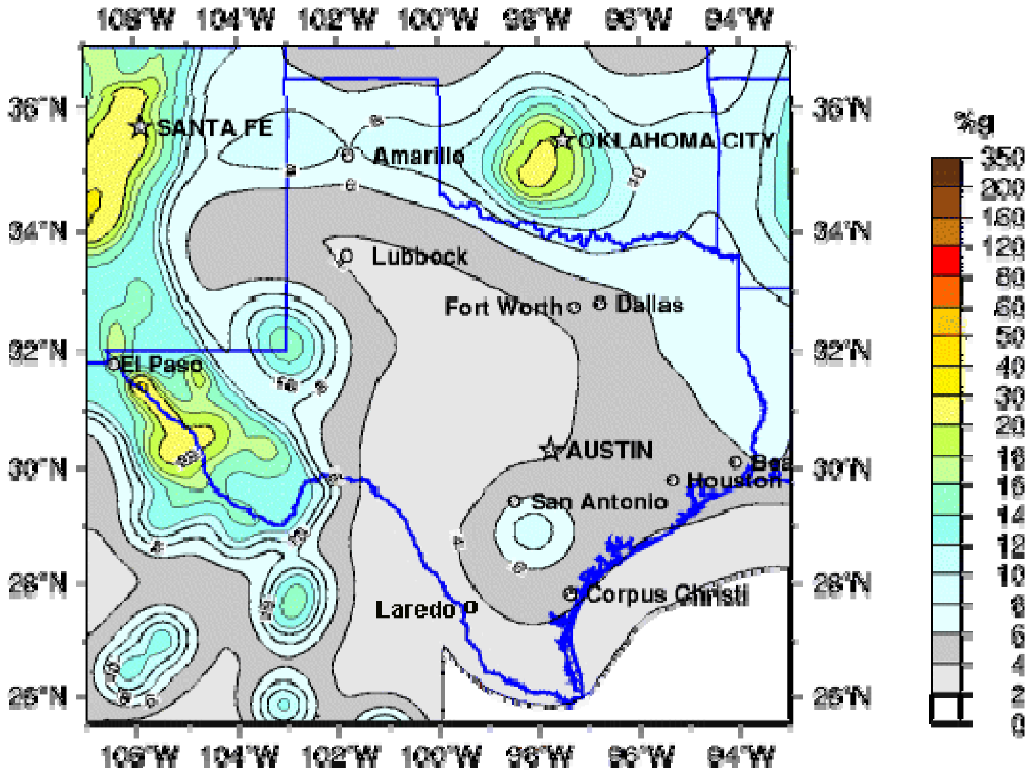
Verick fine sandy loam (SC, SM) typically has a yellowish brown surface layer, is a calcareous moderately alkaline fine sandy loam about 9 inches thick. The subsoil, from 9 to 15 inches, is light yellowish brown, calcareous, moderately alkaline fine sandy loam. The underlying layer is light yellowish brown weakly cemented sandstone to a depth of 60 inches or more. This soil is well drained, has very low available water capacity, medium surface runoff, moderate permeability, and a shallow rooting zone. Water erosion is a moderate hazard.

Lagloria silt loam (CL, ML) typically is a pale brown silt loam surface layer about 19 inches thick. The subsoil, which extends to a depth of 42 inches, is pale brown loam. The underlying layer to a depth of 63 inches is light yellowish brown loam. The soil is calcareous and moderately alkaline throughout. This soil is well drained, has medium available water capacity, slow surface runoff, moderate permeability, and a deep rooting zone. Water erosion is a slight hazard. (Source: Soil Survey of Webb County, 1985).

The soils along the Chacon Creek in the study area are erosive. A trapezoidal grass lined channel may be a design option on the reach of Chacon Creek between the Tex-Mex Railroad Bridge and the Highway 359 Bridge. The proposed channel will require flat channel slopes and erosion protection for the soil on the channel slopes to prevent damage from erosion.

Soil on the north bank of Chacon Creek near Cortez St.
(14 September 2006 Site Visit)

2.3. Seismicity. The closest recorded earthquake occurred in 1975 approximately 280 miles northwest of Laredo. This quake was of low intensity and its epicenter was located near Study Butte in Big Bend National Park, Brewster County, Texas. The United States Seismic Risk Map shows Laredo to be in Zone 0, an area where no damage is expected from earthquakes. USGS National Seismic Hazard Maps (below) shows that Webb County has the possibility of a peek acceleration range of 2% to 4% g with 2% probability of exceedance in 50 years.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

3. CASA BLANCA DAM.

3.1. General Description. Lake Casa Blanca Dam is located approximately three miles northeast of Laredo, Texas and is situated upstream of the Chacon Creek Study area. The dam is a curved earth fill structure and is classified as large in size (impoundment capacity of 77,838 acre-feet at the top of dam elevation). A berm along the entire upstream embankment slope supports a paved roadway. An earth cut service spillway is located approximately 3500 feet northeast of the left abutment. An emergency spillway is located near the right abutment. Flow from both spillways discharges into Chacon Creek below the dam. A pump house is located on the upstream slope approximately 1600 feet from the right end of the dam. Water is piped through the embankment by an eight-inch conduit to the golf course just downstream from the dam. (Source: U.S. Army Corps of Engineers, 1978, Casa Blanca Dam, Phase I Inspection Report).

3.2. Specifications. Lake Casa Blanca Dam is identified in the National Inventory of Dams (NID) as TX02267. (Source: National Dam Safety Program, TCEQ, 2005, Dam Safety Team Dam Inspection Report).

Casa Blanca Dam

Inventory No.:	TX02267
Owner:	Webb County
Stream:	Chacon Creek
Basin:	Rio Grande
Down Stream Hazard:	High
Normal Water Level:	445.1 MSL
Normal Capacity:	17,480 acre-feet
Maximum Capacity:	77,838 acre-feet

Casa Blanca Dam Embankment

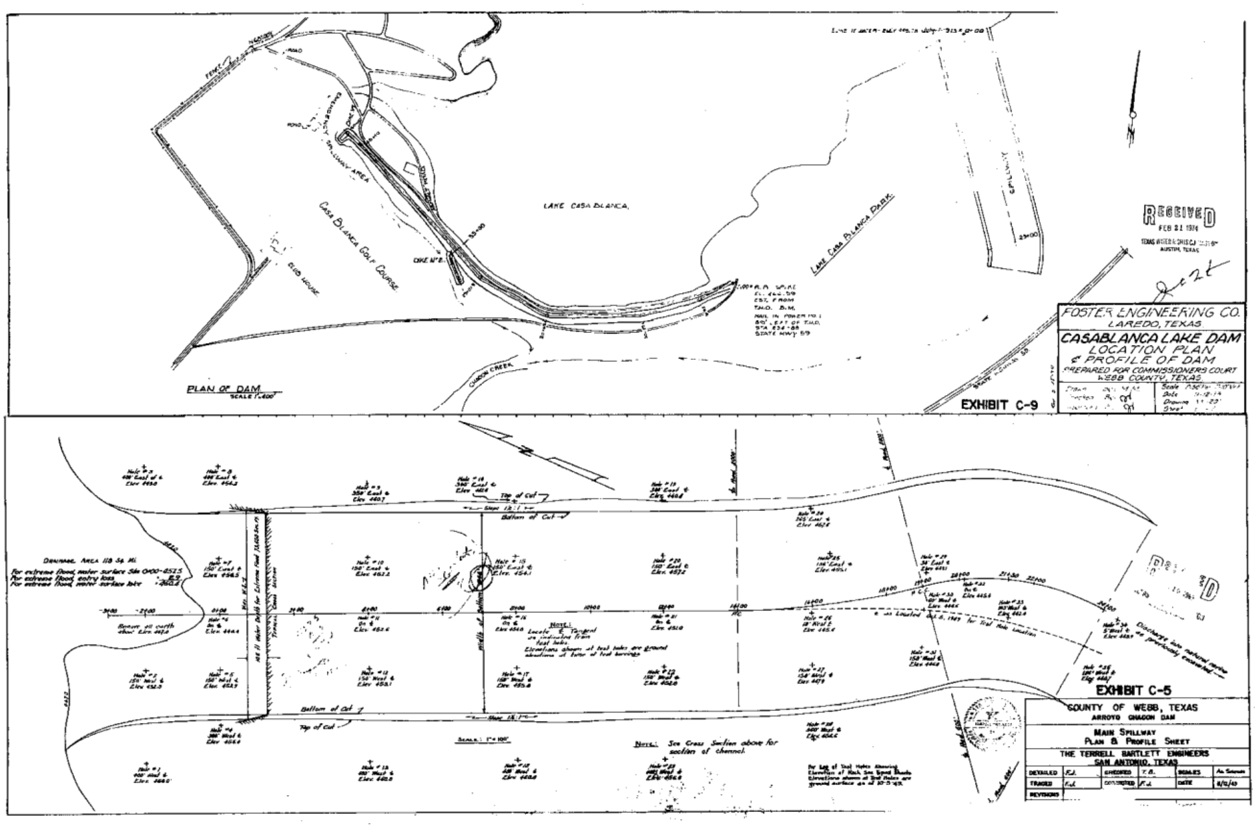
Type:	Earthfill
Length:	5,000 feet
Maximum Height:	73 feet
Crest Elevation:	467.00 feet MSL
Top width:	40 ft. (Average)
Upstream Side Slope:	3H to 1V
Downstream Side Slope:	2H to 1V
Compacted Zoning:	Impervious core, Pervious outer Zones
Cutoff:	Left third of Upstream Zone has Steel Sheet Piling

Casa Blanca Service Spillway

Type:	Earthcut
Crest Length:	546 feet
Crest Elevation:	446.4 feet MSL
Upstream Channel:	596 feet Trapezoidal Channel
Downstream Channel:	300 feet Trapezoidal Channel

Casa Blanca Emergency Spillway

Type:	Natural Channel
Crest Length:	800 feet
Crest Elevation:	458.6 feet MSL
Upstream Channel:	Natural Depression
Downstream Channel:	Natural Channel



Casa Blanca Dam and Service Spillway Plan View.
(Source: U.S. Army Corps of Engineers, 1978, Casa Blanca Dam, Phase I Inspection Report)

3.3. Geology at the Dam. Casa Blanca Dam is located on the outcrop of the Laredo Formation of the Eocene age. The formation is made up of red and brown fine grained sandstone that is cross-bedded, micareous, ferruginous, and in part glauconitic. It is interbedded with an orange-yellow clay. Dark gray limestone concretions are common in the Laredo Formation, some of which are fossiliferous. There are no surface expressions of any tilted or steeply dipping beds, major faulting, or any anomalous features at the dam site. (Source: U.S. Army Corps of Engineers, 1978, Casa Blanca Dam, Phase I Inspection Report).

3.4. Performance History. Lake Casa Blanca Dam was constructed in 1946 by Webb County using county resources. The first flood waters were impounded in 1947 and resulted in severe damage to the structure due to piping under the embankment. A new dam was designed and reconstruction began again in 1947 with completion of construction in 1951. The dam was inspected as part of Phase I of the National Dam Safety Program in 1978. According to historical information documented in the Phase I report, the county's engineer indicated that a fault below the center closure section was the cause for the failure of the dam. Numerous sinkholes have historically been observed on the embankment which indicates dispersive clay or collapsing calcareous soils. The county applied for a water right which was issued in 1975 under the provision that the dam be modified to pass the required design flood by both raising the crest and widening the service spillway. Modifications to the dam were completed in 1982. The principle spillway was lowered and widened to a bottom width of 546 feet. Discharges flow into a downstream channel that is 300 feet wide which empties into Chacon Creek. The embankment was raised and also extended 250 feet towards the right abutment. The emergency spillway is a 800 feet wide low area beyond the end of the right side of the dam. Spillway flows are allowed to travel down the toe of the dam. This area was originally planed to be protected with riprap and a diversion berm which apparently were never constructed. This area is now a four lane thoroughfare. (National Dam Safety Program, TCEQ, 2005, Dam Safety Team Dam Inspection Report).

Casa Blanca Dam upstream slope next to east abutment.
(14 September 2006 Site Visit)

Casa Blanca Dam crest - east abutment looking west.
(14 September 2006 Site Visit)

Casa Blanca Dam erosion on downstream slope.
(14 September 2006 Site Visit)

Midpoint of the Service Spillway channel looking upstream.
(14 September 2006 Site Visit)

3.5. Maintenance. Webb County owns Casa Blanca Dam and Lake. Texas Parks and Wildlife Department operates the facility as a state park; however, their maintenance is limited to park facilities. Maintenance of the dam is the responsibility of Webb County. County work crews perform basic maintenance tasks. (Source: National Dam Safety Program, TCEQ, 2005, Dam Safety Team Dam Inspection Report).

3.6. Inspection History. Casa Blanca Dam was inspected as follows:

18 March 1970	Texas Water Rights Commission
13 October 1971	Texas Water Rights Commission
7 February 1972	Texas Water Rights Commission
5 September 1972	Texas Water Rights Commission
14 June 1973	Texas Water Rights Commission
Nine inspections between 1974 and 1977 during modification work on the dam.	
14 June 1978	Texas Department of Water Resources, Dam Safety
23 April 1980	Texas Department of Water Resources, Dam Safety
13 May 1981	Texas Department of Water Resources, Dam Safety
1 July 1981	Texas Department of Water Resources, Dam Safety
19 August 1981	Texas Department of Water Resources, Dam Safety
7 November 1981	Texas Department of Water Resources, Dam Safety
9 April 1982	Texas Department of Water Resources, Dam Safety
25 April 1985	Texas Department of Water Resources, Dam Safety
3 June 1985	Texas Department of Water Resources, Dam Safety
25 June 1985	Texas Department of Water Resources, Dam Safety
23 January 1990	Texas Water Commission, Dam Safety

14 February of 2005 R.J. Brandes Company for TCEQ

(Source: Debra Rankin, TCEQ, 15 December 2006, Inquiry for Information).

3.7. Recommendations of the 2005 Inspection. Lake Casa Blanca Dam was reported to be in poor condition due to lack of attention paid to the eroding downstream slope and the wave action induced erosion on the upstream slope. Some of the sinkholes or collapsed calcareous soils located on the crest were reported to have openings large enough and deep enough for people to fall into and become trapped. The originally proposed diversion berm for the emergency spillway was never constructed and the proposed rip rap for the downstream slope protection has never been applied to the right side of the downstream slope. It was recommended that the county develop a plan to repair the dam crest and the downstream slope as well as the eroded upstream slope. It was recommended that the county develop a maintenance program to periodically observe the dam and repair identified deficiencies. Due to the increased development below the dam and the fact that the emergency spillway discharges directly into a developed area, the county should develop an Emergency Action Plan which incorporates an Early Warning System to notify downstream residents in the event a of a flood emergency or the potential failure of the dam. In brief the eight recommendations are listed as follows:

Recommendations of 2005 Inspection:

1) Repair eroding downstream slope and establish vegetative erosion protection.
2) Repair sinkhole on the crest, regrade for upstream drainage, and establish vegetative erosion protection.
3) Develop a Emergency Action Plan with a early warning system.
4) Repair eroding upstream slope caused by wave action with riprap.
5) Prevent unauthorized vehicle access to the dam and spillway.
6) Repair erosion on the spillway side slopes.
7) Develop a maintenance program for observation and funding of repairs.
8) Remove trees and brush from the service spillway discharge channel.

(Source: National Dam Safety Program, TCEQ, 2005, Dam Safety Team Dam Inspection Report).

3.8 Rehabilitation of the Dam. In response to the Casa Blanca Dam TCEQ 2005 inspection report, Webb County proposed to address the report recommendations in 3 Phases. Phase I addresses Recommendations 1, 2, 3, and 5. Phase II addresses Recommendations 4 and 6. Phase III addresses Recommendations 7 and 8. Phase I was projected to be completed by January 2007, Phase II was projected to be completed by July 2007, and Phase III was projected to be completed by January 2008. A letter sent to TCEQ from the Webb County Engineering Department on June 15, 2006 indicated that the engineering contract for Phase I would be submitted for Commissioner's Court approval in late June 2006 and indicated the county was approximately 90 days behind schedule; consequently, the originally projected January 2007 completion date was likely to be shifted (Warren Samuelson, P.E. and Debra Rankin, TCEQ, 15 December 2006, Inquiry for Information). A telephone conversation with Tony Alderete, the Senior Webb County Inspector on 9 January 2007 indicated that no additional delay is expected.

3.9. Hazard Classification. Casa Blanca Dam is classified as a large sized, high hazard structure. In the event of failure, loss of downstream life and property could be excessive. The 1990 state inspection indicated that a mobile home park with at least twenty residences were located immediately downstream of the maximum section of the dam. The 2005 TCEQ inspection revealed that the City of Laredo has encompassed the downstream area with housing, businesses, major roadways and industrial development.

The dam does pose a risk to the proposed project, and the dam needs to be maintained and periodically assessed for integrity.

REFERENCES CITED

Barnes, J.R., 1953, Preliminary survey of ground-water conditions near Laredo, Texas: Private consultantís report prepared for Laredo Waterworks System, City of Laredo, Texas, 15 p.

Ewing, T.E., 1991, The tectonic framework of Texas: Austin, University of Texas, Bureau of Economic Geology, map and text, 36 p.

Ricoy, J.U., and Brown, L.F., Jr., 1977, Depositional systems in the Sparta Formation (Eocene) Gulf Coast Basin of Texas, in Bebout, D.G., and Loucks, R.G., eds., Cretaceous carbonates of Texas and Mexico—Applications to subsurface exploration (Abstracts): Transaction of the Gulf Coast Association of Geological Societies, v. 27, p. 139–154.

U.S. Army Corps of Engineers, 1978, Casa Blanca Dam , Webb County, Texas, Phase I Inspection Report National Dam Safety Program, text, p.1-19, A-1 to A-8.

Texas Commission on Environmental Quality (TCEQ), 2005, Texas Commission on Environmental Quality Dam Safety Team Dam Inspection Report, Text, p. 1-7.

Warren Samuelson, P.E. and Debra Rankin, Texas Commission on Environmental Quality (TCEQ), 15 December 2006, Inquiry for Information.

Tony Alderete, Senior Webb County Inspector, 9 January 2007, Inquiry for Information.

APPENDIX G.5

COST ESTIMATING

COST ESTIMATING

INTRODUCTION

This Cost Engineering Appendix is provided to describe the development of costs for use in the updated NED plan economic analysis. This appendix reflects a 2018 update to the 2010 cost estimating work to bring all costs for the NED plan to 2018 dollars. No updates to the cost estimates for the alternatives analysis has been completed at this point.

2010 COST ESTIMATES

The NED plan was estimated in 2010 using MCACES cost estimating software, version 4.0. The estimate was dated 25 May 2010 (See Attachment A for summary print out of 2010 MCACES Estimate). The total project cost within the MCACES shows a total project cost of $43,151,846, which does include contingencies. Various contingency percentages were applied across the different feature accounts. Table 1 provides a summary of costs from the 2010 MCACES construction cost estimate. The table presents the primary feature accounts along with the contingency costs and percentages for each account.

Table 1 – Summary of 2010 MCACES Costs by Feature Account

WBS	Feature Account – Item	Contract Cost	Contingency	Contingency %	Project Cost
01	Lands and Damages - Flood Protection	$7,591,898	$1,530,700	20.16%	$9,122,598
01	Lands and Damages - Ecosystem Restoration	$5,940,226	$1,342,103	22.59%	$7,282,329
01	Lands and Damages - Structure Demolition	$1,631,685	$407,994	25.00%	$2,042,612
06	Fish and Wildlife Facilities - Ecosystem Restoration	$9,483,822	$2,265,597	23.89%	$11,749,419
06	Fish and Wildlife Facilities - Monitoring and Adaptive Management	$856,000	$-	0.00%	$856,000
14	Recreation Facilities	$6,686,648	$1,315,638	19.68%	$8,002,286
30	Planning, Engineering and Design	$1,638,641	$409,660	25.00%	$2,048,301
31	Construction Management	$1,638,641	$409,660	25.00%	$2,048,301
	Totals:	**$35,467,561**	**$7,681,352**	**21.66%**	**$43,151,846**

2018 COST UPDATES

The following sections describe the modifications made to the 2010 cost estimate to generate the total costs for use in the economic analysis of the NED plan.

MCACES Cost Estimate

Based on our review of the 2010 cost estimate, a simple update based on importing the new labor, equipment and cost book databases likely would be insufficient. Many items within the estimate likely would not be updated, as names have changed within the software, and cost overrides likely would have been used that would need to be updated independently. Therefore, in lieu of updating these databases, the use of EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS) has been used to update all prices from the 2010 MCACES. The CWCCIS provides escalation factors for all USACE feature accounts, and allows for calculation of escalation factors for specific features of the project. These factors are developed to be representative of escalations to labor, equipment and material prices.

Escalation Rates

Based on the escalation factors provided in EM 1110-2-1304, the following escalation factors have been calculated for the construction elements of the cost estimate.

Table 2 – CWCCIS Escalation Factors by Feature Account

WBS	Feature Account	3Q10 Factor	2Q18 Factor	Escalation Multiplier
01*	Lands and Damages	729.23	850.34	1.166
06	Ecosystem Restoration	712.33	839.75	1.179
14	Recreation	728.03	824.96	1.133
* Note: the 01 Account factors were taken from the composite index (weighted average)				

Lands and Damages Updates

The 01 – Lands and Damages account shown in Table 2 accounts for the construction aspects of the 01 Account. The 1.166 multiplier is applied to the structure demolition construction work that is included in the 01 Account. An additional change that has been made for clarification, and proper calculation of the 30 and 31 accounts, is that the structural demolition costs have been moved to the 02 Relocations account for the updated estimate.

For the non-construction elements of the 01 Account, price indices developed by the St. Louis Federal Reserve Bank were used to escalate all non-construction real estate costs (see Appendix D – Real Estate for details of escalation to non-construction real estate costs). In addition, the relocation assistance costs have been updated with the latest guidance from the Federal Housing Administration (FHA).

Modifications to Existing NED Recommended Plan

As noted in Appendix A – Economics, the new recommended plan has less structures to be bought out, evacuated, and demolished. This is because some structures have already been removed from the floodplain over the last eight years. Therefore, the updated cost estimate reflects the removal of these structures from the study.

The 2010 estimate included the demolition of 74 residential structures. The average cost of demolition per structure, without contingency, equaled approximately $14,850. The updated NED plan now includes the demolition of 60 total residential structures. Therefore, the updated cost estimate for the NED plan uses the average structure demolition price from the 2010 MCACES estimate, and escalates the unit price by the factors shown in Table 2. Based on these assumptions the current structure demolition costs are presented in Table 3.

Table 3 – Escalation and Quantity Update Summary for Structure Demolitions

Item	Quantity	UOM	Unit Price*	Contract Cost
2010 Structure Demo Costs	74	EA	$14,850	$1,098,900
2018 Structure Demo Costs	60	EA	$17,320	$1,039,200
* Note: Unit price for 2018 cost has been escalated by a factor of 1.166				

All ancillary project work included in the 2010 estimate, such as roadway demolition, overhead power line removals, demo of stormwater systems, and others, have been assumed to remain applicable to the current plan. These costs have all been escalated accordingly based on the factors in Table 2. Table 4 provides the escalated values for the remaining demolition items plus the change to the structure demolition as referenced in Table 3.

Table 4 – Structure Demolition Escalation to 2018 Dollars

Demolition Item	2010 Cost	Escalation Factor	2018 Cost
Structure Demolition*	$1,098,900	1.166	$1,039,200
Underground Gas Line	$44,194		$51,530
Power Pole and Overhead Power Line Removal	$50,230		$58,568
Demo Asphalt Road	$20,372		$23,754
Demo Curb & Gutter	$15,086		$17,590
Demolition Water Line	$4,195		$4,891
Demolition Sanitary Sewer Lines	$6,494		$7,572
Asbestos Removal	$332,473		$387,664
Demolition of Road and Stormwater System (North of Parcels 66-69)	$11,919		$13,898
Demolition of Road and Stormwater System (Mercer Street)	$7,670		$8,943
Erosion Control	$38,465		$44,850
Curb & Gutters at Mercer Street	$1,303		$1,519
Curb & Gutters at South Side of HWY 359	$2,444		$2,850
Total Cost	**$1,633,745**		**$1,662,829**
* Note: 2018 structure demolition costs reflect reduced quantity of structures required to be evacuated			

Recreation Plan Updates

The recreation plan has not changed from the 2010 study. The same quantities and elements that are in the 2010 MCACES have been carried over for these updates. The recreation costs have been escalated based on the factors in Table 2. A summary of the escalation components is presented in Table 5.

Table 5 – Recreation Plan Escalation Summary

Recreation Area	Quantity	UOM	Contract Cost
2010 Costs			
Sub Area 1	1	LS	$437,925
Sub Area 2	1	LS	$1,366,259
Sub Area 3	1	LS	$2,255,082
Sub Area 4	1	LS	$1,840,827
Hwy 359	1	LS	$217,872
Mercer Street	1	LS	$568,683
Totals			**$6,686,648**
2018 Costs (Escalated)			
Sub Area 1	1	LS	$496,169
Sub Area 2	1	LS	$1,547,971
Sub Area 3	1	LS	$2,555,008
Sub Area 4	1	LS	$2,085,657
Hwy 359	1	LS	$246,849
Mercer Street	1	LS	$644,318
Totals:			**$7,575,972**

NER Plan Costs

The results of the current CE/ICA analysis resulted in the same recommended NER plan that was selected in 2010. Therefore, the quantities in the 2010 MCACES estimate are still applicable since the plan has stayed the same in terms of areas to be restored. Consequently, the only changes to the NER costs is to escalate based on the escalation factors in Table 2. A summary of the 2010 NER plan costs, and the escalated 2018 costs are provided in Table 6.

Table 6 – NER Plan Elements Escalation Summary

Ecosystem Restoration Items	Quantity	UOM	Unit Price	Contract Cost
2010 Costs				
Selective Clearing – Salt Cedar Trees	16,000	EA	$22.77	$364,394
Re-Forestation	151	ACR	$58,176.09	$8,784,589
Weirs and Riffle Structures	1	LS	$334,839.00	$334,839
Monitoring	1	LS	$214,000.00	$214,000
Adaptive Management	1	LS	$642,000.00	$642,000
			Totals:	**$10,339,822**
2018 Costs (Escalated)				
Selective Clearing – Salt Cedar Trees	16,000	EA	$26.85	$429,621
Re-Forestation	151	ACR	$68,589.61	$10,357,030
Weirs and Riffle Structures	1	LS	$394,775.18	$394,775
Monitoring	1	LS	$252,306.00	$252,306
Adaptive Management	1	LS	$756,918.00	$756,918
			Totals:	**$12,190,650**

CONTINGENCIES

The 2010 MCACES construction cost estimate contained various contingencies for different aspects of the project. Even within the NER plan, contingencies vary between different activities. Also, in reviewing all documents that had been developed for the 2010 estimate, a Cost and Schedule Risk Analysis (CSRA) had been completed by USACE, and is included as Attachment B. The analysis completed in the CSRA report developed a contingency of 26.92% for the entire project.

At this stage of the project, a constant contingency of 26.92%, which is calculated with a risk-based assessment, appears reasonable to use for the overall project contingency for all construction activities within the 2018 price level estimate. Therefore, in development of the total project cost for the 2018 price level estimate, a contingency of 26.92% has been used for all feature accounts, excluding the non-construction lands and damages costs.

TOTAL PROJECT COST

A Total Project Cost Summary (TPCS) spreadsheet has been developed for the full recommend plan that includes the costs for both the NED and NER plans (Attachment C). The TPCS uses the escalated contract costs, referenced in the tables above, along with the 26.92% contingency for construction activities, and real estate costs with contingency from the real estate appendix. The TPCS is split into three pages. The first page is the overall summary that reflects the total costs for implementing the NED and NER plans. The second page only reflects the NED plan costs, which include real estate costs, structure demolition (now in 02 Account), recreation components, and resulting PED and CM costs. The third page of the TPCS reflects the total costs for the NER plan. Therefore, this page includes the real estate costs associated with the NER plan, the construction elements for the ecosystem restoration, and the resulting PED and CM.

30 and 31 Feature Accounts

The 2010 estimate contained Planning, Engineering and Design (PED) and Construction Management (CM) costs that approximately equaled 9% of construction costs. Therefore, for the 2018 price level updates, 9% has been used within the TPCS to calculate the PED and CM costs for both the NED and NER costs to be consistent with the previous study.

Escalation and Schedule

The TPCS has built in escalation rates that are based on input dates that allow for the escalation from 2018 costs to the fully funded project cost. There are two stages in the TPCS escalation process. The first escalation is done to escalate costs to the program year, and the resulting values are considered the project “first costs”. These first costs are used in the economic analysis of the NER and NED plan, and the values are in fiscal year 2019 dollars.

The next step of escalation is to the midpoint of construction. To develop new dates for escalation, the 2010 study had input fiscal years for each feature account in the MCACES estimate. These years have been pulled out and the following table illustrates which feature accounts were anticipated to be completed in which year according to the 2010 estimate. The bottom row of Table 7 provides the updated years for use in the current escalation calculations.

Table 7 – Simplified Construction Schedule for Escalation Calculations

WBS	Feature Account (Item)	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
30	Planning Engineering & Design								
01	Lands and Damages (Non-Construction)								
01	Lands and Damages (Structure Demo)								
14	Recreation								
06	Ecosystem Restoration (Salt Cedar Removal)								
06	Ecosystem Restoration (Re-Forestation)								
06	Ecosystem Restoration (Weirs and Riffles)								
31	Construction Management								
06	Adaptive Management								
06	Monitoring								
Updated Fiscal Years		**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**

ATTACHMENT A

2010 MCACES Summary Report

GOVERNMENT ESTIMATE
(IGE: MII9d)

For
Flood Buyout/ Recreation/ Eco-System Restoration Chacon Creek
Estimate Date: 01 October 2010

Date of Report: 25 May 2010

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For
Flood Buyout/ Recreation/ Eco-System
Restoration Chacon Creek
Estimate Date: 01 October 2010

Date of Report: 25 May 2010

IGE FINAL SUMMARY

Total Base Bid: $ **43,151,844.00**

Date of Report: 25 May 2010
Effective Date of Estimate: 01 October 2010
PM: Jodi Foster
CS:
Estimate: CESWF (CH/DH)
Amendments:

Approva/t;f :

DATE: 2SX/4(2010

Mil r m R. !:>chm_d_, C. C. C.
ChiPf, Cost Engineering and Specifications Section, CESWF-EC-AC

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Protective marking applies to all pages
This protective marking is canceled afier completion of negotiations.

Chacon Creek - Flood Buyout/Recreation/EcoSystem Restoration
Date of Estimate Originally from: 20 May 2010
Effective Date of Pricing: 01 October 2010

Estimated by	CESWF
Designed by	CESWF
Prepared by	CESWF-EC-AC (revised 25 May 2010)
Preparation Date	5/20/2010
Effective Date of Pricing	10/1/2010
Estimated Construction Time	Days

PROJECT SUMMARY		**43,151,706**	**2,074,044**	**45,225,750**
2 Total Project Cost with Escalation	**LS**	**43,151,706**	**2,074,044**	**45,225,750**
2.1 FY 2011	**LS**	**2,048,301**	**28,471**	**2,076,772**
2.1.1 CONSTRUCTION FY 2011	**LS**	**2,048,301**	**28,471**	**2,076,772**
2.1.1.1 Account 30 Engineering & Design Fiscal Year 2011	**LS**	**2,048,301**	**28,471**	**2,076,772**
(Note: Escalation Cost Index 4Q11 = 727.56, 3Q10 = 717.58; Esc = 1.39%)				
2.1.1.1.1 USR Engineering & Design	LS	2,048,301	28,471	2,076,772
(Note: $2,048,301)				
2.2 FY 2012	**LS**	**16,404,927**	**524,958**	**16,929,885**
2.2.1 01 Account NON_CONSTRUCTION FY 2012	**LS**	**16,404,927**	**524,958**	**16,929,885**
2.2.1.1 01 Account LANDS & DAMAGES (Real Estate, Non-Construction) Fiscal Year 2012	**LS**	**16,404,927**	**524,958**	**16,929,885**
(Note: Escalation Cost Index 4Q12 = 740.52, 3Q10 = 717.58; Esc = 3.20%)				
2.2.1.1.1 TABLE 2A FLOOD RISK MANAGEMENT Fiscal Year 2012	**LS**	**9,122,598**	**291,923**	**9,414,521**
(Note: (Escalation Cost Index 4Q12 = 740.52, 3Q10 = 717.58; Esc = 3.20%))				
2.2.1.1.1.1 USR Real Estate Analysis Documents	LS	9,122,598	291,923	9,414,521
2.2.1.1.2 TABLE 2B ECOSYSTEM RESTORATION PROJECT Fiscal Year 2012	**LS**	**7,282,329**	**233,035**	**7,515,364**
(Note: (Escalation Cost Index 4Q12 = 740.52, 3Q10 = 717.58; Esc = 3.20%))				
2.2.1.1.2.1 USR Real Estate Analysis Documents	LS	7,282,329	233,035	7,515,364
2.3 FY 2013	**LS**	**10,918,141**	**434,323**	**11,352,464**
2.3.1 CONSTRUCTION 2013	**LS**	**10,918,141**	**434,323**	**11,352,464**
2.3.1.1 LANDS & DAMAGES (Real Estate Demo) and CONSTRUCTION Fiscal Year 2013	**LS**	**10,044,758**	**390,741**	**10,435,499**
2.3.1.1.1 01 Account NON-STRUCTURAL BUYOUT PLAN (Demo) Fiscal Year 2013	**LS**	**2,042,474**	**79,452**	**2,121,926**
(Note: Escalation Cost Index 4Q13 = 745.50, 3Q10 = 717.58; Esc = 3.89%)				
2.3.1.1.1.1 USR Real Estate Demolition and Construction	LS	2,042,474	79,452	2,121,926
2.3.1.1.2 14 Account Recreation Fiscal Year 2013	**LS**	**8,002,284**	**311,289**	**8,313,573**
(Note: Escalation Cost Index 4Q13 = 745.50, 3Q10 = 717.58; Esc = 3.89%)				
2.3.1.1.2.1 USR Recreation	LS	8,002,284	311,289	8,313,573
2.3.1.2 Account 31 Construction Management for Real Estate Demolition & Recreation Fiscal Year 2013	**LS**	**873,383**	**43,582**	**916,965**
(Note: Escalation Cost Index 4Q13 = 753.38, 3Q10 = 717.58; Esc = 4.99%)				
2.3.1.2.1 USR Construction Management	LS	873,383	43,582	916,965

Description	UOM	ContractCost	Escalation	ProjectCost
2.4 FY 2014	**LS**	**6,462,169**	**437,489**	**6,899,658**
2.4.1 CONSTRUCTION FY 2014	**LS**	**6,462,169**	**437,489**	**6,899,658**
2.4.1.1 EcoSystem Restoration Fiscal Year 2014	**LS**	**5,874,710**	**397,718**	**6,272,428**
(Note: Escalation Cost Index 4Q14 = 766.19, 3Q10 = 717.58; Esc = 6.77%)				
2.4.1.1.1 USR EcoSystem Restoration Selective Clearing - Salt Cedar Tree Removal (50%)	LS	227,746	15,418	243,164
2.4.1.1.2 USR EcoSystem Restoration Re-Forestation (50%)	LS	5,437,689	368,132	5,805,821
2.4.1.1.3 USR EcoSystem Restoration Weirs and Riffle Structures (50%)	LS	209,275	14,168	223,443
2.4.1.2 Account 31 Construction Management for Ecosystem Restoration Fiscal Year 2014	**LS**	**587,459**	**39,771**	**627,230**
(Note: Escalation Cost Index 4Q14 = 766.19, 3Q10 = 717.58; Esc = 6.77%)				
2.4.1.2.1 USR Construction Management	LS	587,459	39,771	627,230
2.5 FY 2015	**LS**	**6,462,169**	**555,100**	**7,017,269**
2.5.1 CONSTRUCTION FY 2015	**LS**	**6,462,169**	**555,100**	**7,017,269**
2.5.1.1 EcoSystem Restoration Fiscal Year 2015	**LS**	**5,874,710**	**504,638**	**6,379,348**
(Note: Escalation Cost Index 4Q15 = 779.22, 3Q10 = 717.58; Esc = 8.59%)				
2.5.1.1.1 USR EcoSystem Restoration Selective Clearing - Salt Cedar Tree Removal (50%)	LS	227,746	19,563	247,309
2.5.1.1.2 USR EcoSystem Restoration Re-Forestation (50%)	LS	5,437,689	467,097	5,904,786
2.5.1.1.3 USR EcoSystem Restoration Weirs and Riffle Structures (50%)	LS	209,275	17,977	227,252
2.5.1.2 Account 31 Construction Management for Ecosystem Restoration Fiscal Year 2015	**LS**	**587,459**	**50,463**	**637,922**
(Note: Escalation Cost Index 4Q15 = 779.22, 3Q10 = 717.58; Esc = 8.59%)				
2.5.1.2.1 USR Construction Management	LS	587,459	50,463	637,922
(Note: $587,459)				
2.6 FY 2016	**LS**	**713,333**	**74,472**	**787,805**
2.6.1 CONSTRUCTION FY 2016	**LS**	**713,333**	**74,472**	**787,805**
(Note: Escalation Cost Index 4Q16 = 792.46, 3Q10 = 717.58; Esc = 10.44%)				
2.6.1.1 EcoSystem Restoration Adaptive Management Fiscal Year 2016	**LS**	**642,000**	**67,025**	**709,025**
2.6.1.1.1 USR Adaptive Management	LS	642,000	67,025	709,025
2.6.1.2 EcoSystem Restoration Monitoring Fiscal Year 2016	**LS**	**71,333**	**7,447**	**78,780**
2.6.1.2.1 USR Monitoring	LS	71,333	7,447	78,780
(Note: $71,333)				
2.7 FY 2017	**LS**	**71,333**	**8,895**	**80,228**

2.7.1 CONSTRUCTION FY 2017	**LS**	**71,333**	**8,895**	**80,228**
(Note: Escalation Cost Index 4Q17 = 807.03, 3Q10 = 717.58; Esc = 12.47%)				
2.7.1.1 EcoSystem Restoration Monitoring Fiscal Year 2017	**LS**	**71,333**	**8,895**	**80,228**
2.7.1.1.1 USR Monitoring	LS	71,333	8,895	80,228
2.8 FY 2018	**LS**	**71,333**	**10,336**	**81,669**
2.8.1 CONSTRUCTION FY 2018	**LS**	**71,333**	**10,336**	**81,669**
(Note: Escalation Cost Index 4Q18 = 821.56, 3Q10 = 717.58; Esc = 14.49%)				
2.8.1.1 EcoSystem Restoration Monitoring Fiscal Year 2018	**LS**	**71,333**	**10,336**	**81,669**
2.8.1.1.1 USR Monitoring	LS	71,333	10,336	81,669

ATTACHMENT B

2010 Cost and Schedule Risk Analysis Report

This report is referenced on page 5 of the Cost Appendix

US Army Corps
of Engineers®

Chacon Creek - Flood Buyout/Recreation/Ecosystem Restoration, Laredo, Texas

Project Feasibility Study

Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Fort Worth District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

August 6, 2010

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Under the auspices of the US Army Corps of Engineers (USACE), Fort Worth District, this report presents a recommendation for the project cost and schedule contingencies for the Chacon Creek - Flood Buyout/Recreation/Ecosystem Restoration (Chacon Creek). In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated project cost.

Specific to the Chacon Creek Project, the most likely project cost (at price level) is estimated at approximately $35 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $9.5 Million, or 27%. This contingency includes $8.9 Million (25%) for cost growth potential due to risk analyzed in the baseline cost estimate and $668,000 (2%) for cost growth potential due to risk analyzed in the baseline schedule. The report, herein, reflects the raw result of 26.92% contingency.

Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies for the project. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$35,470,003**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$33,958,611	-4.26%
50%	$41,128,027	15.95%
80%	**$45,017,030**	**26.92%**
95%	$55,532,976	56.56%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

CHACON CREEK		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	15,166	4,082	19,248
14	RECREATION FACILITIES	6,687	1,800	8,487
18	CULTURAL RESOURCE PRESERVATION	10,340	2,784	13,124
30	PLANNING, ENGINEERING AND DESIGN	1,639	441	2,080
31	CONSTRUCTION MANAGEMENT	1,638	440	2,078
	TOTAL PROJECT COSTS	**35,470**	**9,547**	**45,017**
	Schedule Completion with Contingency	**30 Jun 2018**	**50 months**	**11 Sep 2022**

Notes:
1) Costs include all contingencies, supported by a risk analysis
2) Costs exclude O&M and Life Cycle Cost estimates

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis are Risks PPM-6 (Unplanned Work That Must Be Accommodated), CA-1 (Acquisition Strategy is Incomplete), and CA-2 (Numerous Separate Contracts), which together contribute nearly 90 percent of the statistical cost variance.

The key schedule risk drivers identified through sensitivity analysis are Risks PPM-6 (Unplanned Work That Must Be Accommodated), CA-1 (Acquisition Strategy is Incomplete), and CA-2 (Numerous Separate Contracts), which together contribute 52 percent of the statistical cost variance.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Fort Worth District, this report presents a recommendation for the project cost and schedule contingencies for the Chacon Creek - Flood Buyout/Recreation/Ecosystem Restoration Project.

2.0 BACKGROUND

The Chacon Creek - Flood Buyout/Recreation/Ecosystem Restoration Project Recommended Plan is the result of combining the recommended NED plan (alternative 5 - addresses flooding and recreation) and the recommended NER plan (alternative 6 - addresses ecosystem restoration).

The NED plan will help alleviate the risk of flooding in an area known to have had significant events in recent years and provide additional recreational amenities. The flooding events are alleviated by a Real Estate buyout plan. The homes and other property impacted by the buyout generally require demolition of wood framed houses, driveways and the associated utility service lines.

The Ecosystem Restoration portion of the Recommended Plan will restore three wetland sites totaling 16.75 acres. It includes riparian measures that restore 401 acres of riparian woodlands by removing buffel grass and salt cedar trees. The salt cedar stumps will be treated with herbicides to prevent re-growth. Native trees and grass species will be planted and irrigated until the plants are established. Riparian measures require land purchases which is within the 01 Real Estate account. The riparian measures also include constructing weirs and riffles (water ponding structures constructed to appear as natural formations) across the creek channel. Additional riparian measures include the removal of some debris and a concrete barrier.

As a part of this effort, Fort Worth District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the most likely Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Fort Worth District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Dx. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering Dx.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering Dx assembled a team, also relying on local Fort Worth District staff to further augment labor, expertise and information gathering. The Cost Engineering Dx cost engineer facilitated a risk identification and qualitative analysis meeting via teleconference and web meeting with the Fort Worth on January 21, 2010. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. The cost and schedule risk models were completed and results reported on March 17, 2010.

Subsequent revisions to the estimate occurred, requiring revisions to the CSRA. The resulting risk models were completed and results reported on August 6, 2010.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

Formal PDT meetings are held for the purposes of identifying and assessing risk factors. The meetings should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/Program managers
- Contracting/acquisition
- Real Estate
- Relocations
- Environmental
- Civil and Coastal Design

- Cost and schedule engineers
- Construction
- Key Sponsors

The initial formal meetings should focus primarily on risk factor identification using brainstorming techniques, but also include some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings should focus primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings are conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT’s risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team’s decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the with- and without-project conditions at Chacon Creek.

a. The MII MCACES (Micro-Computer Aided Cost Estimating Software) file “7ChaconCreek_DrCheckCompliance_BuyoutFloodRec&EcoSystem_3Feb10.mlp” was the basis for the cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. The schedule was analyzed for impact to the project cost in terms of “Hotel” costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay) only, as this project location is not susceptible to uncaptured escalation above the national average (allowed and projected by OMB).

d. Per the data in the estimate, the FOOH amount for the Contract Cost comprises approximately 3.57% of the Project Cost at Baseline. Thus, the assumed “Hotel” rate for this project is 3.57%. For the P80 schedule, this comprises approximately 2% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list" for further monitoring and evaluation.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $9.5 Million at the P80 confidence level (27% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 16% and 57% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Total Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$35,470,000	$5,658,000	15.95%
80% Confidence Level			
Project Cost	$35,470,000	$9,547,000	26.92%
100% Confidence Level			
Project Cost	$35,470,000	$20,063,000	56.56%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to total project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 3 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 50 months based on the P80 level of confidence. These contingencies were used to calculate the projected "Hotel" cost impact of project delays that are included in the Table 1 presentation of cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected "Hotel" costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)	Contingency (%)
50% Confidence Level			
Total Project Duration	90	40	45%
80% Confidence Level			
Total Project Duration	90	50	56%
100% Confidence Level			
Total Project Duration	90	78	86%

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 3.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

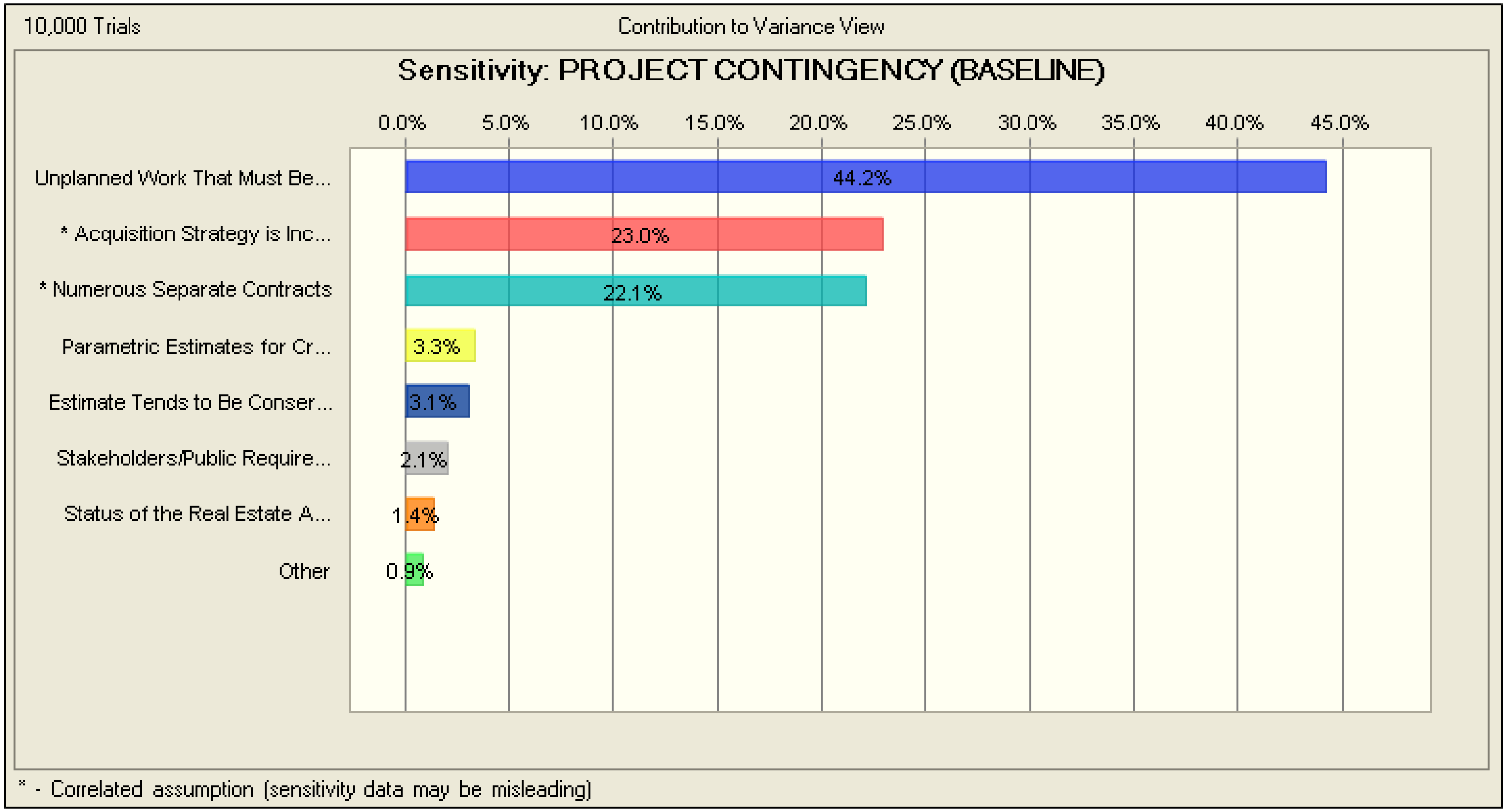
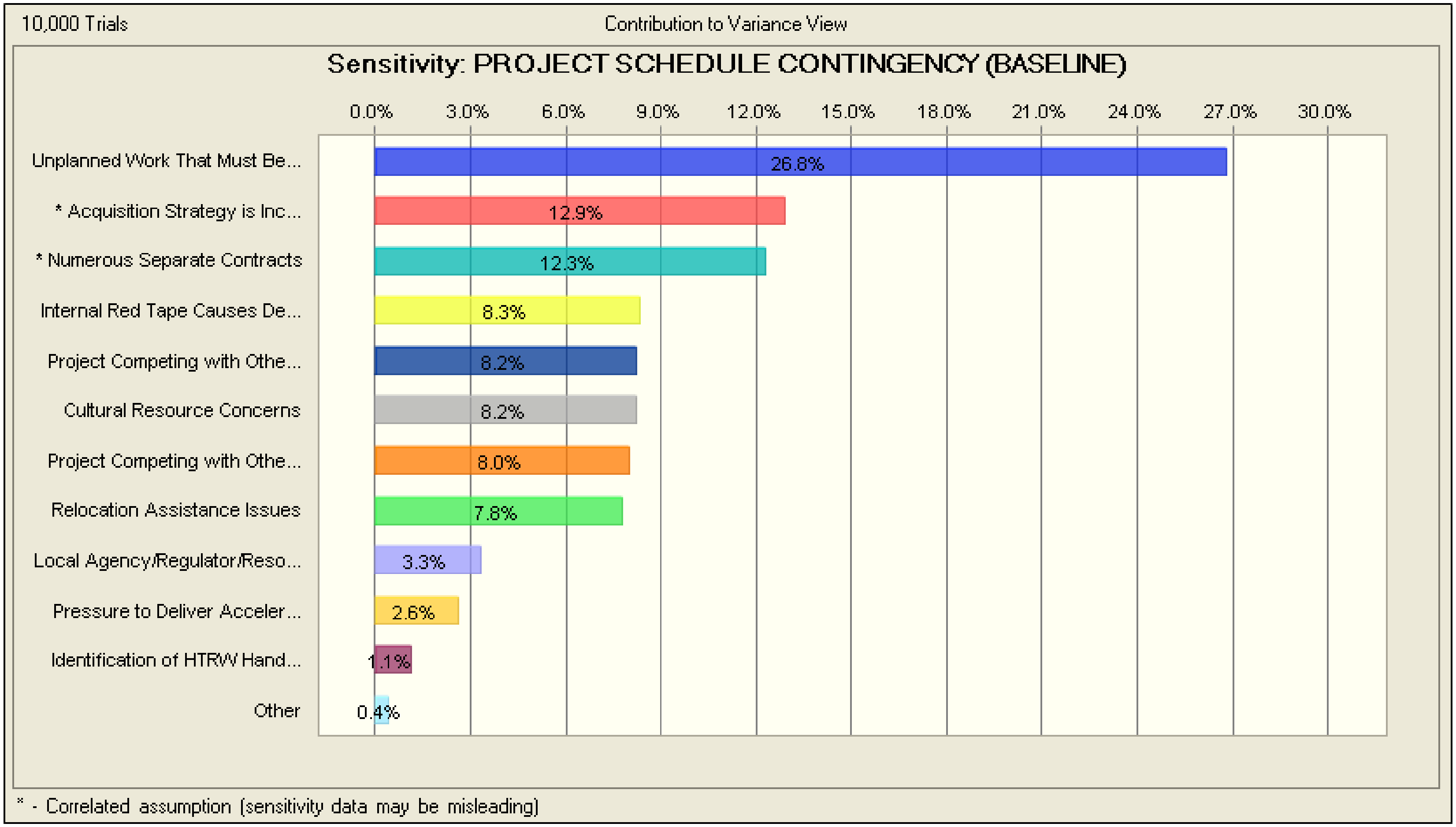


Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 4 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis are Risks PPM-6 (Unplanned Work That Must Be Accommodated), CA-1 (Acquisition Strategy is Incomplete), and CA-2 (Numerous Separate Contracts), which together contribute nearly 90 percent of the statistical cost variance.

2. The key schedule risk drivers identified through sensitivity analysis are Risks PPM-6 (Unplanned Work That Must Be Accommodated), CA-1 (Acquisition Strategy is Incomplete), and CA-2 (Numerous Separate Contracts), which together contribute 52 percent of the statistical cost variance.

3. The schedule was not resource loaded and contains open-ended tasks, and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected “Hotel” costs. Resource impacts related to potential schedule delays could not be evaluated.

4. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$28,670,311**	**-19.17%**
P5	**$33,958,611**	**-4.26%**
P10	**$35,376,561**	**-0.26%**
P15	**$36,372,231**	**2.54%**
P20	**$37,187,997**	**4.84%**
P25	**$37,913,115**	**6.89%**
P30	**$38,624,886**	**8.89%**
P35	**$39,325,242**	**10.87%**
P40	**$39,975,613**	**12.70%**
P45	**$40,512,255**	**14.22%**
P50	**$41,128,027**	**15.95%**
P55	**$41,720,866**	**17.62%**
P60	**$42,285,144**	**19.21%**
P65	**$42,886,910**	**20.91%**
P70	**$43,575,090**	**22.85%**
P75	**$44,231,640**	**24.70%**
P80	**$45,017,030**	**26.92%**
P85	**$45,943,172**	**29.53%**
P90	**$47,086,467**	**32.75%**
P95	**$48,766,929**	**37.49%**
P100	**$55,532,976**	**56.56%**

Figure 3. Project Cost Summary

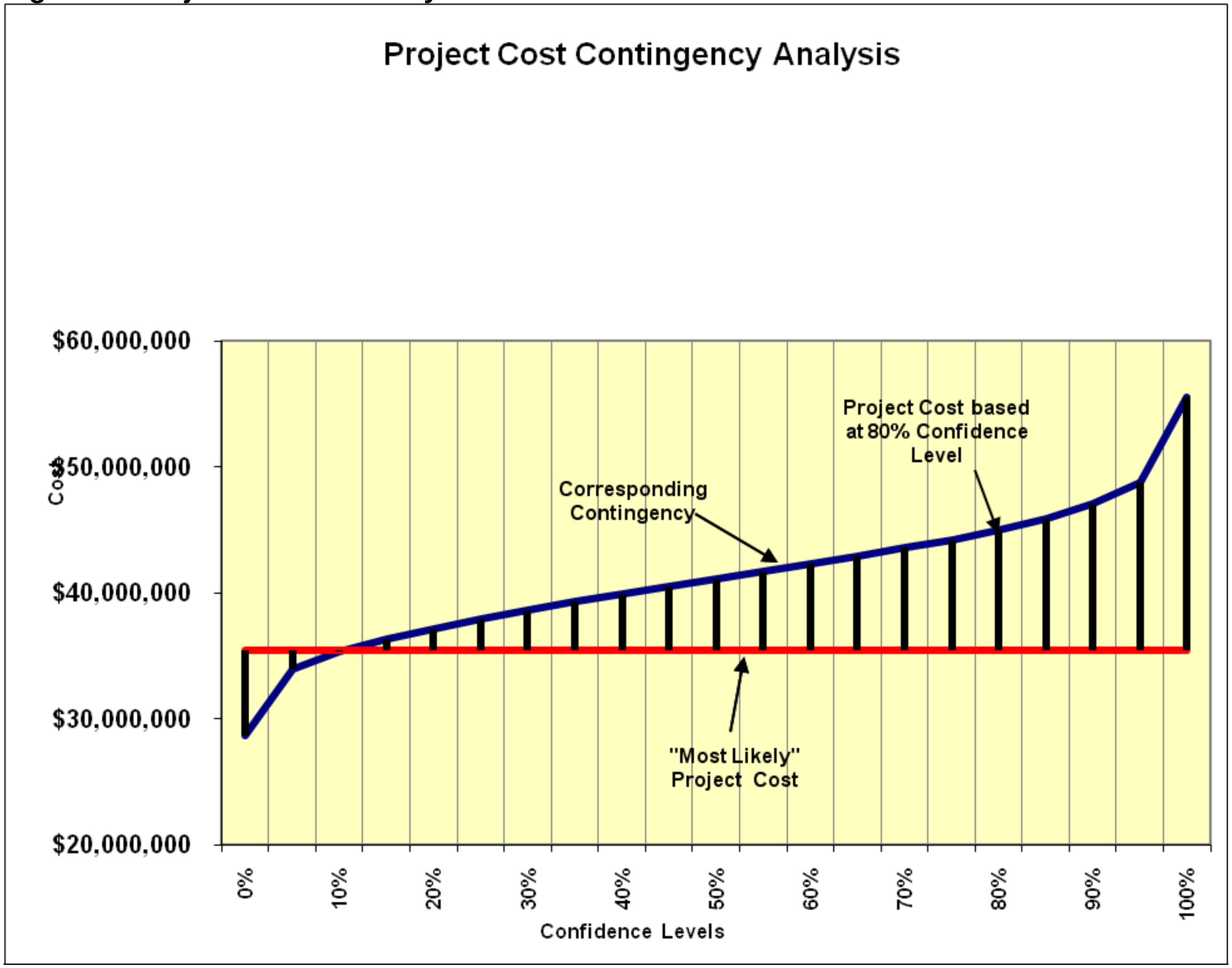
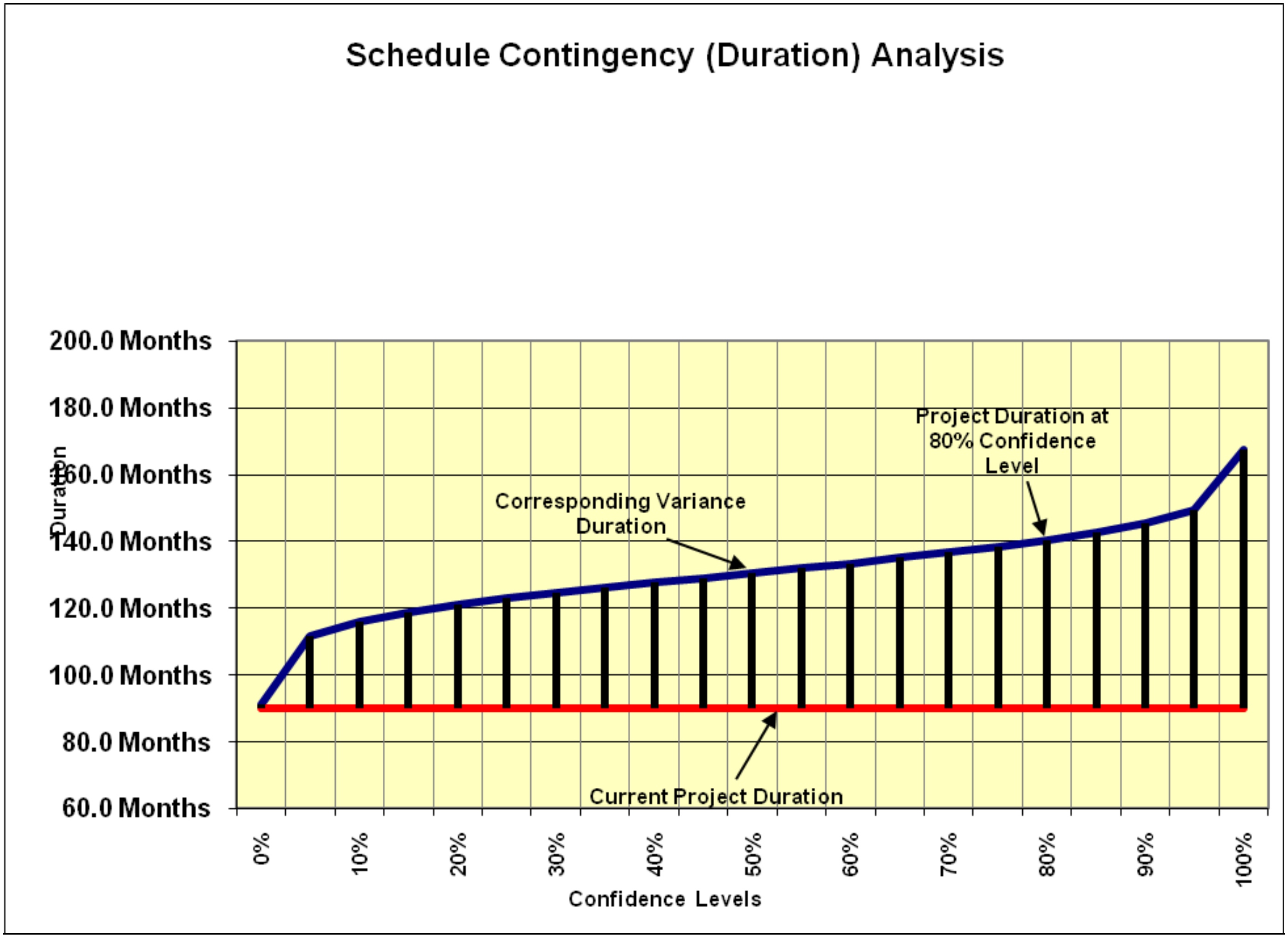


Figure 4. Project Duration Summary



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all-inclusive.

1. Key Cost and Schedule Risk Drivers: The key cost and schedule risk drivers identified through sensitivity analysis are Risks PPM-6 (Unplanned Work That Must Be Accommodated), CA-1 (Acquisition Strategy is Incomplete), and CA-2 (Numerous Separate Contracts), which together contribute nearly 90 percent of the statistical cost variance and 52 percent of the statistical schedule variance.

a) Unplanned Work That Must Be Accommodated: With respect to Unplanned Work That Must Be Accommodated (Risk PPM-6), Cost Dx recommends that project leadership attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies prior to project authorization, continuing to refine scoping details during the Pre-Construction Engineering and Design (PED Phase). Cost Dx also recommends proactive project management with respect to the schedule and the timeline for budget approval and disbursement of project funds. Changes to the anticipated timeline with respect to schedule should be controlled and reported to management for expeditious schedule recovery efforts. Ultimately, an amount and duration for this issue should be included and protected within the contingency and/or management reserve.

b) Acquisition Strategy is Incomplete: With respect to Acquisition Strategy is Incomplete (Risk CA-1), Cost Dx recommends proactive measures to obtain decisions regarding acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance. Project leadership should develop the acquisition strategy to maximize competition and cost control, so that current working estimates can capture the probable costs and schedule durations.

c) Numerous Separate Contracts: With respect to Numerous Separate Contracts (Risk CA-2), Cost Dx recommends proactive measures to obtain decisions regarding acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance. Project leadership should develop the acquisition strategy to maximize competition and cost control, so that current working estimates can capture the probable costs and schedule durations. The number and type of contracts is related to acquisition strategy and also the ultimate funding situation. Thus, ultimately, an amount and duration for this issue should be included and protected within the contingency and/or management reserve.

2. Risk Management: Cost Engineering Dx recommends use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

3. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

Chacon Creek Feasibility Study - PDT Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Overall Project Scope
The Chacon Creek - Flood Buyout/Recreation/EcoSystem Restoration Project Recommended Plan is the result of combining the recommended NED plan (alternative 5 - addresses flooding and recreation) and the recommended NER plan (alternative 6 - addresses ecosystem restoration).

Cost Impacts
For the Chacon Creek Project, any cost impact of $500,000 or higher should be considered at least "Significant." Anything over $200,000 should be considered at least "Marginal."

Schedule Impacts
For the Chacon Creek Project, any schedule impact of 6 months or greater should be considered at least "Significant." Anything over 1 month should be considered at least "Marginal."

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	Internal Red Tape Causes Delay Getting Approvals & Decisions	The PDT currently has a recommended plan. The configuration could change based on the results of higher level review processes.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.7 Months	Uniform		Project Manager	Project Schedule
PPM-2	Product Development by Multiple Sources	The sponsor is using their own resources for the design and contracting of the recreation components.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	PPM-8	Project Manager	Project Cost & Schedule
PPM-3	Project Competing with Other Projects	Project is a high priority in the District. However, there are other larger projects in the District that are also high priority. The other larger value projects tend to obtain resources more readily.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.6 Months	Yes-No		District Management	Project Schedule
PPM-4	Insufficient Time to Plan	The PDT has expressed that the project study has been accelerated, and there is some potential for some configuration issues arising from insufficient time to plan.	If there are significant modifications required to the plan (per historical experience), it could leave the PDT with insufficient time to plan for the new configuration. Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Likely	Marginal	Moderate	1.6 Months	Triangular		District Management	Project Schedule
PPM-5	Pressure to Deliver Accelerated Schedule	PDT needs a Chief's Report by December 2010 (WRDA in FY 2010) - contingent authorization. Otherwise, would need the Chief's Report by June 2010.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	-1.2 Months	Uniform		District Management	Project Schedule
PPM-6	Unplanned Work That Must Be Accommodated	There may be some additional scope required (most likely for the study), due to new requirements and regulations, etc.	This could significantly impact cost and schedule issues.	Unlikely	Significant	Moderate	$5,000,000	Unlikely	Significant	Moderate	10.9 Months	Uniform		District Management	Project Cost & Schedule
PPM-7	Local Agency/Regulator/Resource Agency Issues	There are other agencies that are involved, such as FWS, TCEQ, TPWD, etc. that are contributing to the decisions/coordination. Not obtaining decisions and the necessary coordination and documents in a timely fashion could impact the project.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Likely	Significant	High	5.0 Months	Triangular		Project Manager	Project Schedule
PPM-8	Coordination/Communication Difficulties	PDT is communicating well internally. However, this has been an issue with external and public communications.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	PPM-2	Project Manager	Project Schedule
	CONTRACT ACQUISITION RISKS														
CA-1	Acquisition Strategy is Incomplete	The PDT has as strategy. However, there is no consensus and decision as to the actual acquisition deliver at this time. It is likely that some of the contracts would be performed by small businesses or 8(a)s.	Could affect cost and schedule.	Likely	Significant	High	$3,000,000	Unlikely	Significant	Moderate	3.7 Months	Triangular	CA-2	TASB	Contract Cost & Project Schedule
CA-2	Numerous Separate Contracts	The current estimate is reflecting one contract. The PDT has acknowledged that the project will likely be performed by several separate contracts (potentially small businesses).	Could affect cost and schedule.	Likely	Significant	High	$3,000,000	Likely	Marginal	Moderate	5.0 Months	Triangular	CA-1	Contracting	Contract Cost & Project Schedule
	TECHNICAL RISKS														
TL-1	Identification of HTRW Handling Requirements	There is some uncertainty as to whether the percentage estimated for houses requiring special handling requirements during demolition. There are 62 structures (10 estimated with asbestos).	Could affect costs (positively or negatively).	Likely	Significant	High	$500,000	Likely	Marginal	Moderate	2.2 Months	Yes-No		Environmental Compliance	Project Cost & Schedule
TL-2	Sufficiency of As-Built Data	The PDT acknowledges that there are some utility relocation and conflict issues, and there is not confidence in the existing as-built data.	Could affect cost, but likely would not be high impact.	Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost & Project Schedule
	LANDS AND DAMAGES RISKS														

	OPPORTUNITY														
LD-1	Status of the Real Estate Acquisition	The project consists of 50% RE cost for the ER component (whereas the regulations indicated 25%). The real estate estimate is currently being revised. The PDT originally included costs for the worse case scenario. However, it has been determined that the City already owns more of the property than originally contemplated.	This is a significant opportunity for cost savings.	Very Likely	Significant	High	($400,000)	Very Unlikely	Negligible	Low	Low - Not Studied				
LD-2	Relocation Assistance Issues	The demographics of the Laredo area may introduce factors (specific to relocation assistance requirements -- "housing of last resort") that will cause variance in the cost of the relocations associated with the buyout.	This could affect cost and schedule.	Likely	Marginal	Moderate	$126,000	Likely	Significant	High	9.7 Months	Yes-No		Real Estate	Project Schedule
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-1	Cultural Resource Concerns	The PDT has not completed the SHPO compliance surveys in all areas. PDT has not received the section 106 compliance yet.	PDT does not believe that there are any major issues relating to cultural resources. Could impact cost and schedule.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.6 Months	Yes-No		Environmental Compliance	Project Schedule
RE-2	Adaptive Management Features	There is currently no monitoring plan developed. PDT acknowledges that there will be consideration for adaptive management features.	Could impact the costs.	Likely	Marginal	Moderate	$116,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Environmental Compliance	Project Cost
	CONSTRUCTION RISKS														
CON-1	Material Availability and Delivery	There is a substantial amount of planting of trees involved. If there was a scarcity or shortage, this could lead to increased costs or schedule delays.	This could impact cost and schedule.	Likely	Marginal	Moderate	$155,000	Unlikely	Marginal	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
CON-2	Survey Information	The PDT does not have surveys completed for the area. This could lead to some impacts to the construction costs.	This could impact costs.	Likely	Marginal	Moderate	$142,000	Likely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost
CON-3	Consideration for Standard Weather Impact	The area is arid, but susceptible to hurricanes and flooding. Also, area is susceptible to fires.	Could impact schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Likely	Negligible	Low	Low - Not Studied	Triangular		Construction	Project Schedule
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Parametric Estimates for Critical Features	Currently, the estimate reflects some parametric estimates for critical features. At some point, the estimate will have to be convert to a more detailed breakdown of costs and level of effort.	Could have some impact on cost and schedule.	Likely	Significant	High	$1,250,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
EST-2	Availability of Skilled Trades Labor	PDT has mentioned concern that some of the workforce would likely come from outside the area, necessitating payment of per diem and premium pay.	Could affect the costs.	Likely	Marginal	Moderate	$830,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
EST-3	Contracting/Subcontracting Configuration	Based on whether or not MATOC or similar contract mechanisms are utilized, this could produce multiple layers of contractor/subcontractor markups and other considerations.	Could affect the costs.	Likely	Marginal	Moderate	Not Studied - Captured by CA-2	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
	OPPORTUNITY														
EST-4	Estimate Tends to Be Conservative	This presents the potential for substantial savings for certain components of the project.	Could positively affect the costs.	Likely	Significant	High	($370,000)	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Project Cost
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
PR-1	Stakeholders/Public Require Scope Changes	After PDT takes the package to the public, new work or scope changes are required.	Could impact cost and schedule. PDT feels that this is likely to occur with one amenity (specific to the trail).	Likely	Significant	High	$1,550,000	Likely	Negligible	Low	Low - Not Studied	Uniform		Project Manager	Project Cost
PR-2	Political Factors at Local and Federal Level Cause Impacts	The PDT has expressed concern over the impact at the local (City) level regarding the project. At the Federal level, there is less support for recreation projects.	Could impact cost and schedule.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Uniform		Project Manager	Project Cost & Schedule
PR-3	Project Competing with Other Projects at National Level	This project is also competing with other projects at the national level at HQ in the same funding cycle.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Likely	Marginal	Moderate	9.6	Yes-No		Project Manager	Project Schedule
PR-4	Severe Weather Impact	Historically, this area has been susceptible to both severe droughts as well as hurricanes and wildfires.	Could affect the cost and schedule.	Likely	Negligible	Low	Low - Not Studied	Likely	Negligible	Low	Low - Not Studied	Triangular		N/A	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Chacon Creek Feasibility Study - Cost and Schedule Risk Analysis

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$35,470,003**
Baseline Estimate Cost Contingency Amount ->	$8,879,475
Baseline Estimate Construction Cost (80% Confidence) ->	**$44,349,478**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**90.0 Months**
Schedule Contingency Duration ->	50.4 Months
Project Schedule Duration (80% Confidence) ->	**140.4 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$667,552**

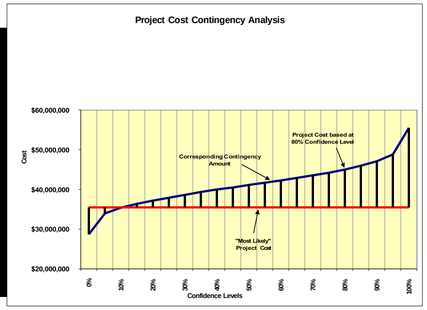
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$9,547,027**
Project Contingency Percentage (80% Confidence) ->	**27%**

Project Cost (80% Confidence) ->	**$45,017,030**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

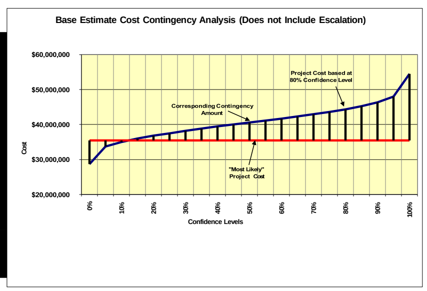
Most Likely Cost Estimate	$35,470,003	
Confidence Level	**Value**	**Contingency**
0%	**$28,670,311**	**-19.17%**
5%	**$33,958,611**	**-4.26%**
10%	**$35,376,561**	**-0.26%**
15%	**$36,372,231**	**2.54%**
20%	**$37,187,997**	**4.84%**
25%	**$37,913,115**	**6.89%**
30%	**$38,624,886**	**8.89%**
35%	**$39,325,242**	**10.87%**
40%	**$39,975,613**	**12.70%**
45%	**$40,512,255**	**14.22%**
50%	**$41,128,027**	**15.95%**
55%	**$41,720,866**	**17.62%**
60%	**$42,285,144**	**19.21%**
65%	**$42,886,910**	**20.91%**
70%	**$43,575,090**	**22.85%**
75%	**$44,231,640**	**24.70%**
80%	**$45,017,030**	**26.92%**
85%	**$45,943,172**	**29.53%**
90%	**$47,086,467**	**32.75%**
95%	**$48,766,929**	**37.49%**
100%	**$55,532,976**	**56.56%**

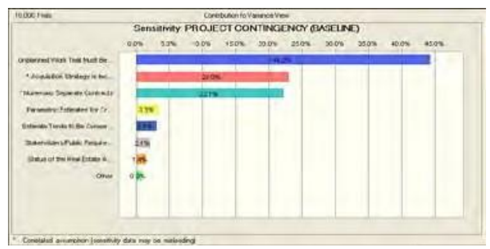


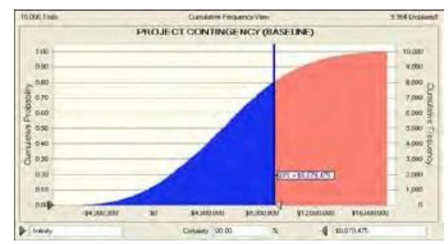
- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$35,470,003	
Confidence Level	**Value**	**Contingency**
0%	**$28,656,240**	**-19.21%**
5%	**$33,670,489**	**-5.07%**
10%	**$35,030,985**	**-1.24%**
15%	**$35,994,088**	**1.48%**
20%	**$36,778,170**	**3.69%**
25%	**$37,477,061**	**5.66%**
30%	**$38,165,435**	**7.60%**
35%	**$38,845,532**	**9.52%**
40%	**$39,477,251**	**11.30%**
45%	**$39,995,509**	**12.76%**
50%	**$40,592,687**	**14.44%**
55%	**$41,164,961**	**16.06%**
60%	**$41,709,538**	**17.59%**
65%	**$42,289,771**	**19.23%**
70%	**$42,955,894**	**21.10%**
75%	**$43,590,086**	**22.89%**
80%	**$44,349,478**	**25.03%**
85%	**$45,245,274**	**27.56%**
90%	**$46,351,576**	**30.68%**
95%	**$47,978,778**	**35.27%**
100%	**$54,506,003**	**53.67%**



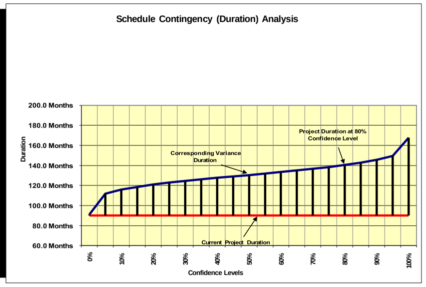


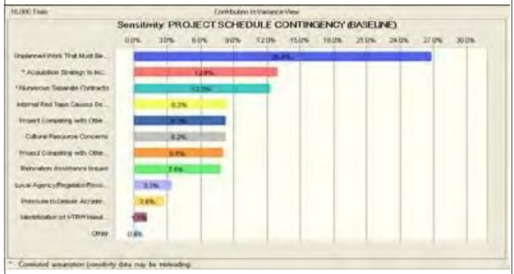


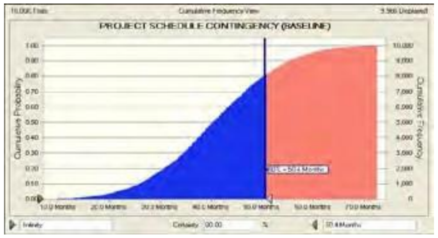
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

Most Likely Schedule	90.0 Months	
Confidence Level	Value	Contingency
0%	91.0 Months	1.18%
5%	111.7 Months	24.19%
10%	116.1 Months	29.01%
15%	118.5 Months	31.75%
20%	120.9 Months	34.41%
25%	122.9 Months	36.61%
30%	124.7 Months	38.58%
35%	126.2 Months	40.28%
40%	127.6 Months	41.84%
45%	129.0 Months	43.39%
50%	130.4 Months	44.95%
55%	132.0 Months	46.67%
60%	133.5 Months	48.33%
65%	135.1 Months	50.14%
70%	136.7 Months	51.99%
75%	138.4 Months	53.87%
80%	140.4 Months	56.05%
85%	142.7 Months	58.60%
90%	145.5 Months	61.70%
95%	149.5 Months	66.17%
100%	167.6 Months	86.23%



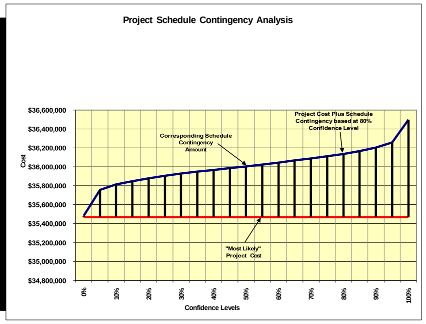




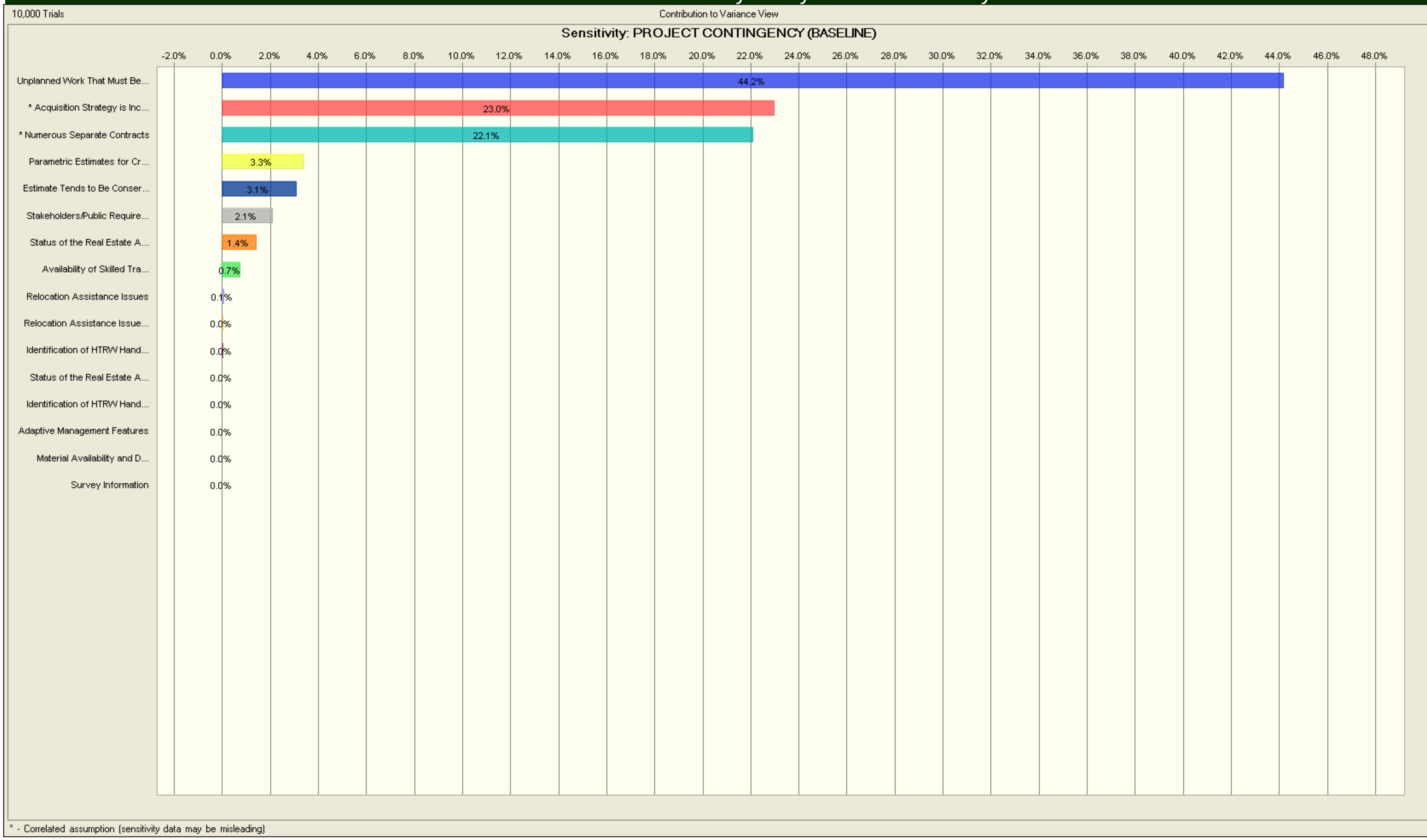
- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$35,470,003	
Confidence Level	Value	Contingency
0%	$14,071	0.04%
5%	$288,122	0.81%
10%	$345,576	0.97%
15%	$378,143	1.07%
20%	$409,828	1.16%
25%	$436,054	1.23%
30%	$459,451	1.30%
35%	$479,710	1.35%
40%	$498,362	1.41%
45%	$516,746	1.46%
50%	$535,339	1.51%
55%	$555,905	1.57%
60%	$575,606	1.62%
65%	$597,139	1.68%
70%	$619,196	1.75%
75%	$641,554	1.81%
80%	$667,552	1.88%
85%	$697,899	1.97%
90%	$734,891	2.07%
95%	$788,151	2.22%
100%	$1,026,973	2.90%



Chacon Creek Feasibility Study - Cost Risk Analysis

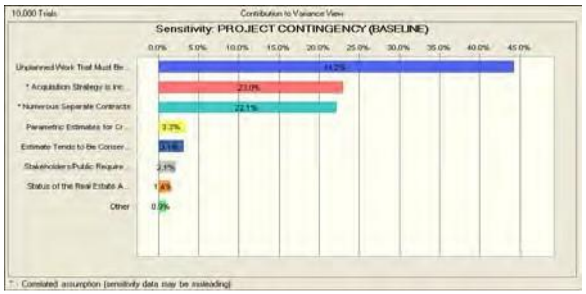


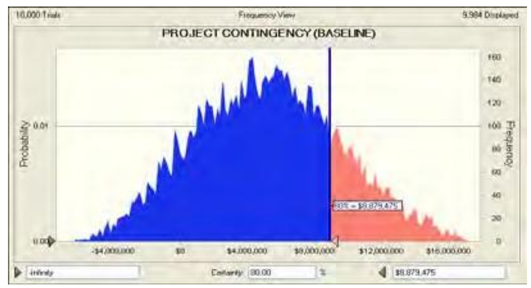
Chacon Creek Feasibility Study - Cost Risk Analysis Model

		Project Cost					Crystal Ball Simulation Expected Values ($$$)				Crystal Ball Simulation Expected Values (%s)				
Risk No.	Risk/Opportunity Event	Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Low	Most Likely	High		Low	Most Likely	High		
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
PROJECT & PROGRAM MGMT															
PPM-6	Unplanned Work That Must Be Accommodated	Unlikely	Significant	Moderate	Uniform		($3,547,000)	$0	$7,094,001		-10.00%	0.00%	20.00%		
CONTRACT ACQUISITION RISKS															
CA-1	Acquisition Strategy is Incomplete	Likely	Significant	High	Triangular	CA-2	($933,030)	$0	$5,598,179		-2.63%	0.00%	15.78%		
CA-2	Numerous Separate Contracts	Likely	Significant	High	Triangular	CA-1	$0	$0	$5,490,409		0.00%	0.00%	15.48%		
TECHNICAL RISK															
TL-1	Identification of HTRW Handling Requirements	Likely	Significant	High	Yes-No/Uniform		$0	$0	$581,828		0.00%	0.00%	1.64%	0	0
LANDS AND DAMAGES RISKS															
	OPPORTUNITY										0.00%	0.00%	0.00%		
LD-1	Status of the Real Estate Acquisition	Very Likely	Significant	High	Yes-No/Uniform		($2,000,000)	$0	$0		-5.64%	0.00%	0.00%	0	0
LD-2	Relocation Assistance Issues	Likely	Marginal	Moderate	Yes-No/Triangular		($139,500)	$0	$279,000		-0.39%	0.00%	0.79%	0	0
REGULATORY AND ENVIRONMENTAL RISKS															
RE-2	Adaptive Management Features	Likely	Marginal	Moderate	Triangular		$0	$0	$208,100		0.00%	0.00%	0.59%		
CONSTRUCTION RISKS															
CON-1	Material Availability and Delivery	Likely	Marginal	Moderate	Triangular		($60,906)	$0	$304,532		-0.17%	0.00%	0.86%		
CON-2	Survey Information	Likely	Marginal	Moderate	Triangular		$0	$0	$258,496		0.00%	0.00%	0.73%		
ESTIMATE AND SCHEDULE RISKS															
EST-1	Parametric Estimates for Critical Features	Likely	Significant	High	Triangular		($1,866,060)	$0	$2,799,090		-5.26%	0.00%	7.89%		
EST-2	Availability of Skilled Trades Labor	Likely	Marginal	Moderate	Triangular		$0	$0	$1,500,920		0.00%	0.00%	4.23%		
EST-3	Contracting/Subcontracting Configuration	Likely	Marginal	Moderate						***This risk is captured by Risk CA-2***					
	OPPORTUNITY										0.00%	0.00%	0.00%		
EST-4	Estimate Tends to Be Conservative	Likely	Significant	High	Triangular		($3,547,000)	$0	$0		-10.00%	0.00%	0.00%		
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-1	Stakeholders/Public Require Scope Changes	Likely	Significant	High	Uniform		($516,991)	$0	$2,067,964		-1.46%	0.00%	5.83%		
										Not Part of Study - Placeholder for Project Summation Purposes Only					
								$0							

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

PROJECT CONTINGENCY (BASELINE)	Percentile	Baseline TPC	Contingency	Baseline w/ Contingency	Contingency %
	0%	$35,470,003	($6,813,763)	$28,656,240	-19.21%
	5%	$35,470,003	($1,799,514)	$33,670,489	-5.07%
	10%	$35,470,003	($439,018)	$35,030,985	-1.24%
	15%	$35,470,003	$524,085	$35,994,088	1.48%
	20%	$35,470,003	$1,308,167	$36,778,170	3.69%
	25%	$35,470,003	$2,007,058	$37,477,061	5.66%
	30%	$35,470,003	$2,695,432	$38,165,435	7.60%
	35%	$35,470,003	$3,375,529	$38,845,532	9.52%
	40%	$35,470,003	$4,007,248	$39,477,251	11.30%
	45%	$35,470,003	$4,525,506	$39,995,509	12.76%
	50%	$35,470,003	$5,122,684	$40,592,687	14.44%
	55%	$35,470,003	$5,694,958	$41,164,961	16.06%
	60%	$35,470,003	$6,239,535	$41,709,538	17.59%
	65%	$35,470,003	$6,819,768	$42,289,771	19.23%
	70%	$35,470,003	$7,485,891	$42,955,894	21.10%
	75%	$35,470,003	$8,120,083	$43,590,086	22.89%
	80%	$35,470,003	$8,879,475	$44,349,478	25.03%
	85%	$35,470,003	$9,775,271	$45,245,274	27.56%
	90%	$35,470,003	$10,881,573	$46,351,576	30.68%
	95%	$35,470,003	$12,508,775	$47,978,778	35.27%
	100%	$35,470,003	$19,036,000	$54,506,003	53.67%





Chacon Creek Feasibility Study - Cost Risk Analysis Model

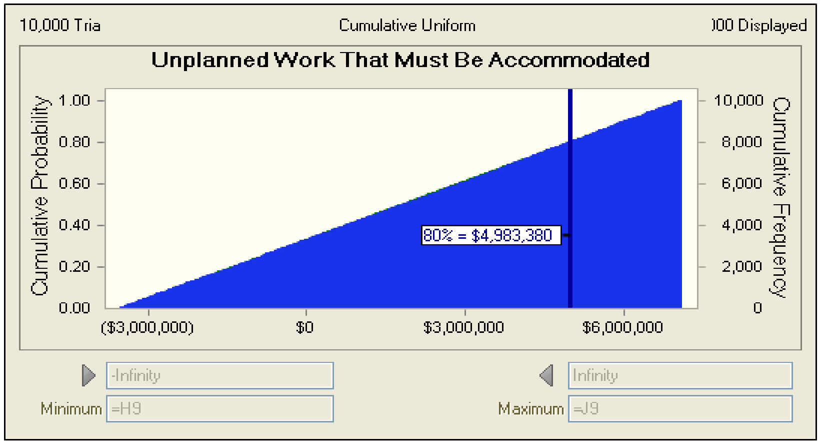
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-6	Unplanned Work That Must Be Accommodated	($3,547,000)	$0	$7,094,001

Notes: This item captures the risk that unplanned work will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that the scope may decrease by up to 10%, resulting in a 10% reduction in project cost.

High High assumes that the scope may increase by up to 20%, resulting in a 20% increase in project cost.



Assumption: **Unplanned Work That Must Be Accommodated**

Percentile	Assumption values
0%	($3,545,306)
10%	($2,514,753)
20%	($1,391,713)
30%	($345,317)
40%	$744,939
50%	$1,812,104
60%	$2,892,853
70%	$3,926,677
80%	$4,983,380
90%	$5,993,192
100%	$7,093,619

Chacon Creek Feasibility Study - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CA-1	Acquisition Strategy is Incomplete	($933,030)	$0	$5,598,179

Notes: This item captures the risk that the ultimate acquisition strategy plan will cause a variance from the current baseline estimate.

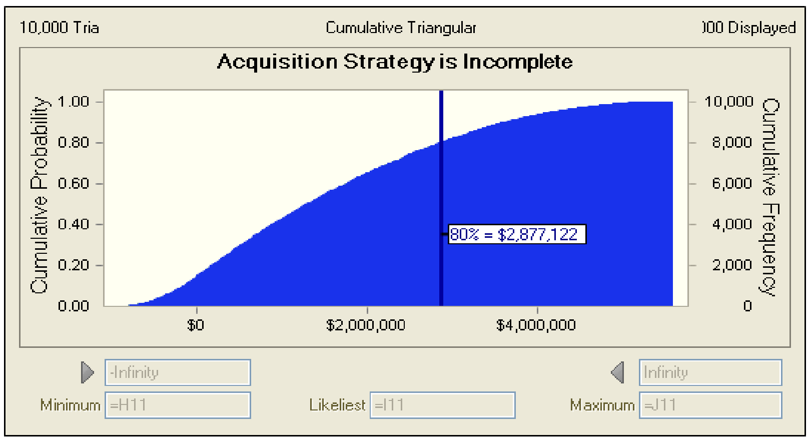
Likely Likely assumes no change from the baseline estimate.

Low Low assumes that the acquisition plan will lead to more favorable prices for demolition and ER construction than anticipated, reducing the costs of the buyout plan and the ER by up to 5%.

High

High assumes that the acquisition plan will lead to less favorable costs for demolition and ER construction than anticipated (due to the letting of more contracts, the use of 8(a)s and small businesses, etc.), increasing the costs of the buyout plan and the ER by up to 30%.

	Likely	Best Case	Worst Case
NON-STRUCTURAL BUYOUT PLAN (Demo)	$8,320,775.00	$7,904,736.25	$10,817,007.50
EcoSystem Restoration	$10,339,822.00	$9,822,830.90	$13,441,768.60
Total	$18,660,597.00	$17,727,567.15	$24,258,776.10
Difference	**$0.00**	**($933,029.85)**	**$5,598,179.10**



Assumption: **Acquisition Strategy is Incomplete**

Percentile	Assumption values	
0%	($885,011)	
10%	($153,498)	
20%	$188,389	
30%	$525,532	
40%	$901,564	
50%	$1,308,434	
60%	$1,769,964	
70%	$2,289,785	
80%	$2,877,122	
90%	$3,639,463	
100%	$5,552,099	

Chacon Creek Feasibility Study - Cost Risk Analysis Model

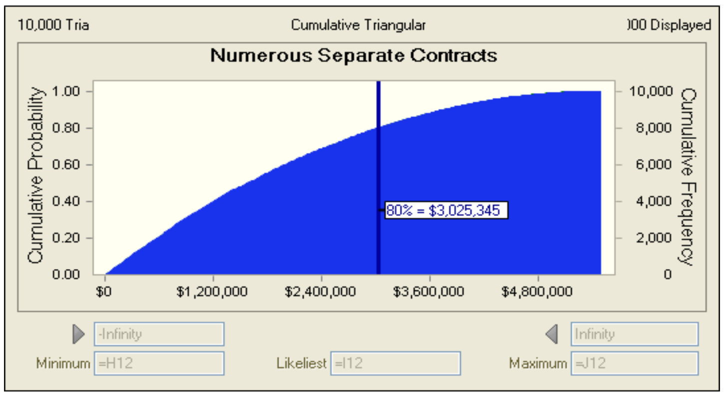
Risk Refer No.	Risk Event	Low	Most Likely	High
CA-2	Numerous Separate Contracts	$0	$0	$5,490,409

Notes: This item captures the risk that the letting of numerous separate contracts will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that numerous separate contracts would make it very likely that more 8(a)s and small businesses would perform the demolition and construction, leading to markups potentially on the higher end of ROTs. Also, several separate contracts could double the cost of engineering and S&A costs (30 and 31 accounts). Worst case is the difference in overall contract mark up and costs of doubling the 30 and 31 accounts.



Assumption: Numerous Separate Contracts

Percentile	Assumption values
0%	$660
10%	$281,994
20%	$573,805
30%	$871,843
40%	$1,199,168
50%	$1,583,945
60%	$1,999,072
70%	$2,479,693
80%	$3,025,345
90%	$3,762,877
100%	$5,441,735

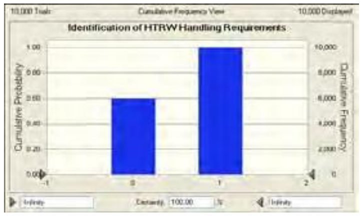
	26.5%	*25.5%*	
Current	***Own Work***	***Sub Work***	
Prime HOOH	*$250,412*	*$711,760*	
Prime JOOH	*$329,164*	*$831,646*	
Prime Profit	*$344,836*	*$971,154*	
Prime Bond	*$51,105*	*$145,257*	
Subtotal	*$975,517*	*$2,659,818*	
Total	***$3,635,335***		*$3,841,185*
	157.62%		
Worst Case (Difference)	***Own Work***	***Sub Work***	
Prime HOOH	*$346,906*	*$346,906*	
Prime JOOH	*$785,447*	*$261,816*	
Prime Profit	*$176,726*	*$176,726*	
Prime Bond	*$0*	*$0*	
Subtotal	*$1,309,078*	*$785,447*	
Total (Difference)	***$2,094,525***		*$5,729,860*
			$6,054,312
Prime HOOH	***7.35%***	***7.35%***	**$2,213,127**
Prime JOOH	***9.00%***	***8.00%***	
Prime Profit	***8.65%***	***8.65%***	
Prime Bond	***1.50%***	***1.50%***	
Total	***26.50%***	***25.50%***	
Prime HOOH	***10.00%***	***10.00%***	
Prime JOOH	***15.00%***	***10.00%***	
Prime Profit	***10.00%***	***10.00%***	
Prime Bond	***1.50%***	***1.50%***	
Total	***36.50%***	***31.50%***	

	Current	***Worst Case***
30 Account	*$1,638,641*	*$3,277,282*
31 Account	*$1,638,641*	*$3,277,282*
Total	***$3,277,282***	***$6,554,564***
Difference	***$0***	***$3,277,282***

Chacon Creek Feasibility Study - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
TL-1	Identification of HTRW Handling Requirements	$0	$0	$581,828

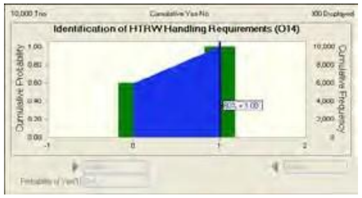
Notes: This item captures the risk that asbestos removal costs will cause a variance from the current baseline estimate.
Likely Likely assumes no change from the baseline estimate.
Low Low assumes no change from the baseline estimate.
High High assumes that half of the houses (31) require asbestos removal. The current estimate is that 10 houses will require asbestos removal.



	Likely	*Worst Case (half of the houses)*
Asbestos Removal (10 houses)	*$277,061.19*	*$858,890*
Difference	***$581,828***	

Assumption: **Identification of HTRW Handling Requirements**

Percentile	Assumption values	
0%	0	
10%	0	
20%	0	
30%	0	
40%	0	
50%	0	
60%	1	
70%	1	
80%	1	
90%	1	
100%	1	



Assumption: **Identification of HTRW Handling Requirements**

Percentile	Assumption values	
0%	0	
10%	0	
20%	0	
30%	0	
40%	0	
50%	0	
60%	1	
70%	1	
80%	1	
90%	1	
100%	1	

Assumption: **Identification of HTRW Handling Requirements**

Percentile	Assumption values	
0%	$69	
10%	$57,137	
20%	$117,442	
30%	$176,744	
40%	$236,342	
50%	$296,138	
60%	$352,290	
70%	$408,961	
80%	$468,161	
90%	$524,575	
100%	$581,781	

Risk Refer No.	Risk Event	Low	Most Likely	High
LD-1	Status of the Real Estate Acquisition	($2,000,000)	$0	$0

Notes: This item captures the risk that the ultimate real estate costs will cause a positive variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes savings of up to $2 Million (per the PDT) for real estate acquisitions based on how the city has previously acquired the land.

High High assumes no change from the baseline estimate.

Forecast: **Status of the Real Estate Acquisition**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	1
50%	1
60%	1
70%	1
80%	1
90%	1
100%	1

Assumption: **Status of the Real Estate Acquisition**

Percentile	Assumption values
0%	Assumption values
10%	0
20%	0
30%	0
40%	0
50%	1
60%	1
70%	1
80%	1
90%	1
100%	1

Assumption: **Status of the Real Estate Acquisition**

Percentile	Assumption values
0%	($1,999,859)
10%	($1,796,171)
20%	($1,594,333)
30%	($1,398,925)
40%	($1,200,613)
50%	($997,434)
60%	($800,000)
70%	($605,212)
80%	($404,863)
90%	($197,150)
100%	($73)

Chacon Creek Feasibility Study - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
LD-2	Relocation Assistance Issues	($139,500)	$0	$279,000

Notes: This item captures the risk that issues with relocation assistance (i.e. housing of last resort issues) will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that only half of the contemplated contingency (20%) will be necessary to handle the relocation costs.

High High assumes that double the current contingency rate of 20% will be necessary to cover the relocation costs.

	Likely	Best Case	Worst Case
Relocation Costs	*$1,395,000*	*$1,395,000*	*$1,395,000*
Contingency	*$279,000*	*$139,500*	*$558,000*
Total	*$1,674,000*	*$1,534,500*	*$1,953,000*
Difference	***$0***	***($139,500)***	***$279,000***

Forecast: **Relocation Assistance Issues**

Percentile	Assumption values	
0%	0	
10%	0	
20%	0	
30%	0	
40%	0	
50%	0	
60%	1	
70%	1	
80%	1	
90%	1	
100%	1	

Assumption: **Relocation Assistance Issues**

Percentile	Assumption values	
0%	0	
10%	0	
20%	0	
30%	0	
40%	0	
50%	0	
60%	1	
70%	1	
80%	1	
90%	1	
100%	1	

Assumption: **Relocation Assistance Issues**

Percentile	Assumption values	
0%	($136,372)	
10%	($63,948)	
20%	($32,256)	
30%	($9,341)	
40%	$13,861	
50%	$35,935	
60%	$61,951	
70%	$90,794	
80%	$125,733	
90%	$168,987	
100%	$276,200	

Chacon Creek Feasibility Study - Cost Risk Analysis Model

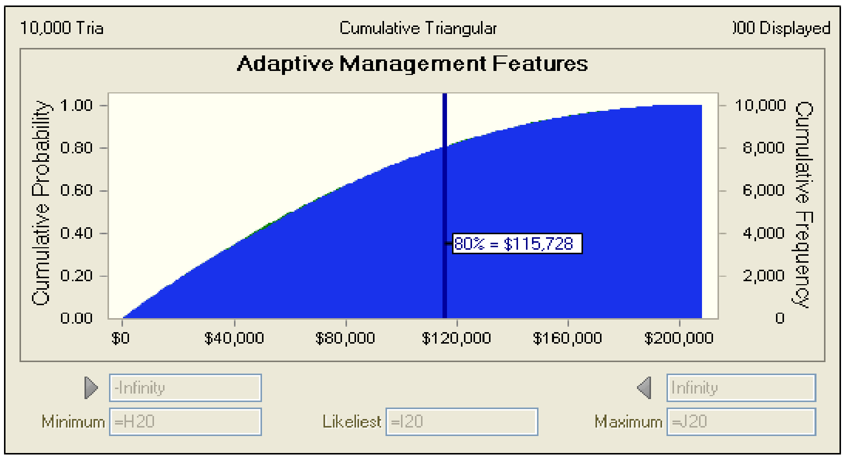
Risk Refer No.	Risk Event	Low	Most Likely	High
RE-2	Adaptive Management Features	$0	$0	$208,100

Notes: This item captures the risk that adaptive management features will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes up to 3% of the estimate for adaptive management features. There is already $856K in the project estimate for adaptive management (2.6%). The maximum this cost can increase by regulation is 0.37% (3% - 2.63%), or $208,100.



Assumption: **Adaptive Management Features**

Percentile	Assumption values
0%	$8
10%	$10,862
20%	$22,371
30%	$34,741
40%	$48,162
50%	$62,068
60%	$77,519
70%	$94,011
80%	$115,728
90%	$142,608
100%	$205,447

Chacon Creek Feasibility Study - Cost Risk Analysis Model

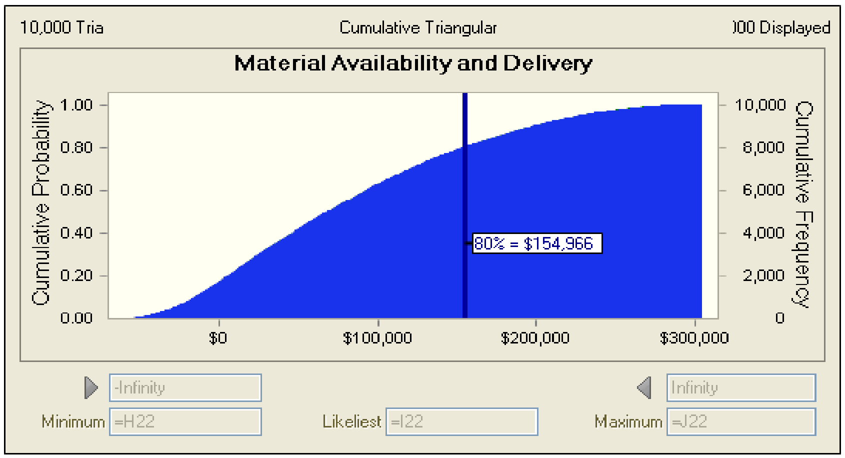
Risk Refer No.	Risk Event	Low	Most Likely	High
CON-1	Material Availability and Delivery	($60,906)	$0	$304,532

Notes: This item captures the risk that availability and delivery of trees and shrubbery will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that better than anticipated pricing and delivery on trees could reduce the overall cost of "planting" by up to 5%.

High High assumes that issues with availability affect pricing and delivery on trees, increasing the overall cost of "planting" by up to 25%.



Assumption: **Material Availability and Delivery**

Percentile	Assumption values
0%	($59,738)
10%	($14,763)
20%	$5,941
30%	$25,656
40%	$46,734
50%	$68,862
60%	$93,374
70%	$121,330
80%	$154,966
90%	$199,130
100%	$301,927

Chacon Creek Feasibility Study - Cost Risk Analysis Model

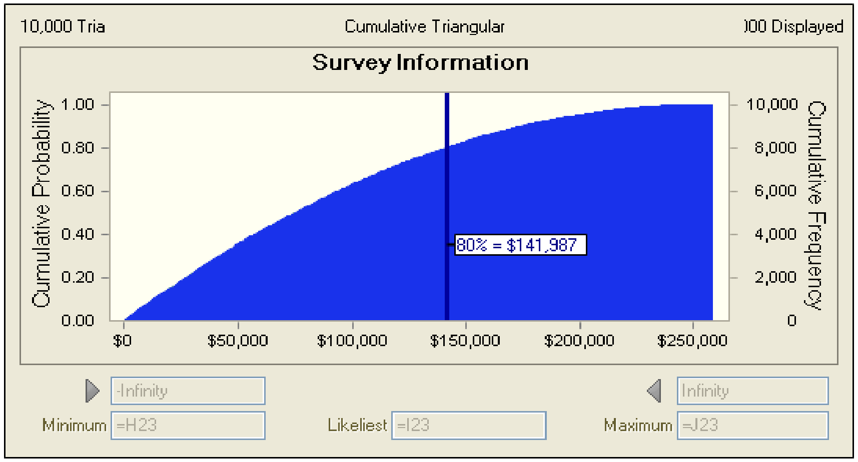
Risk Refer No.	Risk Event	Low	Most Likely	High
CON-2	Survey Information	$0	$0	$258,496

Notes: This item captures the risk that lack of survey data will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that lack of survey information could ultimately cause the ER construction costs to vary by up to 2.5%.



Assumption: **Survey Information**

Percentile	Assumption values
0%	$2
10%	$12,880
20%	$27,205
30%	$41,770
40%	$57,330
50%	$75,384
60%	$94,275
70%	$115,477
80%	$141,987
90%	$175,183
100%	$257,534

Chacon Creek Feasibility Study - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EST-1	Parametric Estimates for Critical Features	($1,866,060)	$0	$2,799,090

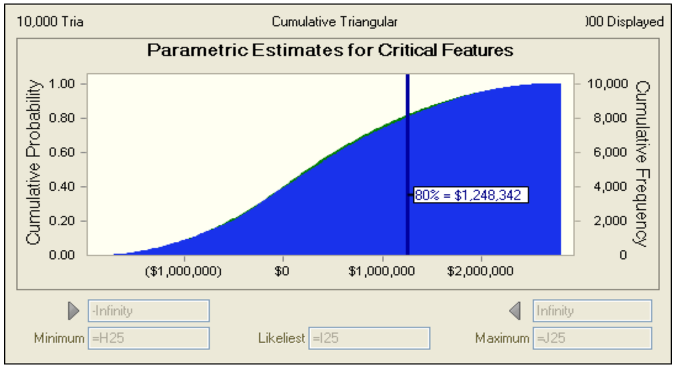
Notes: This item captures the risk that the current estimate reflecting parametric estimating for critical features will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that detailed estimating taking place after authorization could lead to a variance up to -10% on the overall costs of the buyout and ER construction.

High High assumes that detailed estimating taking place after authorization could lead to a variance up to 15% on the overall costs of the buyout and ER construction.

	Likely	Best Case	Worst Case
NON-STRUCTURAL BUYOUT PLAN (Demo)	$8,320,775.00	$7,488,697.50	$9,568,891.25
EcoSystem Restoration	$10,339,822.00	$9,305,839.80	$11,890,795.30
Total	$18,660,597.00	$16,794,537.30	$21,459,686.55
Difference	**$0.00**	**($1,866,059.70)**	**$2,799,089.55**



Assumption: **Parametric Estimates for Critical Features**

Percentile	Assumption values
0%	($1,850,851)
10%	($924,127)
20%	($513,242)
30%	($230,135)
40%	$25,663
50%	$286,234
60%	$563,785
70%	$873,152
80%	$1,248,342
90%	$1,704,400
100%	$2,785,902

Chacon Creek Feasibility Study - Cost Risk Analysis Model

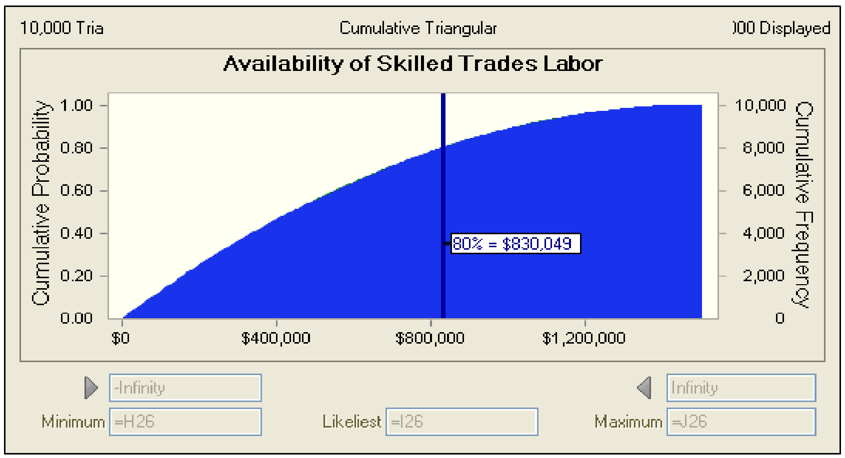
Risk Refer No.	Risk Event	Low	Most Likely	High
EST-2	Availability of Skilled Trades Labor	$0	$0	$1,500,920

Notes: This item captures the risk that the availability of skilled trades labor will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that the worst case scenario is that labor will include the equivalent of 75% of the GSA allowance for lodging and subsistence for Laredo, Texas plus $2/hour premium pay.



Assumption: **Availability of Skilled Trades Labor**

Percentile	Assumption values
0%	$97
10%	$78,961
20%	$158,261
30%	$246,118
40%	$337,878
50%	$440,328
60%	$557,805
70%	$682,868
80%	$830,049
90%	$1,032,746
100%	$1,493,252

Chacon Creek Feasibility Study - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EST-3	Contracting/Subcontracting Configuration			

This risk is captured by Risk CA-2

Chacon Creek Feasibility Study - Cost Risk Analysis Model

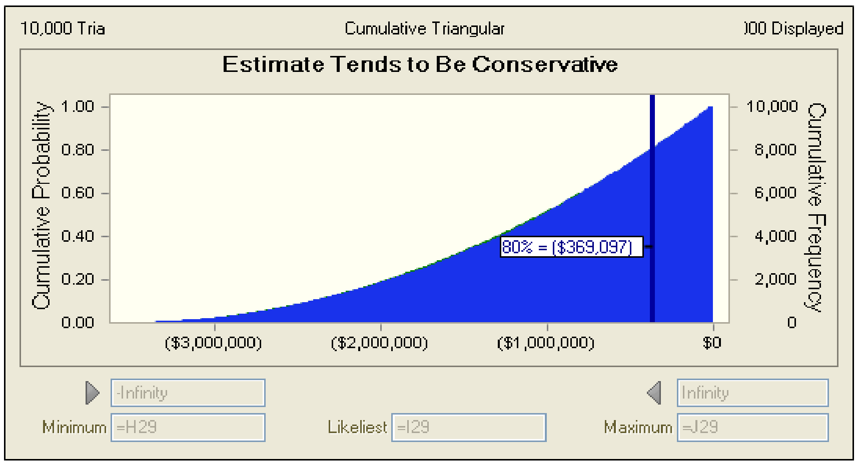
Risk Refer No.	Risk Event	Low	Most Likely	High
EST-4	Estimate Tends to Be Conservative	($3,547,000)	$0	$0

Notes: This item captures the risk that the conservative nature of the current estimate will cause a positive variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that the ultimate cost of the project could potentially be up to 10% less than currently estimated, since the estimate is currently overly conservative.

High High assumes no change from the baseline estimate.



Assumption: **Estimate Tends to Be Conservative**

Percentile	Assumption values
0%	($3,502,870)
10%	($2,422,443)
20%	($1,944,598)
30%	($1,578,264)
40%	($1,272,955)
50%	($1,018,567)
60%	($791,348)
70%	($575,000)
80%	($369,097)
90%	($185,875)
100%	($123)

Chacon Creek Feasibility Study - Cost Risk Analysis Model

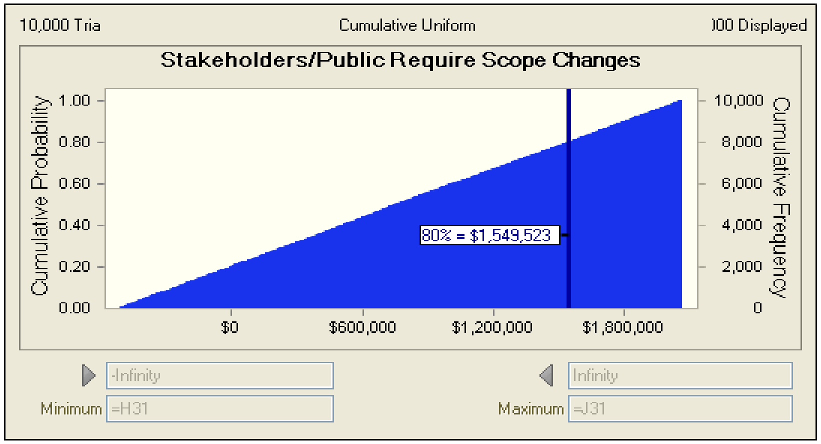
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-1	Stakeholders/Public Require Scope Changes	($516,991)	$0	$2,067,964

Notes: This item captures the risk that late changes from the public or stakeholder will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that late changes required by the public or stakeholders could reduce the ER construction costs by up to 5%.

High High assumes that late changes required by the public or stakeholders could increase the ER construction costs by up to 20%.



Assumption: **Stakeholders/Public Require Scope Changes**

Percentile	Assumption values
0%	($516,956)
10%	($260,791)
20%	($7,193)
30%	$253,466
40%	$505,341
50%	$752,482
60%	$1,014,131
70%	$1,282,317
80%	$1,549,523
90%	$1,810,560
100%	$2,067,423

Chacon Creek Feasibility Study - PDT Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Overall Project Scope
The Chacon Creek - Flood Buyout/Recreation/EcoSystem Restoration Project Recommended Plan is the result of combining the recommended NED plan (alternative 5 - addresses flooding and recreation) and the recommended NER plan (alternative 6 - addresses ecosystem restoration).

Cost Impacts
For the Chacon Creek Project, any cost impact of $500,000 or higher should be considered at least "Significant." Anything over $200,000 should be considered at least "Marginal."

Schedule Impacts
For the Chacon Creek Project, any schedule impact of 6 months or greater should be considered at least "Significant." Anything over 1 month should be considered at least "Marginal."

				Project Cost				Project Schedule							
Risk No.	**Risk/Opportunity Event**	**Concerns**	**PDT Discussions**	**Likelihood***	**Impact***	**Risk Level***	**Rough Order Impact ($)**	**Likelihood***	**Impact***	**Risk Level***	**Rough Order Impact (mo)**	**Variance Distribution**	**Correlation to Other(s)**	**Responsibility/POC**	**Affected Project Component**
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	Internal Red Tape Causes Delay Getting Approvals & Decisions	The PDT currently has a recommended plan. The configuration could change based on the results of higher level review processes.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.7 Months	Uniform		Project Manager	Project Schedule
PPM-2	Product Development by Multiple Sources	The sponsor is using their own resources for the design and contracting of the recreation components.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	PPM-8	Project Manager	Project Cost & Schedule
PPM-3	Project Competing with Other Projects	Project is a high priority in the District. However, there are other larger projects in the District that are also high priority. The other larger value projects tend to obtain resources more readily.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.6 Months	Yes-No		District Management	Project Schedule
PPM-4	Insufficient Time to Plan	The PDT has expressed that the project study has been accelerated, and there is some potential for some configuration issues arising from insufficient time to plan.	If there are significant modifications required to the plan (per historical experience), it could leave the PDT with insufficient time to plan for the new configuration. Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Likely	Marginal	Moderate	1.6 Months	Triangular		District Management	Project Schedule
PPM-5	Pressure to Deliver Accelerated Schedule	PDT needs a Chief's Report by December 2010 (WRDA in FY 2010) - contingent authorization. Otherwise, would need the Chief's Report by June 2010.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	-1.2 Months	Uniform		District Management	Project Schedule
PPM-6	Unplanned Work That Must Be Accommodated	There may be some additional scope required (most likely for the study), due to new requirements and regulations, etc.	This could significantly impact cost and schedule issues.	Unlikely	Significant	Moderate	$5,000,000	Unlikely	Significant	Moderate	10.9 Months	Uniform		District Management	Project Cost & Schedule
PPM-7	Local Agency/Regulator/Resource Agency Issues	There are other agencies that are involved, such as FWS, TCEQ, TPWD, etc. that are contributing to the decisions/coordination. Not obtaining decisions and the necessary coordination and documents in a timely fashion could impact the project.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Likely	Significant	High	5.0 Months	Triangular		Project Manager	Project Schedule
PPM-8	Coordination/Communication Difficulties	PDT is communicating well internally. However, this has been an issue with external and public communications.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	PPM-2	Project Manager	Project Schedule
	CONTRACT ACQUISITION RISKS														
CA-1	Acquisition Strategy is Incomplete	The PDT has as strategy. However, there is no consensus and decision as to the actual acquisition deliver at this time. It is likely that some of the contracts would be performed by small businesses or 8(a)s.	Could affect cost and schedule.	Likely	Significant	High	$3,000,000	Unlikely	Significant	Moderate	3.7 Months	Triangular	CA-2	TASB	Contract Cost & Project Schedule
CA-2	Numerous Separate Contracts	The current estimate is reflecting one contract. The PDT has acknowledged that the project will likely be performed by several separate contracts (potentially small businesses).	Could affect cost and schedule.	Likely	Significant	High	$3,000,000	Likely	Marginal	Moderate	5.0 Months	Triangular	CA-1	Contracting	Contract Cost & Project Schedule
	TECHNICAL RISKS														
TL-1	Identification of HTRW Handling Requirements	There is some uncertainty as to whether the percentage estimated for houses requiring special handling requirements during demolition. There are 62 structures (10 estimated with asbestos).	Could affect costs (positively or negatively).	Likely	Significant	High	$500,000	Likely	Marginal	Moderate	2.2 Months	Yes-No		Environmental Compliance	Project Cost & Schedule
TL-2	Sufficiency of As-Built Data	The PDT acknowledges that there are some utility relocation and conflict issues, and there is not confidence in the existing as-built data.	Could affect cost, but likely would not be high impact.	Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost & Project Schedule
	LANDS AND DAMAGES RISKS														

	OPPORTUNITY														
LD-1	Status of the Real Estate Acquisition	The project consists of 50% RE cost for the ER component (whereas the regulations indicated 25%). The real estate estimate is currently being revised. The PDT originally included costs for the worse case scenario. However, it has been determined that the City already owns more of the property than originally contemplated.	This is a significant opportunity for cost savings.	Very Likely	Significant	High	($400,000)	Very Unlikely	Negligible	Low	Low - Not Studied				
LD-2	Relocation Assistance Issues	The demographics of the Laredo area may introduce factors (specific to relocation assistance requirements -- "housing of last resort") that will cause variance in the cost of the relocations associated with the buyout.	This could affect cost and schedule.	Likely	Marginal	Moderate	$126,000	Likely	Significant	High	9.7 Months	Yes-No		Real Estate	Project Schedule
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-1	Cultural Resource Concerns	The PDT has not completed the SHPO compliance surveys in all areas. PDT has not received the section 106 compliance yet.	PDT does not believe that there are any major issues relating to cultural resources. Could impact cost and schedule.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Significant	Moderate	9.6 Months	Yes-No		Environmental Compliance	Project Schedule
RE-2	Adaptive Management Features	There is currently no monitoring plan developed. PDT acknowledges that there will be consideration for adaptive management features.	Could impact the costs.	Likely	Marginal	Moderate	$116,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Environmental Compliance	Project Cost
	CONSTRUCTION RISKS														
CON-1	Material Availability and Delivery	There is a substantial amount of planting of trees involved. If there was a scarcity or shortage, this could lead to increased costs or schedule delays.	This could impact cost and schedule.	Likely	Marginal	Moderate	$155,000	Unlikely	Marginal	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
CON-2	Survey Information	The PDT does not have surveys completed for the area. This could lead to some impacts to the construction costs.	This could impact costs.	Likely	Marginal	Moderate	$142,000	Likely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost
CON-3	Consideration for Standard Weather Impact	The area is arid, but susceptible to hurricanes and flooding. Also, area is susceptible to fires.	Could impact schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Likely	Negligible	Low	Low - Not Studied	Triangular		Construction	Project Schedule
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Parametric Estimates for Critical Features	Currently, the estimate reflects some parametric estimates for critical features. At some point, the estimate will have to be convert to a more detailed breakdown of costs and level of effort.	Could have some impact on cost and schedule.	Likely	Significant	High	$1,250,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
EST-2	Availability of Skilled Trades Labor	PDT has mentioned concern that some of the workforce would likely come from outside the area, necessitating payment of per diem and premium pay.	Could affect the costs.	Likely	Marginal	Moderate	$830,000	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
EST-3	Contracting/Subcontracting Configuration	Based on whether or not MATOC or similar contract mechanisms are utilized, this could produce multiple layers of contractor/subcontractor markups and other considerations.	Could affect the costs.	Likely	Marginal	Moderate	Not Studied - Captured by CA-2	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
	OPPORTUNITY														
EST-4	Estimate Tends to Be Conservative	This presents the potential for substantial savings for certain components of the project.	Could positively affect the costs.	Likely	Significant	High	($370,000)	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Project Cost
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
PR-1	Stakeholders/Public Require Scope Changes	After PDT takes the package to the public, new work or scope changes are required.	Could impact cost and schedule. PDT feels that this is likely to occur with one amenity (specific to the trail).	Likely	Significant	High	$1,550,000	Likely	Negligible	Low	Low - Not Studied	Uniform		Project Manager	Project Cost
PR-2	Political Factors at Local and Federal Level Cause Impacts	The PDT has expressed concern over the impact at the local (City) level regarding the project. At the Federal level, there is less support for recreation projects.	Could impact cost and schedule.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Uniform		Project Manager	Project Cost & Schedule
PR-3	Project Competing with Other Projects at National Level	This project is also competing with other projects at the national level at HQ in the same funding cycle.	Could affect schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Likely	Marginal	Moderate	9.6	Yes-No		Project Manager	Project Schedule
PR-4	Severe Weather Impact	Historically, this area has been susceptible to both severe droughts as well as hurricanes and wildfires.	Could affect the cost and schedule.	Likely	Negligible	Low	Low - Not Studied	Likely	Negligible	Low	Low - Not Studied	Triangular		N/A	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Chacon Creek Feasibility Study - Cost and Schedule Risk Analysis

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$35,470,003**
Baseline Estimate Cost Contingency Amount ->	$8,879,475
Baseline Estimate Construction Cost (80% Confidence) ->	**$44,349,478**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**90.0 Months**
Schedule Contingency Duration ->	50.4 Months
Project Schedule Duration (80% Confidence) ->	**140.4 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$667,552**

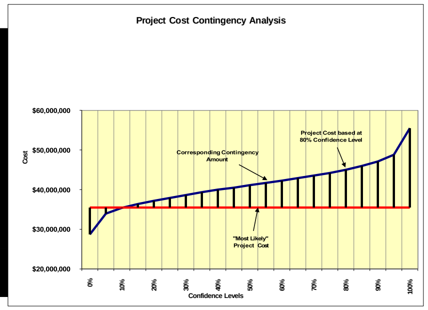
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$9,547,027**
Project Contingency Percentage (80% Confidence) ->	**27%**

Project Cost (80% Confidence) ->	**$45,017,030**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

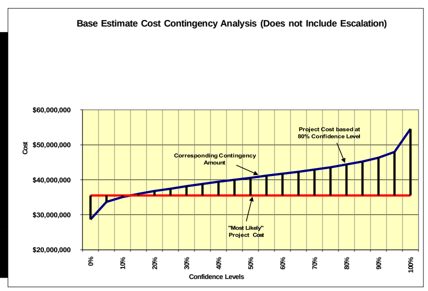
Most Likely Cost Estimate	$35,470,003	
Confidence Level	**Value**	**Contingency**
0%	$28,670,311	-19.17%
5%	$33,958,611	-4.26%
10%	$35,376,561	-0.26%
15%	$36,372,231	2.54%
20%	$37,187,997	4.84%
25%	$37,913,115	6.89%
30%	$38,624,886	8.89%
35%	$39,325,242	10.87%
40%	$39,975,613	12.70%
45%	$40,512,255	14.22%
50%	$41,128,027	15.95%
55%	$41,720,866	17.62%
60%	$42,285,144	19.21%
65%	$42,886,910	20.91%
70%	$43,575,090	22.85%
75%	$44,231,640	24.70%
80%	**$45,017,030**	**26.92%**
85%	$45,943,172	29.53%
90%	$47,086,467	32.75%
95%	$48,766,929	37.49%
100%	$55,532,976	56.56%

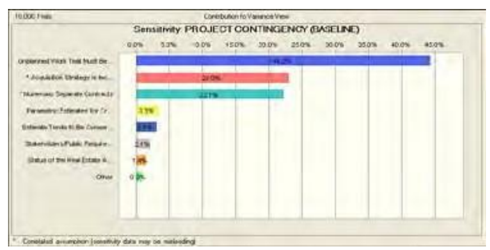


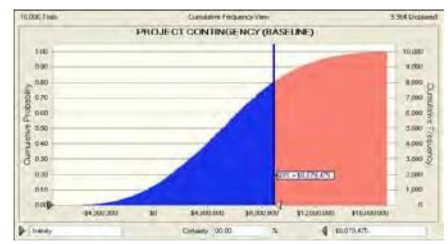
- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$35,470,003	
Confidence Level	**Value**	**Contingency**
0%	$28,656,240	-19.21%
5%	$33,670,489	-5.07%
10%	$35,030,985	-1.24%
15%	$35,994,088	1.48%
20%	$36,778,170	3.69%
25%	$37,477,061	5.66%
30%	$38,165,435	7.60%
35%	$38,845,532	9.52%
40%	$39,477,251	11.30%
45%	$39,995,509	12.76%
50%	$40,592,687	14.44%
55%	$41,164,961	16.06%
60%	$41,709,538	17.59%
65%	$42,289,771	19.23%
70%	$42,955,894	21.10%
75%	$43,590,086	22.89%
80%	**$44,349,478**	**25.03%**
85%	$45,245,274	27.56%
90%	$46,351,576	30.68%
95%	$47,978,778	35.27%
100%	$54,506,003	53.67%



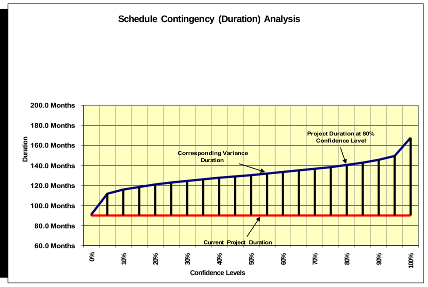




- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

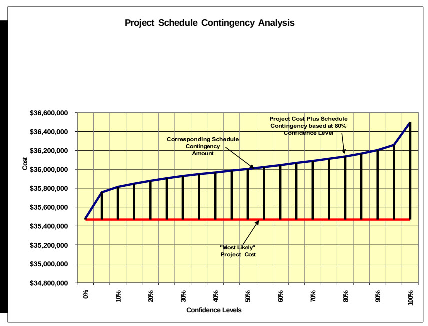
Most Likely Schedule	90.0 Months	
Confidence Level	**Value**	**Contingency**
0%	91.0 Months	1.18%
5%	111.7 Months	24.19%
10%	116.1 Months	29.01%
15%	118.5 Months	31.75%
20%	120.9 Months	34.41%
25%	122.9 Months	36.61%
30%	124.7 Months	38.58%
35%	126.2 Months	40.28%
40%	127.6 Months	41.84%
45%	129.0 Months	43.39%
50%	130.4 Months	44.95%
55%	132.0 Months	46.67%
60%	133.5 Months	48.33%
65%	135.1 Months	50.14%
70%	136.7 Months	51.99%
75%	138.4 Months	53.87%
80%	140.4 Months	56.05%
85%	142.7 Months	58.60%
90%	145.5 Months	61.70%
95%	149.5 Months	66.17%
100%	167.6 Months	86.23%

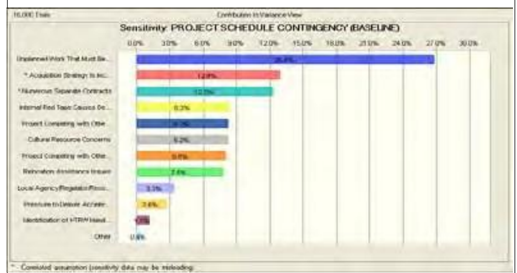


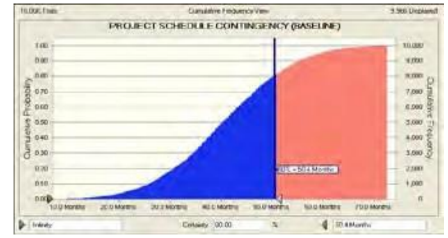
- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

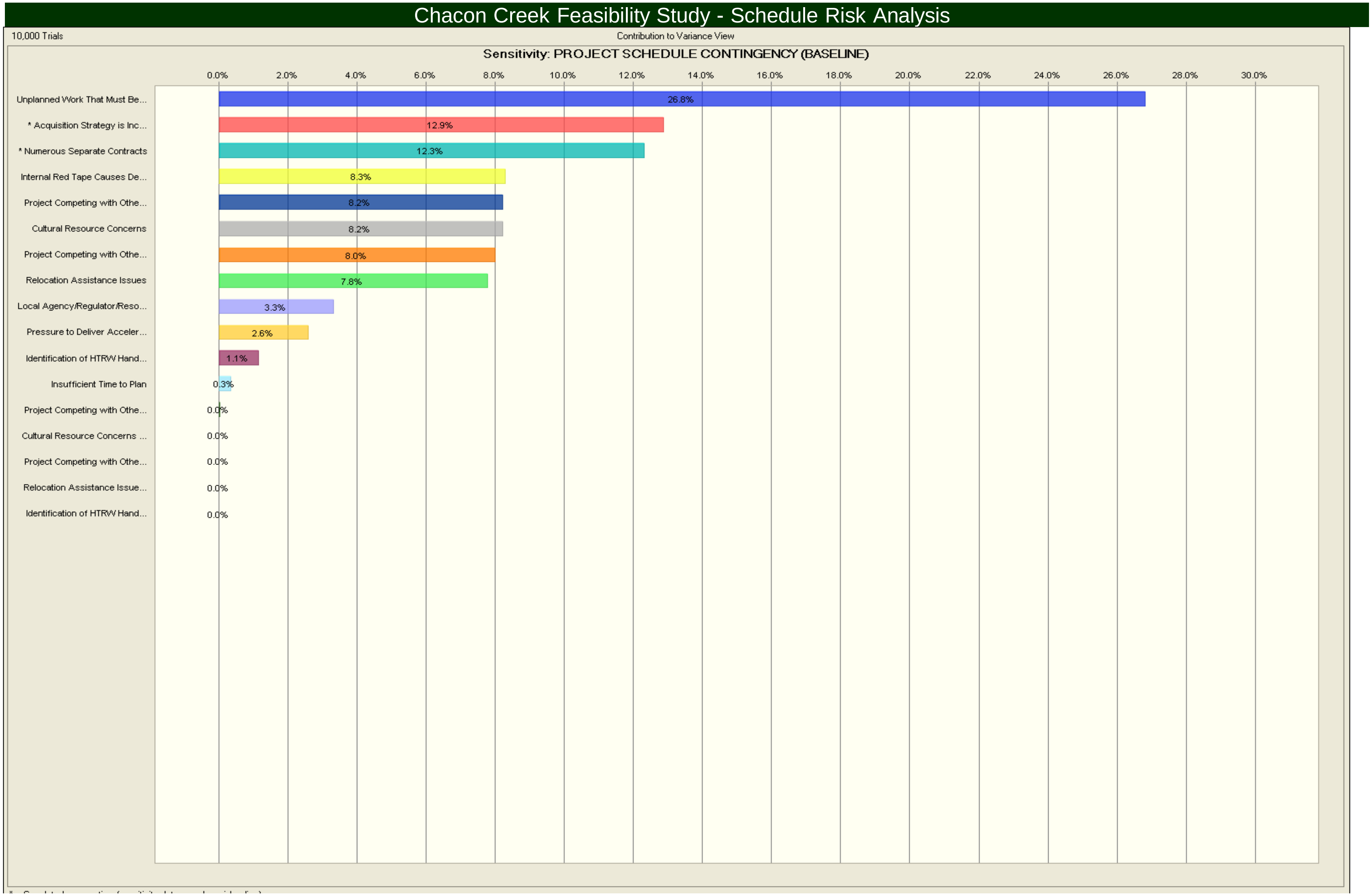
Contingency Analysis

Most Likely Cost Estimate	$35,470,003	
Confidence Level	**Value**	**Contingency**
0%	$14,071	0.04%
5%	$288,122	0.81%
10%	$345,576	0.97%
15%	$378,143	1.07%
20%	$409,828	1.16%
25%	$436,054	1.23%
30%	$459,451	1.30%
35%	$479,710	1.35%
40%	$498,362	1.41%
45%	$516,746	1.46%
50%	$535,339	1.51%
55%	$555,905	1.57%
60%	$575,606	1.62%
65%	$597,139	1.68%
70%	$619,196	1.75%
75%	$641,554	1.81%
80%	$667,552	1.88%
85%	$697,899	1.97%
90%	$734,891	2.07%
95%	$788,151	2.22%
100%	$1,026,973	2.90%







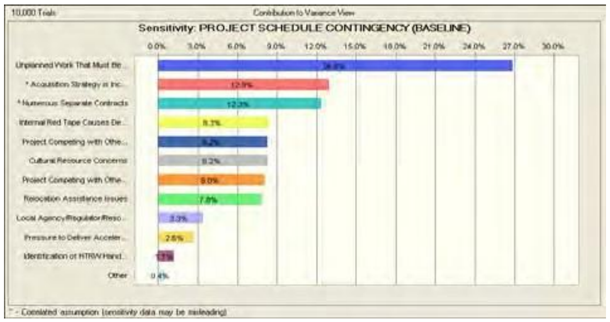

Chacon Creek Feasibility Study - Schedule Risk Analysis
10,000 Trials
Contribution to Variance View
Sensitivity: PROJECT SCHEDULE CONTINGENCY (BASELINE)
0.0%
2.0%
4.0%
6.0%
8.0%
10.0%
12.0%
14.0%
16.0%
18.0%
20.0%
22.0%
24.0%
26.0%
28.0%
30.0%
Unplanned Work That Must Be...
26.8%
* Acquisition Strategy is Inc...
12.9%
* Numerous Separate Contracts
12.3%
Internal Red Tape Causes De...
8.3%
Project Competing with Othe...
8.2%
Cultural Resource Concerns
8.2%
Project Competing with Othe...
8.0%
Relocation Assistance Issues
7.8%
Local Agency/Regulator/Reso...
3.3%
Pressure to Deliver Acceler...
2.6%
Identification of HTRW Hand...
1.1%
Insufficient Time to Plan
0.3%
Project Competing with Othe...
0.0%
Cultural Resource Concerns ...
0.0%
Project Competing with Othe...
0.0%
Relocation Assistance Issue...
0.0%
Identification of HTRW Hand...
0.0%

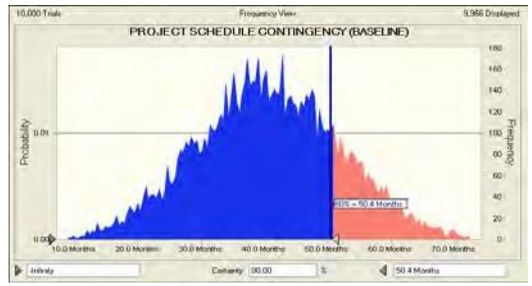
Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Risk No.	Risk/Opportunity Event	Project Cost Likelihood*	Project Cost Impact*	Project Cost Risk Level*	Variance Distribution	Correlation to Other(s)	Crystal Ball Simulati Expected Values (mo Low	Most Likely			Crystal Ball Simulation Expected Values (%s) Low	Most Likely	High		
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
PROJECT & PROGRAM MGMT															
PPM-1	Internal Red Tape Causes Delay Getting Approvals & Decisions	Unlikely	Significant	Moderate	Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	13.34%		
PPM-3	Project Competing with Other Projects	Unlikely	Significant	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	13.34%	0	0
PPM-4	Insufficient Time to Plan	Very Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	3.0 Months		0.00%	0.00%	3.33%		
PPM-5	Pressure to Deliver Accelerated Schedule	Unlikely	Significant	Moderate	Uniform		-6.0 Months	0.0 Months	0.0 Months		-6.67%	0.00%	0.00%		
PPM-6	Unplanned Work That Must Be Accommodated	Unlikely	Significant	Moderate	Uniform		-6.0 Months	0.0 Months	15.0 Months		-6.67%	0.00%	16.67%		
PPM-7	Local Agency/Regulator/Resource Agency Issues	Likely	Significant	High	Triangular		0.0 Months	0.0 Months	9.0 Months		0.00%	0.00%	10.00%		
CONTRACT ACQUISITION RISKS															
CA-1	Acquisition Strategy is Incomplete	Unlikely	Significant	Moderate	Triangular	CA-2	-6.0 Months	0.0 Months	9.0 Months		-6.67%	0.00%	10.00%		
CA-2	Numerous Separate Contracts	Likely	Marginal	Moderate	Triangular	CA-1	0.0 Months	0.0 Months	9.0 Months		0.00%	0.00%	10.00%		
TECHNICAL RISKS															
TL-1	Identification of HTRW Handling Requirements	Likely	Marginal	Moderate	Yes-No/Uniform		-1.0 Months	0.0 Months	3.0 Months		-1.11%	0.00%	3.33%	0	0
LANDS AND DAMAGES RISKS															
LD-2	Relocation Assistance Issues	Likely	Significant	High	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	13.34%	0	0
REGULATORY AND ENVIRONMENTAL RISKS															
RE-1	Cultural Resource Concerns	Unlikely	Significant	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	13.34%	0	0
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-3	Project Competing with Other Projects at National Level	Very Likely	Marginal	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	13.34%	0	0
										Not Part of Study - Placeholder for Project Summation Purposes Only					
								0.0 Months							

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

PROJECT SCHEDULE CONTINGENCY (BASELINE)	Percentile	Baseline Schedule Duration	Contingency	Baseline w/ Contingency	Contingency
	0%	90.0 Months	1.1 Months	91.0 Months	1.18%
	5%	90.0 Months	21.8 Months	111.7 Months	24.19%
	10%	90.0 Months	26.1 Months	116.1 Months	29.01%
	15%	90.0 Months	28.6 Months	118.5 Months	31.75%
	20%	90.0 Months	31.0 Months	120.9 Months	34.41%
	25%	90.0 Months	32.9 Months	122.9 Months	36.61%
	30%	90.0 Months	34.7 Months	124.7 Months	38.58%
	35%	90.0 Months	36.2 Months	126.2 Months	40.28%
	40%	90.0 Months	37.6 Months	127.6 Months	41.84%
	45%	90.0 Months	39.0 Months	129.0 Months	43.39%
	50%	90.0 Months	40.4 Months	130.4 Months	44.95%
	55%	90.0 Months	42.0 Months	132.0 Months	46.67%
	60%	90.0 Months	43.5 Months	133.5 Months	48.33%
	65%	90.0 Months	45.1 Months	135.1 Months	50.14%
	70%	90.0 Months	46.8 Months	136.7 Months	51.99%
	75%	90.0 Months	48.5 Months	138.4 Months	53.87%
	80%	90.0 Months	50.4 Months	140.4 Months	56.05%
	85%	90.0 Months	52.7 Months	142.7 Months	58.60%
	90%	90.0 Months	55.5 Months	145.5 Months	61.70%
	95%	90.0 Months	59.5 Months	149.5 Months	66.17%
	100%	90.0 Months	77.6 Months	167.6 Months	86.23%





Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Enter Estimated Total Project Cost (Price Level)	**$35,470,003.00**
Max. Anticipated Annual Amount	**$4,733,438**
Enter Current OMB Escalation Rate	**1.80%**
Enter Current Project Location Escalation Rate	**1.80%**
Enter Assumed Hotel Rate	**3.57%**

	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
Enter Current Project Start	1-Jan-11			
Enter Baseline Project Completion	30-Jun-18			
Project Completion at 0% Confidence	1-Aug-18		$14,959.88	$14,959.88
Project Completion at 5% Confidence	22-Apr-20		$306,325.92	$306,325.92
Project Completion at 10% Confidence	1-Sep-20		$367,409.69	$367,409.69
Project Completion at 15% Confidence	14-Nov-20		$402,034.40	$402,034.40
Project Completion at 20% Confidence	26-Jan-21		$435,721.08	$435,721.08
Project Completion at 25% Confidence	28-Mar-21		$463,604.25	$463,604.25
Project Completion at 30% Confidence	20-May-21		$488,479.82	$488,479.82
Project Completion at 35% Confidence	6-Jul-21		$510,018.94	$510,018.94
Project Completion at 40% Confidence	18-Aug-21		$529,849.39	$529,849.39
Project Completion at 45% Confidence	29-Sep-21		$549,394.58	$549,394.58
Project Completion at 50% Confidence	11-Nov-21		$569,162.94	$569,162.94
Project Completion at 55% Confidence	28-Dec-21		$591,028.02	$591,028.02
Project Completion at 60% Confidence	11-Feb-22		$611,973.68	$611,973.68
Project Completion at 65% Confidence	2-Apr-22		$634,867.33	$634,867.33
Project Completion at 70% Confidence	22-May-22		$658,317.35	$658,317.35
Project Completion at 75% Confidence	13-Jul-22		$682,088.42	$682,088.42
Project Completion at 80% Confidence	11-Sep-22		$709,728.75	$709,728.75
Project Completion at 85% Confidence	19-Nov-22		$741,993.03	$741,993.03
Project Completion at 90% Confidence	12-Feb-23		$781,322.18	$781,322.18
Project Completion at 95% Confidence	15-Jun-23		$837,947.49	$837,947.49
Project Completion at 100% Confidence	14-Dec-24		$1,091,858.74	$1,091,858.74

Entry Required

Do Not Overwrite

Summary Data -- Do Not Overwrite

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

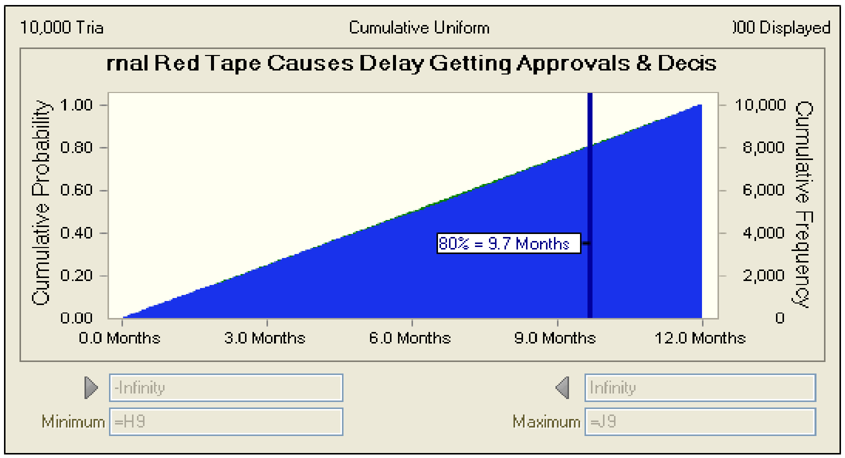
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-1	Internal Red Tape Causes Delay Getting Approvals & Decisions	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that internal red tape delaying approvals and decisions will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that issues with internal red tape could cause delays prior to PED that could delay the overall project implementation schedule by up to 12 months.



Assumption: **Internal Red Tape Causes Delay Getting Approvals & Decisions**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.5 Months
30%	3.6 Months
40%	4.9 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.9 Months
100%	12.0 Months

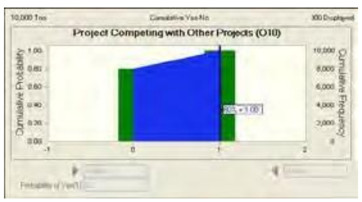
Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-3	Project Competing with Other Projects	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that the project competing with other project internally will cause a variance from the current baseline schedule.
Likely Likely assumes no change from the baseline schedule.
Low Low assumes no change from the baseline schedule.
High High assumes that issues with the project competing with other projects in the District could cause delays to the implementation schedule by up to 12 months.

Forecast: **Project Competing with Other Projects**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	1
90%	1
100%	1



Assumption: **Project Competing with Other Projects**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	1
90%	1
100%	1

Assumption: **Project Competing with Other Projects**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.8 Months
50%	6.0 Months
60%	7.2 Months
70%	8.3 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

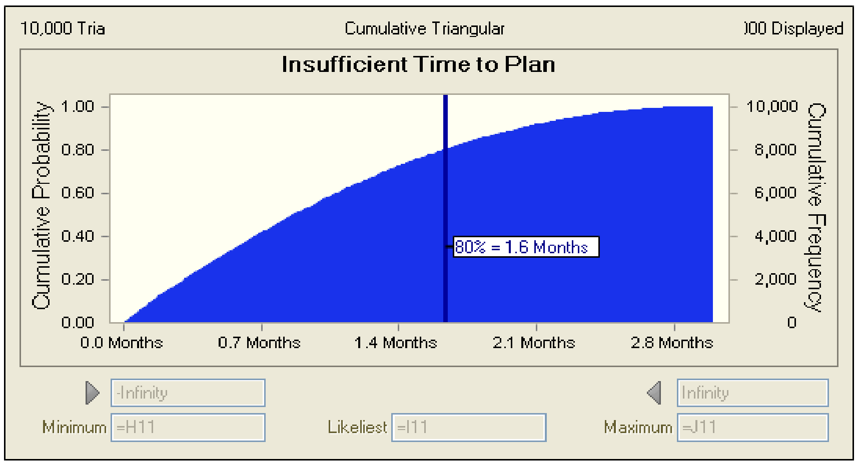
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-4	Insufficient Time to Plan	0.0 Months	0.0 Months	3.0 Months

Notes: This item captures the risk that insufficient time to plan will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that insufficient time to plan will lead to configuration issues that will delay the project implementation schedule by up to 3 months.



Assumption: Insufficient Time to Plan

Percentile	Assumption values
0%	0.0 Months
10%	0.1 Months
20%	0.3 Months
30%	0.5 Months
40%	0.7 Months
50%	0.9 Months
60%	1.1 Months
70%	1.3 Months
80%	1.6 Months
90%	2.0 Months
100%	3.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

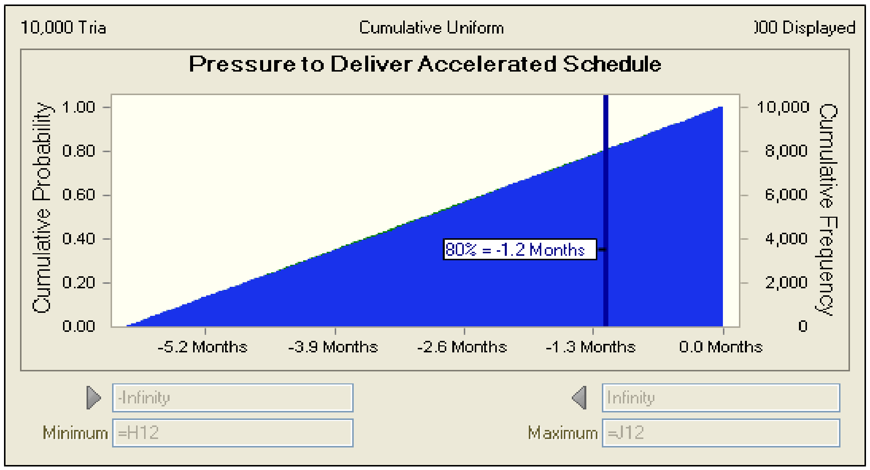
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-5	Pressure to Deliver Accelerated Schedule	-6.0 Months	0.0 Months	0.0 Months

Notes: This item captures the risk that pressure to deliver on an accelerated schedule will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes that pressure to deliver on an accelerated schedule may improve the overall implementation schedule by up to 6 months.

High High assumes no change from the baseline schedule.



Assumption: **Pressure to Deliver Accelerated Schedule**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-5.4 Months
20%	'-4.8 Months
30%	'-4.2 Months
40%	'-3.6 Months
50%	'-3.0 Months
60%	'-2.4 Months
70%	'-1.8 Months
80%	'-1.2 Months
90%	'-0.6 Months
100%	0.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

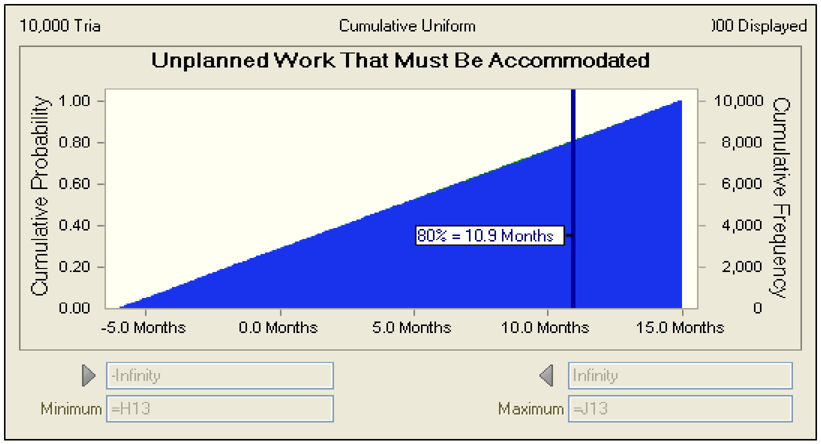
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-6	Unplanned Work That Must Be Accommodated	-6.0 Months	0.0 Months	15.0 Months

Notes: This item captures the risk that unplanned work that must be accommodated will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes unplanned work results in a scope change that reduces the overall schedule by up to 6 months.

High High assumes unplanned work results in a scope change that delays the overall implementation schedule by up to 15 months.



Assumption: **Unplanned Work That Must Be Accommodated**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-3.9 Months
20%	'-1.9 Months
30%	0.3 Months
40%	2.4 Months
50%	4.5 Months
60%	6.7 Months
70%	8.9 Months
80%	10.9 Months
90%	12.9 Months
100%	15.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

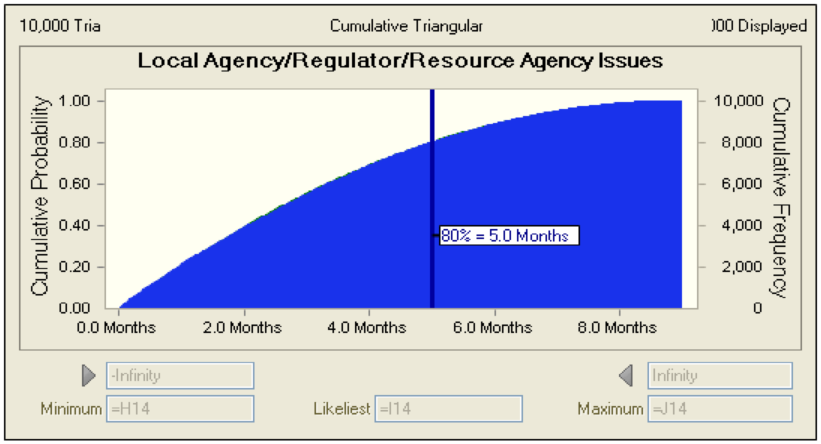
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-7	Local Agency/Regulator/Resource Agency Issues	0.0 Months	0.0 Months	9.0 Months

Notes: This item captures the risk that local agency/regulator issues will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that there are issues with obtaining the necessary coordination and documents in a timely fashion, resulting in an overall delay of the implementation schedule of up to 9 months.



Assumption: **Local Agency/Regulator/Resource Agency Issues**

Percentile	Assumption values
0%	0.0 Months
10%	0.5 Months
20%	0.9 Months
30%	1.5 Months
40%	2.1 Months
50%	2.7 Months
60%	3.3 Months
70%	4.1 Months
80%	5.0 Months
90%	6.2 Months
100%	9.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CA-1	Acquisition Strategy is Incomplete	-6.0 Months	0.0 Months	9.0 Months

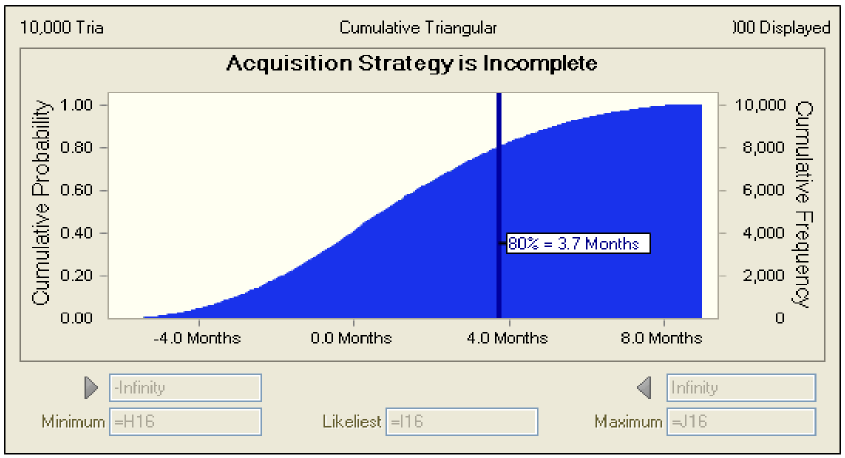
Notes: This item captures the risk that issues with the ultimate acquisition strategy plan will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low

Low assumes the ultimate acquisition strategy plan will lead to more favorable contracts than anticipated, improving the overall implementation schedule by up to 6 months.

High High assumes that the ultimate acquisition strategy plan will lead to a less favorable contract situation, delaying the overall implementation schedule by up to 9 months.



Assumption: **Acquisition Strategy is Incomplete**

Percentile	Assumption values
0%	'-5.9 Months
10%	'-3.1 Months
20%	'-1.8 Months
30%	'-0.9 Months
40%	'-0.1 Months
50%	0.8 Months
60%	1.6 Months
70%	2.6 Months
80%	3.7 Months
90%	5.3 Months
100%	8.8 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

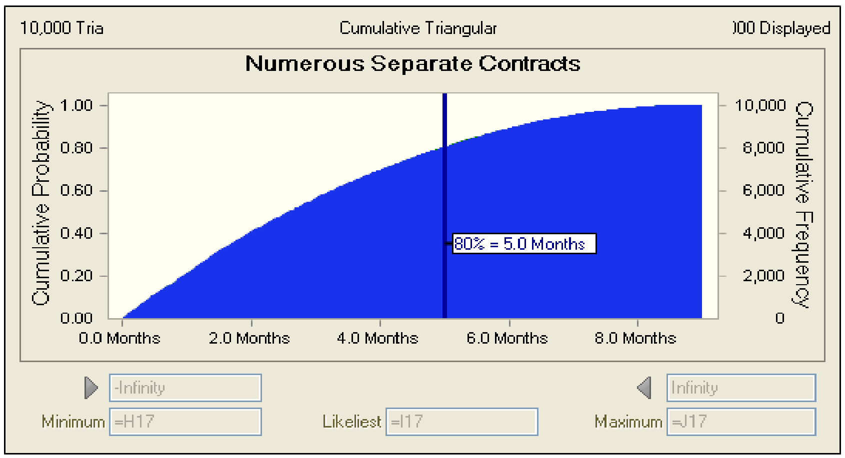
Risk Refer No.	Risk Event	Low	Most Likely	High
CA-2	Numerous Separate Contracts	0.0 Months	0.0 Months	9.0 Months

Notes: This item captures the risk that having numerous separate contracts will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that the number of contracts goes from 4 to 10. Assuming 45 days as a minimum for pre-award activities up to six time could delay of the implementation schedule of up to 9 months.



Assumption: **Numerous Separate Contracts**

Percentile	Assumption values
0%	0.0 Months
10%	0.5 Months
20%	1.0 Months
30%	1.4 Months
40%	2.0 Months
50%	2.6 Months
60%	3.3 Months
70%	4.1 Months
80%	5.0 Months
90%	6.2 Months
100%	8.9 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

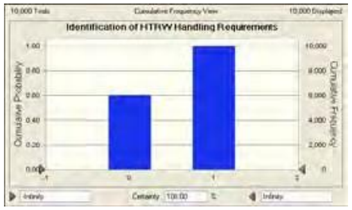
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-1	Identification of HTRW Handling Requirements	-1.0 Months	0.0 Months	3.0 Months

Notes: This item captures the risk that asbestos handling and removal requirements will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

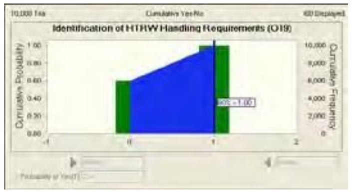
Low Low assumes that efficiencies in asbestos handling are realized, improving the overall schedule by up to 1 month.

High High assumes that more asbestos handling and removal is required than anticipated, delaying the overall implementation schedule by up to 3 months.



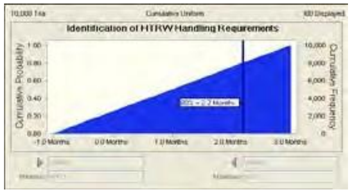
Forecast: **Identification of HTRW Handling Requirements**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	1
80%	1
90%	1
100%	1



Assumption: **Identification of HTRW Handling Requirements**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	1
80%	1
90%	1
100%	1



Assumption: **Identification of HTRW Handling Requirements**

Percentile	Assumption values
0%	-1.0 Months
10%	-0.6 Months
20%	-0.2 Months
30%	0.2 Months
40%	0.6 Months
50%	1.0 Months
60%	1.4 Months
70%	1.8 Months
80%	2.2 Months
90%	2.6 Months
100%	3.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
LD-2	Relocation Assistance Issues	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that relocation assistance issues will cause a variance from the current baseline schedule.

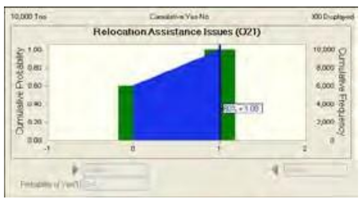
Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that there are many housing of last resort issues to contend with, delaying the overall implementation schedule by up to 12 months.

Forecast: **Relocation Assistance Issues**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	1
80%	1
90%	1
100%	1



Assumption: **Relocation Assistance Issues**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	1
80%	1
90%	1
100%	1

Assumption: **Relocation Assistance Issues**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.7 Months
40%	4.9 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

Chacon Creek Feasibility Study - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
RE-1	Cultural Resource Concerns	0.0 Months	0.0 Months	12.0 Months

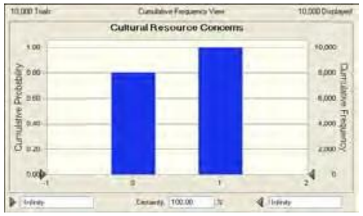
Notes: This item captures the risk that cultural resource concerns will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High

High assumes that cultural resource issues may be encountered, although not anticipated, that could potentially delay the overall implementation schedule by up to 12 months.



Forecast: **Cultural Resource Concerns**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	1
90%	1
100%	1

Assumption: **Cultural Resource Concerns**

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	1
90%	1
100%	1

Assumption: **Cultural Resource Concerns**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.7 Months
40%	4.8 Months
50%	6.1 Months
60%	7.3 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

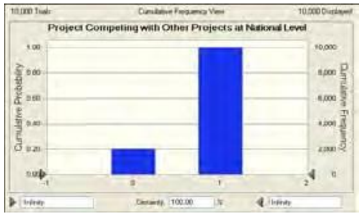
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-3	Project Competing with Other Projects at National Level	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that the project competing for funding at the national level will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

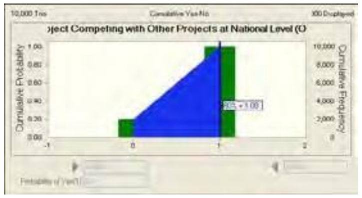
Low Low assumes no change from the baseline schedule.

High High assumes that other national level projects trump this project, delaying implementation one funding cycle (annual), delaying the overall implementation by up to 12 months.



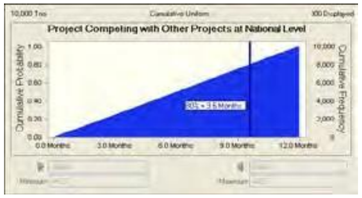
Forecast: Project Competing with Other Projects at National Level

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	1
40%	1
50%	1
60%	1
70%	1
80%	1
90%	1
100%	1



Assumption: Project Competing with Other Projects at National Level

Percentile	Assumption values
0%	0
10%	0
20%	0
30%	1
40%	1
50%	1
60%	1
70%	1
80%	1
90%	1
100%	1



Assumption: Project Competing with Other Projects at National Level

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.9 Months
50%	6.1 Months
60%	7.2 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

ATTACHMENT C

2018 Total Project Cost Summary

PROJECT: **Chacon Creek Flood Dam. Reduction and Ecosys. Restoration**
PROJECT NO: 0
LOCATION: Laredo, TX

DISTRICT: Forth Worth District **PREPARED: 2/12/2018**
POC: CHIEF, COST ENGINEERING, xxx

This Estimate reflects the scope and schedule in report; Chacon Creek Feasibility Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis) Program Year (Budget EC): 2019 Effective Price Level Date: 1 OCT 18						TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-17 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$1,663	$448	26.9%	$2,110	2.1%	$1,697	$457	$2,154	$0	$2,154	5.1%	$1,783	$480	$2,263
06	FISH & WILDLIFE FACILITIES	$12,191	$3,282	26.9%	$15,472	2.1%	$12,441	$3,349	$15,790	$0	$15,790	10.4%	$13,736	$3,698	$17,433
14	RECREATION FACILITIES	$7,576	$2,039	26.9%	$9,615	2.1%	$7,731	$2,081	$9,813	$0	$9,813	5.1%	$8,125	$2,187	$10,312
	CONSTRUCTION ESTIMATE TOTALS:	$21,429	$5,769		$27,198	2.1%	$21,869	$5,887	$27,756	$0	$27,756	8.1%	$23,644	$6,365	$30,009
01	LANDS AND DAMAGES	$16,401	$3,479	21.2%	$19,880	2.1%	$16,738	$3,550	$20,288	$0	$20,288	3.0%	$17,244	$3,657	$20,902
30	PLANNING, ENGINEERING & DESIGN	$1,929	$519	26.9%	$2,448	3.9%	$2,003	$539	$2,542	$0	$2,542	5.5%	$2,112	$569	$2,681
31	CONSTRUCTION MANAGEMENT	$1,929	$519	26.9%	$2,448	3.9%	$2,003	$539	$2,542	$0	$2,542	17.4%	$2,351	$633	$2,984
	PROJECT COST TOTALS:	$41,688	$10,286	24.7%	$51,974		$42,613	$10,516	**$53,128**	$0	**$53,128**	6.5%	$45,352	$11,224	$56,576

ESTIMATED TOTAL PROJECT COST: $56,576

________________________ **CHIEF, COST ENGINEERING, xxx**

________________________ **PROJECT MANAGER, xxx**

________________________ **CHIEF, REAL ESTATE, xxx**

________________________ **CHIEF, PLANNING, xxx**

________________________ **CHIEF, ENGINEERING, xxx**

________________________ **CHIEF, OPERATIONS, xxx**

________________________ **CHIEF, CONSTRUCTION, xxx**

________________________ **CHIEF, CONTRACTING,xxx**

________________________ **CHIEF, PM-PB, xxxx**

________________________ **CHIEF, DPM, xxx**

**** TOTAL PROJECT COST SUMMARY ****

NED PLAN - FLOOD RISK MANAGEMENT & RECREATION

****** CONTRACT COST SUMMARY ******

PROJECT: Chacon Creek Flood Dam. Reduction and Ecosys. Restoration
LOCATION: Laredo, TX
This Estimate reflects the scope and schedule in report; Chacon Creek Feasibility Report

DISTRICT: Forth Worth District
POC: CHIEF, COST ENGINEERING, xxx
PREPARED: 2/12/2018

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 12-Feb-18				Program Year (Budget EC): 2019								
		Effective Price Level: 1-Oct-17				Effective Price Level Date: 1 OCT 18								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Flood Risk Management & Recreation													
02	RELOCATIONS	$1,663	$448	26.9%	$2,110	2.1%	$1,697	$457	$2,154	2021Q3	5.1%	$1,783	$480	$2,263
06	FISH & WILDLIFE FACILITIES	$0	$0	26.9%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
14	RECREATION FACILITIES	$7,576	$2,039	26.9%	$9,615	2.1%	$7,731	$2,081	$9,813	2021Q3	5.1%	$8,125	$2,187	$10,312
	CONSTRUCTION ESTIMATE TOTALS:	$9,239	$2,487	26.9%	**$11,726**		$9,428	$2,538	$11,966			$9,908	$2,667	$12,575
01	LANDS AND DAMAGES	$9,352	$1,885	20.2%	$11,237	2.1%	$9,544	$1,923	$11,467	2020Q3	3.0%	$9,833	$1,982	$11,814
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
0.5%	Planning & Environmental Compliance	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
4.0%	Engineering & Design	$370	$99	26.9%	$469	3.9%	$384	$103	$487	2019Q3	2.1%	$392	$105	$497
0.5%	Reviews, ATRs, IEPRs, VE	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
0.5%	Life Cycle Updates (cost, schedule, risks)	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
0.5%	Contracting & Reprographics	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
1.0%	Engineering During Construction	$92	$25	26.9%	$117	3.9%	$96	$26	$122	2021Q3	10.7%	$106	$29	$135
1.0%	Planning During Construction	$92	$25	26.9%	$117	3.9%	$96	$26	$122	2021Q3	10.7%	$106	$29	$135
0.0%	Adaptive Management & Monitoring	$0	$0	26.9%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Project Operations	$46	$12	26.9%	$59	3.9%	$48	$13	$61	2019Q3	2.1%	$49	$13	$62
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$647	$174	26.9%	$821	3.9%	$672	$181	$852	2021Q3	10.7%	$743	$200	$943
1.0%	Project Operation:	$92	$25	26.9%	$117	3.9%	$96	$26	$122	2021Q3	10.7%	$106	$29	$135
1.0%	Project Management	$92	$25	26.9%	$117	3.9%	$96	$26	$122	2021Q3	10.7%	$106	$29	$135
	CONTRACT COST TOTALS:	$20,254	$4,820		$25,073		$20,699	$4,927	**$25,626**			$21,594	$5,148	**$26,742**

NER PLAN - ECOSYSTEM RESTORATION

****** CONTRACT COST SUMMARY ******

PROJECT: Chacon Creek Flood Dam. Reduction and Ecosys. Restoration
LOCATION: Laredo, TX
This Estimate reflects the scope and schedule in report; Chacon Creek Feasibility Report

DISTRICT: Forth Worth District
POC: CHIEF, COST ENGINEERING, xxx
PREPARED: 2/12/2018

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			**12-Feb-18**	Program Year (Budget EC):			2019					
		Effective Price Level:			1-Oct-17	Effective Price Level Date:			1 OCT 18					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Ecoystems Restoration Items													
02	RELOCATIONS	$0	$0	26.9%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$12,191	$3,282	26.9%	$15,472	2.1%	$12,441	$3,349	$15,790	2024Q1	10.4%	$13,736	$3,698	$17,433
14	RECREATION FACILITIES	$0	$0	26.9%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$12,191	$3,282	26.9%	**$15,472**		$12,441	$3,349	$15,790			$13,736	$3,698	$17,433
01	LANDS AND DAMAGES	$7,049	$1,594	22.6%	$8,643	2.1%	$7,194	$1,626	$8,820	2020Q3	3.0%	$7,412	$1,676	$9,088
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
0.5%	Planning & Environmental Compliance	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
4.0%	Engineering & Design	$488	$131	26.9%	$619	3.9%	$506	$136	$643	2019Q3	2.1%	$517	$139	$656
0.5%	Reviews, ATRs, IEPRs, VE	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
0.5%	Life Cycle Updates (cost, schedule, risks)	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
0.5%	Contracting & Reprographics	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
1.0%	Engineering During Construction	$122	$33	26.9%	$155	3.9%	$127	$34	$161	2024Q1	22.5%	$155	$42	$197
1.0%	Planning During Construction	$122	$33	26.9%	$155	3.9%	$127	$34	$161	2024Q1	22.5%	$155	$42	$197
0.0%	Adaptive Management & Monitoring	$0	$0	26.9%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Project Operations	$61	$16	26.9%	$77	3.9%	$63	$17	$80	2019Q3	2.1%	$65	$17	$82
31	CONSTRUCTION MANAGEMENT													
7.0%	Construction Management	$853	$230	26.9%	$1,083	3.9%	$886	$239	$1,125	2024Q1	22.5%	$1,085	$292	$1,377
1.0%	Project Operation:	$122	$33	26.9%	$155	3.9%	$127	$34	$161	2024Q1	22.5%	$155	$42	$197
1.0%	Project Management	$122	$33	26.9%	$155	3.9%	$127	$34	$161	2024Q1	22.5%	$155	$42	$197
	CONTRACT COST TOTALS:	$21,434	$5,466		$26,900		$21,914	$5,589	**$27,503**			$23,757	$6,076	**$29,833**

APPENDIX H

CORRESPONDENCE

United S ates Department of the Interior

FISH AND WILDLIFESERVlCE
Ecological Services
do TAMU-CC. Campus Box 338
6300 Oce;J.1D1 rive
Corpus Christi, Texas 78112

May I0, 2008

Jodie Foster
Project Manager
U.S. Army Corps of Engineers
Fort W011h District
819 Taylor Street
Fott Worth, TX 76102

Consultation No. 21410-2010-1-0283

Dear Mr. Foster:

Enclosed is the U.S. Fish and Wildlife Service's (Service) Planning Aid Report in accordance with the Fish and Wjldlife Coordination Act guidelines. We have incorporated all the U.S. Arm Corps of Engineers (USACE) comments on the draft repo1t submitted in April, 2010. Based on the review of proposed project materials and documents, we recommend thrt the USACE prepare a Biological Assessment in accordance with section 7 oftj1e Endangered Species Act of I973. as amended (16 U.S.C. §1531 et seq.) to address temPiorary adverse impacts to the endangered ocelot *(Leopardus pardalis)* and endangered Gulf Coast jaguanmdj *(Fe/is yagouaroundi cacomitli)* that may use the project area as a travel corridor, and may be affected during construction and maintenance phases of the project. The Service acknowledges, as addressed in the Planning Aid Repo11, that pro osed project components will also have the capacity to create benefits to ocelot and jaguanmcli habitat by increasing access to water, increasing plant diversity, and increasing prey base species availability.

Please address any comments or questions on the final document to Dr. Larisa Ford. The Service is available to assist Ms. Hope Pollman with the development of the Biological Assesment and can provide some basic information for her use. Dr. Larisa Ford can be contacted at 361-994-9005 (office), 36l-533-2797 (cell) or by email at larisa_ford@.fws.gov.

Sincerely,

llan M. Strand
Field Supervisor

U.S. Deportment
ot Transportation
federal Aviation
Administration

Airports Division
Southwest Region
Arkansas, Louisiana,
New Mexico. Oklahoma,
Texas

2601 Meacham Blvd
Fort Worth, Texas 76137

Mr. Jodie **R.** Foster, Economist
U.S. Army Corps of Engineers
Fort Worth District
819 Taylor Street
P.O. Box 17300
Fort Worth, **TX** 76102-0300

Dear Mr. Foster:

Thank you for the opportunity to review the Corps of Engineers' proposed civil works project in Laredo, Texas. The project involves enhancing two wetland sites less than 10,000 feet from end of Runway 35L at the Laredo International Airport.

After careful consideration and coordination with the Director of Aviation at the Laredo International Airport, we have no objection to the project from a wildlife hazard standpoint.

If you have any questions, please call me at 817 222-5656.

Sincerely,

Faye Neddcrman
Executive Technical Assistant

cc: Jose Flores, Director of Aviation
Laredo International Airport
5210 Bob Bullock Loop
Laredo, TX 78041

Texas Department of Transportation
Division of Aviation
125 East 11th Street
Austin, **TX** 78701-2483

lJnited States Departn1ent of the Interior

HSH AND 'w1LDUFF SERVICE
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63(h) 0cm. Drive
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September 22, 2008

Hope Pollmann
Environmental **Resource** Planner
U S. Army Corps of **Engineers**
Fort Worth District
P.O. Box 17300
Fort Worth, TX 76102

Dear Ms. Pollmann:

The U.S. Fish and Wildlife Service (Service) has reviewed the U.S. Army Corps of Engineers (USACE), final report titled, "Existing conditions report for Chacon Creek floodway, Laredo, Texas" dated February 2007. As per your email and our conversation in mid-August 2008, the Service understands that the USACE is ready to move forward 011 this project and requested comments on the final report mentioned above. The Service has reviewed the report and our comments are as follows;

<u>General Comments</u>
The document is vvell prepared and organized. We agree that the report represents existing conditions at Chacon Creek. We have a fow specific comments and suggest that the USACE make a "note to fik" to address each of the comments instead of making a full revision of the document.

<u>Specific Comments</u>
<u>2.4.l Federn1, first two senlences, page 14</u>
The Service recommends that the sentences be reworded to **reflect that** there are only 5 federally•· **listed species in Webb** County. **One other species, the** Texas **hornshell, is considered** a **Candidate species.**

<u>3.2 Selection of Evaluation Species, p::1x,cigraph..s:111 ., r,age *11*</u>
The paragraph states **that the yellow** warbler model \.vas **eliminated from further** consideration, but **the** model **and** results are discussed throughout the report.

<u>4.2 Summary, sentence 6, page 37</u>
There is a misspelling: "arc" should be '\uea".

Thank you **for** allowing the Service to comment. Please provide a letter on **official** letterhead that extends the reimbursable agreement (MJPR No. nxMA62087081) to a revised planned completion date, as the initiai agreement the Service has on file **expired on July** 31. 2008. The Service looks **fr1f\vard** to reviewing the alternatives that are proposed for the project If there arc any questions or you need further information please contact Dr. **Larisa** Ford at 361-994-9005.

Sincerely.

Allan M. Strand
Field Supervisor

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. 0. BOX 17300
FORT WORTH, TEXAS 76102--0300

September 25, 2008

Planning, Environmental, and Regulatory Division

Mr. Ailen Strand
Field Supervisor
U.S. Fish and Wildlife Service
Ecological Services
c/o TAMU-CC, Campus Box 338
6300 Ocean Drive
Corpus Christi, TX 78412

Dear Mr. Strand:

The U.S. Army Corps of Engineers (USA CE) is conducting the Chacon Creek Interim Feasibility Study to assess the potential of a multipurpose project for flood damage reduction, ecosystem restoration, and recreation development within the Chacon Creek Watershed in Laredo, Texas. The non-Federal sponsor for the study is the City of Laredo.

Authority for the Chacon Creek Interim Feasibility Study is contained in a resolution by Committee on Transportation and Infrastructure, U.S. House of Representatives, adopted May 21, 2003, as quoted below:

> *Resolved by the Committee on Tramportation and Infrastructure of the United States of Representatives, That the Secretary of the Amiy is requested to review the report of the Chief of Engineers on the Rio Grande and Tributaries, published as House Document 39, 62nd Congress, 1st Session, and other pertinent reports to detennine whether modifications to the recommendations contained therein are advisable at the present time in the interest ofjlood damage reduction, environmental restoration and protection, water conservation and supply, water quality, and related purposes in the Rio Grande Watershed below Falcon Dam.*

A full array of alternatives are being considered during the feasibility study to address the aquatic resource problems, opportunities and needs including best management practices that could be implemented in the uplands. An environmental assessment is being conducted and if necessary an environmental impact statement (EIS) will be integrated into the feasibility report which is scheduled to be released for public review in May 2009. The Chief's Report is scheduled to be transmitted to the Assistant Secretary of the Army for Civil Works in August 2009.

The initial scope of work (SOW) dated July 18, 2006 calls for a Planning Aid Letter and Draft FWCAR in FY07 with a final FWCAR in FY08. Reflecting these revised completion dates, we would like to extend the reimbursable agreement (MIPR No. rtXMA6208708 l) through the end of Fiscal Year 2009.

I want to thank you in advance for your cooperation in this matter. P1ease contact Mr. Jodie Foster of my staff at (817)-886-1679 if you have any additional questions.

Sincerely,

William Fickel, Jr.
Chief, Planning, Environmen al, and
Regulatory Division

Foster/1679
ECKHARDT, CESWF-PM-C
HARBERG, CESWF-PER-E
FICKEL, CESWF-P

APPENDIX I

HTRW ASSESSMENT

EXISTING CONDITIONS
FOR
CHACON CREEK - LAREDO, TEXAS
APRIL 2006

Part 1 – Records Review

Introduction

A review of standard environmental record sources in accordance with ER 1165-2-132 was conducted by the Environmental Design Branch, Fort Worth District, Corps of Engineers as part of a Hazardous, Toxic, and Radioactive Waste (HTRW) Investigation for Chacon Creek, Laredo, Texas. Chacon Creek is located in a high urban growth corridor primarily within the City of Laredo, population 177,000. The study area consisted of an approximate 4.5 mile floodway corridor of Chacon Creek that stretches from HW 59 to the Rio Grande and four unnamed tributaries that drain the watershed east of Chacon Creek. Because specific project objectives and sites are not yet defined, the purpose of this review is to gain a broad understanding of conditions within the study area. In the future, when specific project actions are proposed, then a more precise interpretation of the database results may be possible.

Databases

The following environmental conditions were identified in connection with the study area:

17 RCRIS-SQG sites: **R**esource **C**onservation and **R**ecovery **I**nformation **S**ystem – **S**mall **Q**uantity **G**enerator.

2 ERNS sites: **E**mergency **R**esponse **N**otification **S**ystem. Database of recorded releases of oil and hazardous substances.

10 LUST sites: **L**eaking **U**nderground **S**torage **T**anks.

20 USTs sites: **U**nderground **S**torage **T**anks.

21 FINDS sites: **F**acility **Ind**ex **S**ystem. Contains both facility information and "pointers" to other databases. These databases include: RCRIS, PCS, AIRS. FATES, FTTS, CERCLIS, DOCKET, FURS, FRDS, SIA, CICS, PADS, RCRA-J, TRIS and TSCA.

2 HMIRS sites: **H**azardous **M**aterials **I**nformation **T**racking **S**ystem. Contains information on hazardous material spills reported to the DOT.

3 AST sites: **A**boveground **S**torage **T**anks.

1 TX SPILLS sites: Database of spills within Texas.

12 TX IHW sites: **T**exas **I**ndustrial and **H**azardous **W**aste. Database of summary reports by waste handlers, generators and shippers in Texas.

Discussion

Results from the database search revealed that limited industrial development is present on either side of Chacon Creek within the study area. This observation was verified with the Site Inspection conducted March 2006. The following is a summary of the more significant sites within the study area.

LUSTs

Ten LUST sites were identified within the study area. The status of seven of these sites is "Final Concurrence Issued, Case Closed". Two LUST sites have are undergoing monitoring an one LUST site is developing/implementing a Corrective Action Plan.

RCRIS-SQG

Quality Carriers Inc. located at 1740 Aquila Azteca received five Notice of Violations (NOV) in 1994. Western Atlas Logging Services located on HW 359 received 1 NOV in 1987. Key Energy Services located on HW 359 received eleven NOVs in 1995 and one NOV in 1997.

Conclusion

The April 2006 environmental record database search was similar to the findings reported by Carter & Burgess in January 2001 as part of a Phase I Environmental Site Assessment (ESA). For more detailed information, the original database search of standard environmental record sources should be consulted.

Part 2 – Site Inspection

Introduction

On 28 and 29 March-2006 William Crump from the U.S Army Corps of Engineers – Fort Worth District along with Jerry Cantu, an environmental specialist, from the City of Laredo performed a Site Inspection of the Chacon Creek study area in Laredo, Texas The study area consisted of an approximate 4.5 mile floodway corridor of Chacon Creek that stretches from HW 59 to the Rio Grande and four unnamed tributaries that drain the watershed east of Chacon Creek. In accordance with ER 1165-2-132 the site was investigated for evidence of contamination including partially buried containers, discolored soil, seeping liquids, films on water, abnormal or dead vegetation or animals, suspect odors, dead-end pipes, abnormal grading or depressions.

Field Observations

Weather conditions were partly cloudy to overcast with a light breeze and temperature ranging from the high 70's to the low 80's. Visibility at the site was excellent with no haze , smoke, or smog present. A visual Site Inspection was conducted by driving to accessible locations along Chacon Creek and the four tributaries. The first day was spent inspecting the floodway corridor of Chacon Creek. The corridor was inspected by stating with the southernmost reach of Chacon Creek where it empties into the Rio Grande then moving northward until concluding at HW 59 near the state park. The second day was spent inspecting the four tributaries that drain the watershed to the east of Chacon Creek. The northernmost tributary was inspected first followed in turn by the next closest tributary until the southernmost tributary was reached. The following photolog documents the process.

Stop1. 28-Mar-2006, 9:30 a.m. Mouth of Chacon Creek as it enters the Rio Grande.

Stop 2. 28-Mar-2006, 9:50 a.m. Mouth of Tinnage Creek as it enters Chacon Creek.

Stop 3a. 28-Mar-2006, 10:15 a.m. Near baseball field. Empty drums.

Stop 3b. 28-Mar-2006, 10:15 a.m. Near baseball field. Construction debris.

Stop 3c. 28-Mar-2006, 10:15 a.m. Near baseball field. Lead battery and construction debris.

Stop 4. 28-Mar-2006, 11:00 a.m. Construction debris site owned by 3G Demolition. Near HW 83 Bridge.

Stop 5. 28-Mar-2006, 11:20 a.m. New machine shop construction near Dryan park. Site was location of 2001 Phase II ESA.

Stop 6. 28-Mar-2006, 11:40 a.m. End of the trail. A trail system was finished by the city of Laredo in 2005. As a part of this project, trash and brush were cleared along the creek.

Stop 7a. 28-Mar-2006, 12:00 p.m. Active dump area north of HW 359. Torn down houses nearby.

Stop 7b. 28-Mar-2006, 12:00 p.m. Discarded electronics litter the area.

Stop 7c. 28-Mar-2006, 12:00 p.m. Discarded picture tube.

Stop 8a. 28-Mar-2006, 12:30 p.m. Loma Alta (high hill). The “Villa de Sol” subdivision can be viewed from this bluff. This low lying area is slated for real estate acquisition.

Stop 8b. 28-Mar-2006, 12:30 p.m. Another area viewed from Loma Alta (high hill). More of the “Villa de Sol” subdivision is seen in the distance..

Stop 9. 28-Mar-2006, 1:40 p.m. Oil spill area from 2001 report (photo 11). Since then the drums and visibly contaminated soil were removed.

Stop 10b. 28-Mar-2006, 2:10 p.m. Killam Lake.

Stop 10c. 28-Mar-2006, 2:10 p.m. Another view of Killam Lake.

Stop 11a. 28-Mar-2006, 3:00 p.m. Dump area near backside of Homeland Security building.

Stop 11c. 28-Mar-2006, 3:00 p.m. Dump area continued.

Stop 12a. 29-Mar-2006, 9:30 a.m. Tributary to Chacon Creek off Casa del Sol Blvd. Channel has been widened. Mobile home park on both sides.

Stop 12b. 29-Mar-2006, 9:30 a.m. Tributary to Chacon Creek off Casa del Sol Blvd continued.

Stop 12c. 29-Mar-2006, 9:30 a.m. Tributary to Chacon Creek off Casa del Sol Blvd continued. Further downstream channel narrows and trash is present.

Stop 13a. 29-Mar-2006, 10:00 a.m. Overlooking tributary to Chacon Creek along railroad tracks. No development immediately adjacent to tributary on this side.

Stop 13b. 29-Mar-2006, 10:00 a.m. New houses are being built in the watershed to the tributary to Chacon Creek along the railroad tracks.

Stop 14a. 29-Mar-2006, 10:20 a.m. Established neighborhood along tributary to Chacon Creek near Century Blvd.

Stop 14b. 29-Mar-2006, 10:20 a.m. Established neighborhood along tributary to Chacon Creek near Century Blvd. continued .

Stop 15a. 29-Mar-2006, 10:30 a.m. New construction further upstream from Century Blvd. tributary.

Stop 15b. 29-Mar-2006, 10:30 a.m. New construction further upstream from Century Blvd. tributary continued.

Stop 16. 29-Mar-2006, 11:00 a.m. Southern most tributary into Chacon Creek. Construction debris and trash along channel. Further upstream this tributary flows underground through an older neighborhood.

Conclusion

A Phase I ESA conducted by Carter & Burgess in 2001 identified the following conditions along Chacon Creek: eighteen large dump sites, three clusters of 55-gallon steel drums, and an apparent confined animal feeding operation (CAFO). Until 1998, the City of Laredo did not restrict landfills on private land. None of the landfill sites were permitted or monitored. Personnel from the City of Laredo stated that with the exception of the CAFO these sites have been cleaned. However, this remediation process consisted of removing surface waste and excavation of visibly contaminated soil. During the site inspection it was confirmed that the sites identified in the 2001 Phase I ESA were indeed no longer present. As evidenced by the preceding pictures, dumping still occurs along throughout the study area although to a much reduced scale compared to prior of 2001. In the eastern portion of the study area new construction is widespread. With the exception of several scattered dump sites and trash no evidence of HTRW sites were noted. However, given the previous magnitude of dump sites, surface and subsurface sampling for TPH and metals should precede any excavation within the study area. Also, because of the urban nature of the drainage area, pesticide analyses should also be considered.

Part 3 – Previous Studies

Introduction

Carter & Burgess conducted a Phase I ESA of the floodway corridor along an approximately 4.5 mile segment of Chacon Creek in Laredo, Texas in 2001. The Phase I ESA was performed in support of a restoration and development project along Chacon Creek. The restoration and development project consisted of trash removal, removal of invasive plant species, planting of native trees, and the construction of hike and bike trails along Chacon Creek.

Carter & Burgess conducted a Phase II ESA to determine the impact of historic land uses on subsurface soils and ground water at two sites along Chacon Creek in 2001. The two sites selected for study were identified as Sites 8 and 9 in the previous Phase I ESA. Four soil borings were installed at Site 8 and two borings were installed at Site 9. During the installation of the soil borings, soil samples were collected at various intervals from the borehole. Additionally, temporary monitoring wells were installed in all six of the soil borings. After the purging of three well volumes, groundwater samples were collected from the temporary monitoring wells. All samples were test for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene, and Xylenes (BTEX), and eight RCRA metals which include Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver, and Mercury.

Results

The Phase I ESA identified the following conditions along Chacon Creek: eighteen large dump sites, three clusters of 55-gallon steel drums, and an apparent CAFO.

.

TPH and BTEX were not detected in any samples (soil or groundwater). The eight RCRA metals for soil and groundwater were reported at levels below the Combined Tier 1 Soil Protective Concentration Levels.

Conclusion

Results from the previous study can be used to augment and guide sampling for the Chacon Creek area. However, the 2001 ESA does address the four unnamed tributaries that drain the watershed east of Chacon Creek. Additionally, the Phase II ESA is limited and does not provide adequate assessment of the soil and groundwater in the study area . Supplemental analysis for other contaminants, including TPH and metals, will likely need to be performed once potential projects sites within the study area are determined.

APPENDIX J

MONITORING AND ADAPTIVE MANAGMENT PLAN

Chacon Creek Monitoring and Adaptive Management Plan

April 2018

Prepared by:
Tetra Tech, Inc.
6121 Indian School Rd. NE, Suite 205
Albuquerque, New Mexico 87110

TETRA TECH

Contents

1.0 INTRODUCTION

This study is located in the City of Laredo (the City), Texas in the Lower Chacon Creek watershed. The City is just north of the Rio Grande in Webb County and is a major trucking route for international trade between the United States and Mexico. The City and Webb County are currently experiencing rapid growth causing increased encroachment on the Lower Chacon Creek watershed (Figure 1).

Chacon Creek is an important natural resource located on the eastern side of Laredo, Texas with a wide range of environmental, economic, recreational, and educational needs and opportunities. Years of neglect including illegal dumping, rapid urbanization, and storm runoff have led to contamination, erosion, and loss of wetland habitats and vegetation. Invasive plant species have seriously degraded the value of riparian and riverine habitats for wildlife, as well as altered soil productivity and increased the potential for fires.

A Feasibility Study and Environmental Assessment for Chacon Creek, Laredo, Texas (Study) was conducted by the U.S. Army Corps of Engineers (USACE) in cooperation with the City. The Study examined an array of alternatives to address each of the challenges to reduce flood threat, restore the aquatic and riparian ecosystems, and provide compatible recreational opportunities. The Tentatively Selected Plan (TSP) is a combined National Economic Development/National Ecosystem Restoration (NED/NER) Plan.

This Monitoring and Adaptive Management Plan (Plan) is intended to provide a method to evaluate the goals of the TSP by measuring success criteria through specific, on the ground monitoring of project components. The potential need for adaptive management where success criteria may not have been met is also described.

Adaptive management (AM) is defined as a rigorous approach for designing and implementing management actions to learn about critical uncertainties that affect decisions (Williams et al. 2012). The heart of adaptive decision making is the recognition of alternative hypotheses about resource dynamics (Williams and Brown 2012) and assessment through monitoring. Science-based monitoring is performed to see if actual outcomes match those predicted, and using these results to learn and adjust future management. All the monitoring and adaptive management criteria shall be used to evaluate the degree to which the project meets the goals described in Section 1 below.

1.1 PROJECT AND GOALS

The project goal for ecosystem restoration under the TSP is to provide a diverse and sustainable ecosystem for the Chacon Creek corridor. The primary objective is to improve the suitability and quality of the habitat in the study area in a manner that is sustainable and enhances the natural systems by resolving environmental degradation within the Chacon Creek corridor. The removal of problematic non-native vegetation and establishment of desirable native shrubs and trees is required to increase habitat suitability within the planning area. The increase in habitat quality will increase the amount of habitat for federal listed species and native wildlife.

1.2 AUTHORIZATION FOR MONITORING AND ADAPTIVE MANAGEMENT

Per Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007), feasibility studies for ecosystem restoration are required to include a plan for monitoring the success of the ecosystem restoration. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be need to attain project benefits." Therefore, Section 2039 also directs that a Contingency Plan (Adaptive Management Plan) be developed for all ecosystem restoration projects.

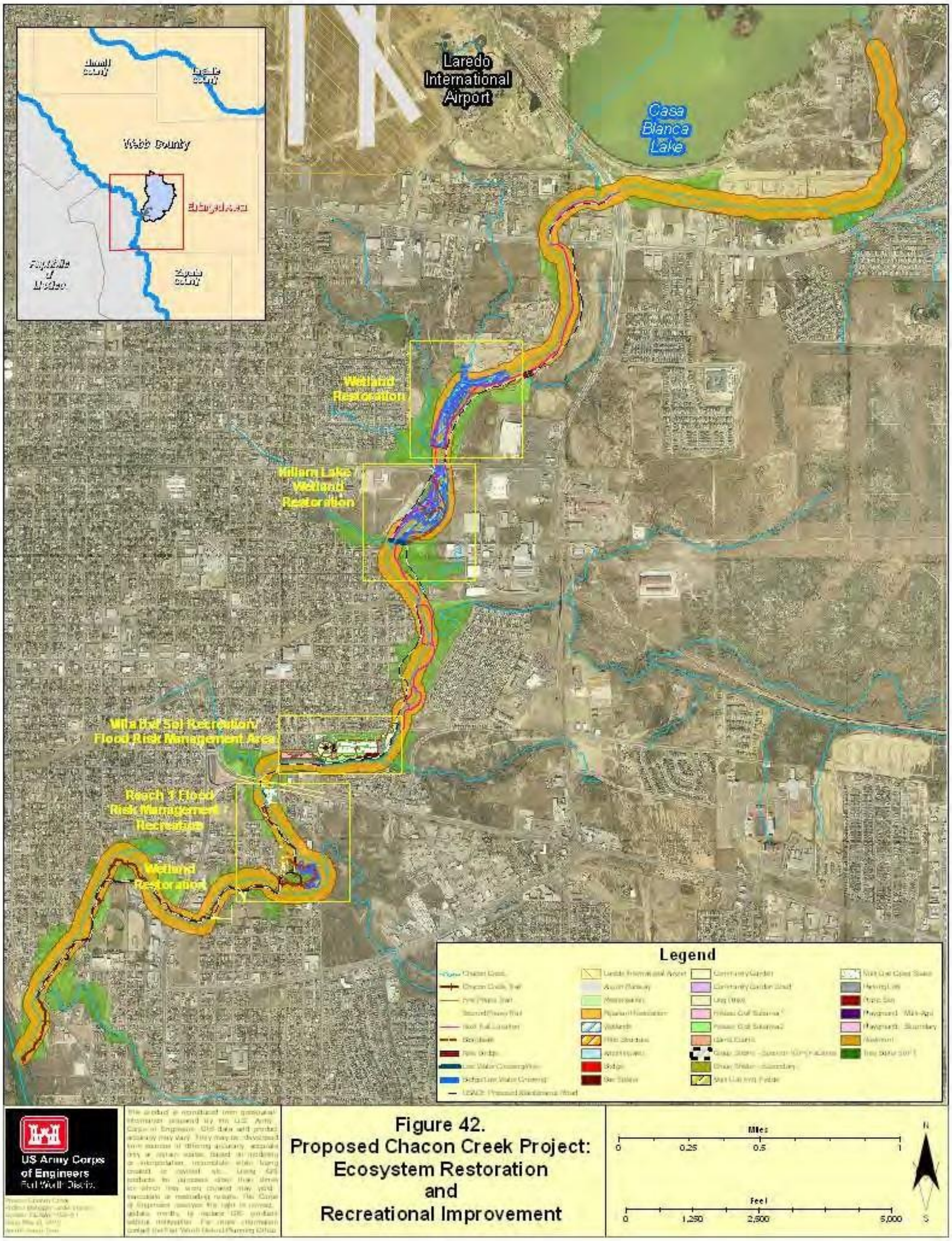
The restoration measures will be periodically surveyed to provide feedback on ecosystem response to the restoration and management measures proposed for the Chacon Creek corridor. By connecting the ecosystem response to the restoration as well as the management measures, potential beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project.

To accomplish this goal, periodic monitoring of the restoration measures by the Federal Government will be conducted during project implementation prior to the project being turned over to the non-Federal sponsor for operation and maintenance, and will be cost-shared between the Government and the non-Federal sponsor as part of the total project cost.

a. Action Implemented

The NER component of the TSP would restore three wetland sites and implement riparian restoration of over 400 acres of aquatic habitat. Figure 1 depicts the location of the aquatic ER component of the TSP. The ER component would restore three wetland sites totaling 16.75 acres and 401 acres of riparian habitat, by removing buffelgrass (*Pennisetum ciliare*) and other invasive non-native grasses and planting native species with temporary irrigation until plants are established. Additional riparian measures include the removal and control of salt cedar (*Tamarix* spp.; salt cedar). The TSP would also include the removal of debris as well as a concrete barrier from the streambed.

The NER Plan includes elements for improving water quality, improving herbaceous cover, reduction in erosion and turbidity, controlling invasive species, and enhancing the quality of wetland, riverine, and riparian habitats. The ecosystem restoration measures for the proposed action are expected to have long-term beneficial effects for the terrestrial and aquatic systems and associated wildlife in the project area by providing improved habitat and a potential corridor between areas of suitable habitat, and would therefore be wholly beneficial for the ocelot (*Leopardus* (=*Felis*) *pardalis*), Gulf Coast jaguarundi (*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*; jaguarundi), and Texas hornshell (*Popenaias popeii*).



(Image source: USACE, 2010)

Figure 1. Restoration Overview

1. Wetland measures

Wetland measures would contribute to ecosystem restoration by increasing the quantity and quality of wetland habitat and improving water quality. The wetland measures would create or expand existing wetland areas. This would be accomplished by constructing weir/riffle structures that would hold a shallow pool of water upstream of the weir, expanding the area of existing wetlands. On the downstream side of the weir, a riffle structure would extend five feet downstream for every one-foot of weir height. This riffle structure would add oxygen to the system and improve water quality. However, its primary purpose would be to prevent scour and provide support to the weir structure. Rain events would be the source for water and seepage from the dam at Lake Casa Blanca. For each site, various weir heights were considered to create wetland area.

The recommended plan includes three wetland areas that will total approximately 16.75 acres, which is an addition of 13.09 acres (Figure 2).

Wetland A, Scale A2

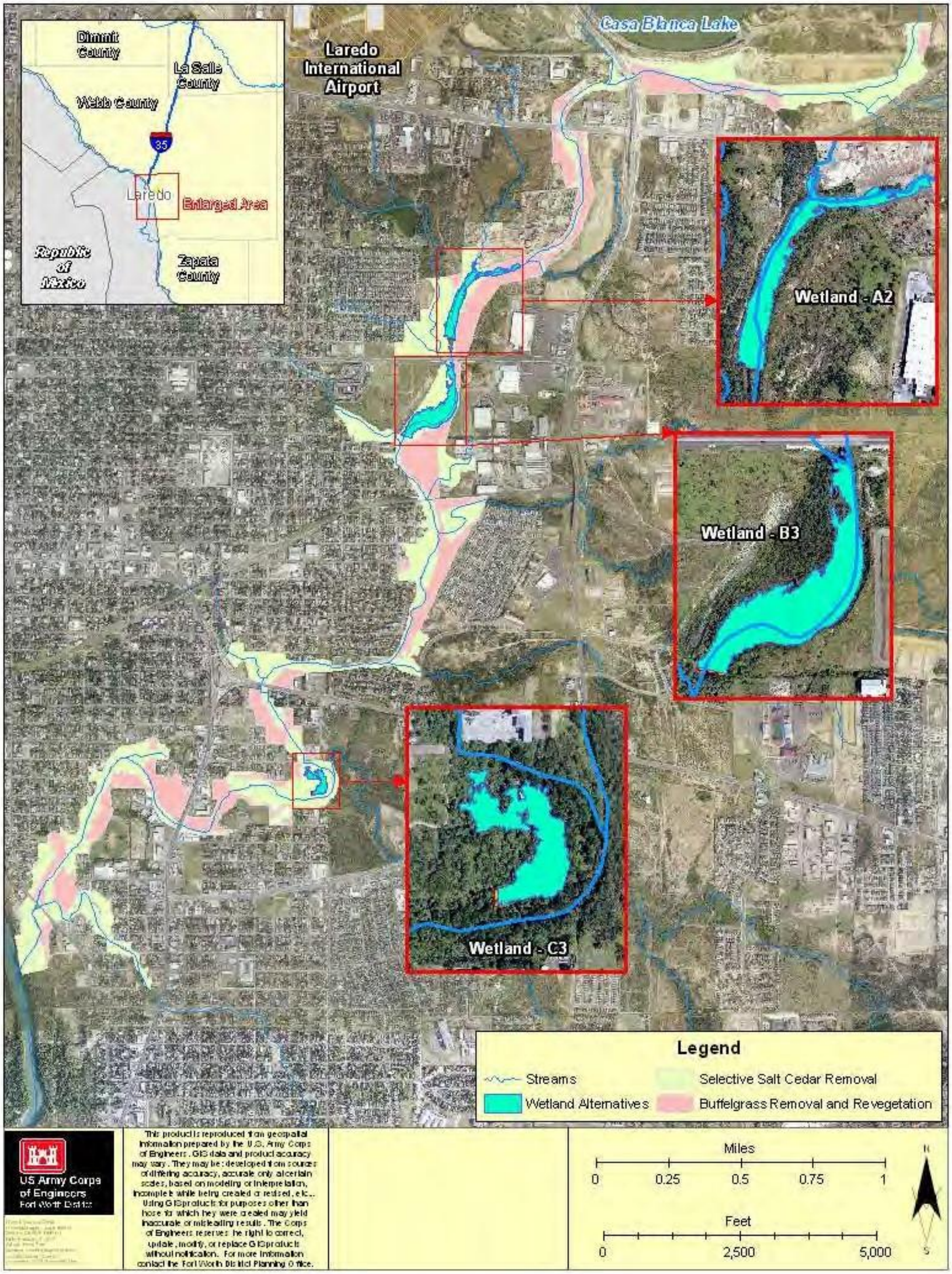
For Wetland A, a weir would be constructed that would raise water levels by two feet. A downstream riffle will be constructed that will primarily prevent scour and support the weir structure. This riffle structure will also enhance riverine habitat by adding oxygen to the water and provide positive changes to the habitat suitability in the area. In this area, upstream from the proposed weir, a concentrated animal feeding operation (CAFO) exists that adds nutrient runoff to the system. As part of the riparian measures, this facility will be removed in the study area.

Wetland B, Scale B3

For wetland B, a weir would also be constructed that would add approximately three feet of permanent water to the site; again, a riffle structure downstream from the weir would be constructed.

Wetland C, Scale C3

For wetland C, an off-channel weir would be constructed that seasonally would add up to three feet of water to the site, and a riffle structure downstream from the weir would be constructed. Extensive debris removal is included in this area. There were several woody species in the area; impacts to these will be avoided and minimized.



(Image source: USACE, 2010)

Figure 2. Wetland Measures Overview

2. Riverine Measures

The recommended plan does not include any additional riffle structures in the three identified riverine reaches.

3. Riparian Measures

The remainder of the study area, the area not included for wetland or riverine ecosystem restoration measures, was identified as “forested” riparian and “non-forested” riparian, and these areas were then used as scales for the riparian measures. The riparian measure, measure G, includes three scales to be implemented on 401 acres. For the area identified as “non-forested,” the alternative (G1) includes removal and control of buffelgrass and other non-native species present, as well as planting native species and would include irrigation. An access road will be installed to support maintenance. For the area identified as “forested,” the alternative (G2) consists of the selective removal and control of salt cedar, an invasive species, as well as the removal of debris. The third scale or alternative G3, the selected alternative, would be a combination of G1 and G2.

Riparian G, Scale G3

For this measure, scale G3 is a combination of scales G1 and G2. Scale G1 includes portions of the study area identified as non-forested riparian, and vegetation consists primarily of buffelgrass, an invasive species. In these areas, native species will be avoided, but otherwise this area will be cleared, grubbed, and treated for control of buffelgrass, followed by the installation of an irrigation system and replanting of native species, as described in the USFWS Site Visit Report in Appendix E, “U.S. Fish and Wildlife Service Coordination.” G2 includes areas identified as forested riparian, and for this measure includes selective removal and stump treatment of salt cedar, as described in the USFWS Site Visit Report.

The riparian restoration consists of the removal and management of invasive species, as well as planting of native species in the riparian area. Salt cedar would be selectively removed from 251 acres, and buffelgrass would be removed from 150 acres within the study area. 150 acres of native species of trees, shrubs, and herbaceous vegetation would be planted in the riparian area. This would ultimately result in 401 acres of restored riparian habitat and 16.75 acres of wetlands. This would primarily have moderate long-term, beneficial impacts on vegetation, which would have indirect beneficial effects on water quality the other resources. Riparian restoration would increase habitat quality for species using the riparian corridors, including the ocelot and jaguarundi. The proposed action would also include the removal of debris as well as a concrete barrier from the streambed.

In total, there are three general ecosystem restoration activities in this study: the creation and restoration of wetlands, improvement to aquatic riverine habitat, and reforestation of riparian habitat. To evaluate these actions, the activities were separated into measures with a series of scales. Table 1 provides a summary of the above-described measures and scales.

Table 1. Ecosystem Restoration Summary

Measure	Scale	Description
Wetland Site A	A2	Weir height 2 feet, width 120 feet, to create approximately 5.99 acres of wetland
Wetland Site B	B3	Weir height 3 feet, width 190 feet, to create approximately 8.69 acres of wetland
Wetland Site C	C3	Weir height 3 feet, width 65 feet, to create approximately 2.07 acres of wetland, debris removal
Riparian G	G1	Reforestation of non-forested area, including buffelgrass control, planting, and irrigation
	G2	Removal of salt cedar from forested areas
	G3	G1 + G2

b. Project Requirements

Under Section 404 of the Clean Water Act (CWA) (33 USC 1344), Congress directed USACE *to regulate the discharge of dredged and fill material into all waters of the United States including wetlands*. Based on information gathered during biological surveys, approximately 4.62 acres of the restoration area are considered Waters of the United States. The work is proposed to be conducted under Nationwide Permit (NWP) 27 and coordination with the Texas Commission on Environmental Quality (TCEQ) regarding water quality certification.

- NWP 27 "Aquatic Habitat Restoration, Enhancement, and Establishment Activities" pertains to activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.
- Best management practices are also required where practicable to reduce the risk of transferring invasive plant and animal species to or from project sites. The TSP would not result in the loss of aquatic sites or streams therefore no mitigation would be required. Best management practices would be implemented to reduce the risk of spreading invasive species.
- The Texas Commission on Environmental Quality (TCEQ) is responsible for conducting Section 401 certification for the discharge of dredged or fill material into waters of the United States, including wetlands. The TCEQ conditionally certifies that the activities authorized by NWP 27 should not result in a violation of established Texas Surface Water Quality Standards as required by Section 401 of the Federal Clean Water Act and pursuant to Title 30, Texas Administrative Code, Chapter 279. General Condition 12 of the certification requires Soil Erosion and Sediment Controls.

Any additional Section 404/401 requirements for implementation and management of the proposed project should be amended to this Plan.

A Draft Biological Assessment (Study Appendix E. USFWS Coordination) was also developed for the project and any requirements of final coordination with the U.S. Fish and Wildlife Service (USFWS) should be amended to this Plan.

Project components, best management practices, and an evaluation of project success are described in Section 2.0 and address as many of the criteria as possible/are known at this time.

c. Operation, Maintenance, Repair, Replacement, and Rehabilitation

The Federal Government and the City would enter into a project partnership agreement (PPA) under which the City would accept the project following completion of construction and ensure its operation, maintenance, repair, rehabilitation, and replacement (OMRRR), in accordance with Federal regulations. The major OMRRR items include the following:

- Regular maintenance of park facilities
- Restriping access areas
- Debris cleanup
- Selective trimming in restoration areas
- Invasive species control

The tasks required under the TSP OMRRR will involve a modest increase in the types of maintenance activities the City is already accustomed to. Recreation maintenance requirements, such as grounds and equipment maintenance and debris cleanup, are things the City already performs to maintain the City parks grounds and facilities. In the case of the TSP, the City would have a larger facility to maintain than what is currently present in the Villa Del Sol neighborhood, as well as additional facilities in Reach 1 south of Highway 359. The ecosystem restoration maintenance activities of selective trimming and invasive species control are already activities the City performs as well, particularly the control of salt cedar.

After completion of the project, an Operation and Maintenance (O&M) Manual for the City would be prepared by USACE, and periodic inspections would be conducted to ensure that all required maintenance was being performed.

This Plan will also be an Appendix to the O&M Manual for implementation by the City.

2.0 MONITORING PLAN COMPONENTS, GOALS AND SUCCESS CRITERIA

The national and state trend for habitat loss is evident in the Laredo area, which makes this significant national, state, and local resource even more important. The Chacon Creek corridor is divided by the dam creating Lake Casa Blanca. A portion of the corridor on the western side of Chacon Creek and south of E Saunders St between the Lake Casa Blanca and the Rio Grande contains a CAFO adjacent to the stream channel. Further habitat degradation is resulting from the introduction and spread of exotic species. The introduction of exotic plant and animal species has rendered substantial effects on riparian areas, leading to displacement of native species and the subsequent alteration of ecosystem properties (NRC 2002). Problematic non-native woody and herbaceous plant species are found throughout the project area. The USFWS and Texas Parks and Wildlife Department (TPWD) recommended local elimination of these species because they limit the value of important riparian ecosystems.

Desirable habitat for migratory waterfowl and neotropical migrants is limited in the Laredo area. However, the project area is centrally located along the Rio Grande River, which runs from Colorado to the Gulf of Mexico, and provides an important corridor through the southwest. Any improvement to the documented degraded state of the riparian zone would increase the amount of scarce habitat along a documented migratory bird corridor.

The study area consists primarily of riparian habitat, yet the approximately 401 acres provide little quality habitat. Exotic species have become established in the riparian area. Non-forested riparian areas and forested areas with adequate solar exposure support a near monoculture of buffelgrass. In the forested riparian areas, salt cedar is becoming established and displacing native vegetation. Specific measures such as exotic species removal and revegetation in the riparian area could directly increase habitat quality and improve the health of the riparian habitat located within the study area. Any improvements to the riparian habitat including riparian woodlands and wetlands would make an important contribution to restoring the one of the last natural stream corridors in the City.

2.1 RIPARIAN HABITAT RESOURCES

a. Vegetation

Gould and et al (1969) divided Texas into ecological regions based on the distribution of vegetation. The study area is within the South Texas Plains Ecological Region. This South Texas region owes its diversity to the convergence of the Chihuahuan Desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande to the south, and coastal grasslands to the east. The South Texas Plains are characterized by a shrubland of mesquite (*Prosopis glandulosa*), blackbrush acacia (*Acacia rigidula*), spiny hackberry (*Celtis pallida*), and other shrubs intermixed with a variety of grasses. Forested areas can develop along small drainages and typically support small trees, such as sugarberry (*Celtis laevigata*) and ash species (*Fraxinus* spp.). The suppression of fire, multiple invasions of non-native plants, loss of wetlands, encroachment of brush, livestock grazing, and habitat fragmentation have arguably altered the current vegetation. A list of vegetation observed in the study area is included in the Study Environmental Appendix B, Addendum C.

As defined by species composition and general appearance, the vegetation communities that the USACE Project Development Team observed in the study area are typical of small drainages in the South Texas Plains. A Mesquite-Mixed Shrub-Buffelgrass shrubland is nearly ubiquitous throughout the study area, and a few remnant stands of Sugarberry-Mexican Ash (*Fraxinus berlandieriana*) forest are found in the middle portion of the study area.

The persistence of invasive non-native plant species, such as salt cedar, Arundo cane (*Arundo donax*), and buffelgrass (*Pennisetum ciliare*), has significantly degraded habitat value for wildlife and ecological function and has prevented the reestablishment of desirable native species. Other introduced invasive plant species include kleingrass (*Panicum coloratum*), Kleberg’s bluestem (*Dichanthium annulatum*), and low abundances of white leadtrees (*Leucaena leucocephala*). These plants escaped from cultivated settings or introduced to provide forage to cattle and proliferated in an environment lacking species specific disease and pests. The plants have and will continue to colonize newly disturbed areas forming dense monotypic stands over wide areas and have little value to native wildlife. Buffelgrass is still being spread and cultivated in large areas as a “superior” forage for cattle. These plants alter fire regimes, out-compete native plant species, and in some cases exhibit allelopathic characteristics.

b. Invasive Plant Species

Several introduced, invasive plants are presently well established in the riparian shrubland habitat and throughout the project area. The most significant are buffelgrass, Kleberg bluestem, salt cedar, guineagrass (*Urochloa maxima*), Arundo cane, castorbean (*Ricinus communis*), and Russian thistle (*Salsola* spp.). Invasive white leadtrees are present at low abundance.

Unlike most native wood riparian plant species salt cedar can propagate in the absence of physical disturbance events in regulated waterways such as Chacon Creek. The seed and seedbed ecology of native woody species requires damp seedbeds found on the active floodplain to initiate germination and promote the establishment of native woody vegetation communities. Salt cedar can regenerate in the absence of physical disturbance events and consequently serves as a major habitat component in degraded riparian areas under altered hydrologic regimes, which are insufficient to support robust native woody species regeneration. The reduced amount of physical disturbance in the floodplain has increased the dominance of salt cedar stands over time.

Habitat characteristics of salt cedar systems confer mixed benefits to animal species. Although salt cedar is a non-native species and native vegetation stands are more desirable, it provides important habitat qualities in riparian areas where physical disturbances are absent and potential for native vegetation regeneration is low. Salt cedar provides vegetation structure and is an important habitat for nesting riparian bird species (Sogge et al. 2008; Paxton et al. 2011). Non-avian use of salt cedar is not fully understood; however, reptile and mammal use of both salt cedar and mixed habitats has been documented (Bateman and Ostoja, 2012).

Buffelgrass is perennial C_4 warm season bunchgrass introduced into areas of Texas from Africa as early as 1917, with increasing successful plantings occurring between 1949 and 1985 (Hanselka 1988). The species has infested areas in south Texas (Cox et al. 1988). The species is considered valuable for livestock and has led to increased cattle stocking rates but is of poor value for wildlife (Hanselka 1988). Buffelgrass is still being spread and cultivated in large areas as a “superior” forage for cattle.

Buffelgrass is present throughout the project area, particularly in open canopy and upland settings. The species exhibits a high tolerance to drought and grazing pressures, and vigorously responds to precipitation events (Marshal et al. 2012). Buffelgrass is ecologically problematic due to its dense monotypic stands, which grow, senesce, and dry in total synchrony, unlike the diverse native vegetation where species avoid competition by partitioning phenological niches (Wolkovich and Cleland 2014). As a result, buffelgrass stands are extremely susceptible to wildfire, unlike the native riparian shrubland vegetation which is very well adapted to wildfire. Once established, the invasive grasses create an increased potential for wildfire and grass cover and a domino syndrome of loss of biodiversity and collapse of the ecosystem. The presence of buffelgrass in south Texas has resulted in reduced forb species richness, density, and total cover (Sands et al. 2009).

The introduction and spread of buffelgrass presents a threat to biodiversity in the study area (Marshall et al. 2012). Buffelgrass is ubiquitous throughout the study area and forms a major component of the herbaceous understory. This non-native species competes with native grasses and forbs and forms extensive monocultures. Although the percent cover of buffelgrass was as high as 80 percent in some areas, this species does little to prevent erosion and does not provide suitable forage for most species. Buffelgrass reaches greater densities compared to native grasses, is fire tolerant, and promotes a grass-fire cycle that is capable or replacing native vegetation (McDonald and McPherson 2011).

c. Wildlife

The South Texas Plains support a wide variety of wildlife (Gould, 1969). Dense riparian vegetation is often an important source of forage and cover that is lacking in the more xeric upland habitats. A list of wildlife observed in the study area is included in the Study Environmental Appendix B, Addendum D. Common birds include the Altimira oriole (*Icterus gularis*), Chachalaca (*Ortalis vetula*), green jay (*Cyanocroax yncas*), olive sparrow (*Arremonops rufivirgatus*), road runner (*Geococcyx californianus*), scaled quail (*Callipepla squamata*), and white-tipped dove (*Leptotila verreauxi*). Also, three rare tropical birds that are considered "South Texas Specialty Species" (Woodin, 2000) were recorded along the Rio Grande in Laredo. These include the White-collared Seedeater (*Sporophila torqueola*), Clay-colored Robin (*Turdus grayi*), and Red-billed Pigeon (*Columba flavirostris*).

Common mammals of the South Texas Plains include badger (*Taxidea taxus*), bobcat (*Felis rufus*), eastern cottontail (*Sylvagus floridanus*), gray fox (*Urocyon cinereoargentus*), javelina (*Tayassu tajacu*), ringtail raccoon (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), and a variety of small mammals including mice and rats.

Common snakes in the South Texas Plains include the blotched water snake (*Thamnophis marcianus transversa*), diamondback water snake (*Nerodia rhombifera*), Mexican racer (*Coluber constrictor oaxaca*), Texas glossy snake (*Arizona elegans*), western diamondback rattlesnake (*Crotalus atrox*), and the Texas indigo snake (*Drymarchon corais*). Common lizards of the South Texas Plains include the blue spiny lizard (*Sceloporus cyanogenys*), southern prairie lizard (*Sceloporus undulatus consobrinus*), Texas banded gecko (*Coleonyx brevis*), Texas spiny lizard (*Sceloporus olivaceus*), and Texas spotted whiptail (*Cnemidophorus gularis*).

d. Riparian Habitat Goals, Success Criteria, and Monitoring Components

The goals related to riparian vegetation include: controlling weed species and exotic woody plant species; survival of planted native trees, shrubs and herbaceous vegetation, and establishment and survival of native vegetation within the project area. For the purposes of this plan, weeds are defined as non-native herbaceous plants and exotic woody plants are invasive and/or phreatophytic trees. Based upon these goals, success criteria, and related monitoring components are noted in Table 2 below. Specific monitoring component methods are described in Section 3.0.

Table 2. Riparian Habitat Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Components
Control weeds and exotic and invasive vegetation species	Maintain the site with no more than 25% weed/exotic herbaceous species	Measure % of weeds and exotic herbaceous species within treated areas
	Maintain the site with no more than 15% exotic woody plant species	Measure % of exotic woody plant species within treated areas
Survival of planted native trees, shrubs	Maintain 80% survival of planted trees and shrubs	Initial inventory of trees and shrubs on pre-defined transects and monitoring of subsequent % survival.

Goal	Success Criteria	Monitoring Components
and herbaceous species	Ensure a growth rate of 1-plant per ft^2 for planted native seed	Random plot measurement along transect in treated areas
Establishment and survival of native vegetation	Survival of at least 80% of native trees and shrubs that established through natural recruitment	Measure % of native species within treated areas and compare to previous year
Increase wildlife habitat	Habitat criteria are the same as vegetation criteria above	Vegetation monitoring components described above
Eliminate presence of debris	Absence of debris accumulation in project area	Monitor for presence/absence of debris accumulation

2.2 AQUATIC RESOURCES

a. Aquatic Habitat

Vegetation removal, urban development, flow alteration, and exotic species invasion have all impacted the aquatic habitat of Chacon Creek. The Chacon Creek low-flow channel generally carries less than five cubic feet per second (cfs) during normal conditions. The narrow stream channel is usually lined and commonly shaded from overhanging vegetation. The lower reach of Chacon Creek is characterized by deeper and wider pools as groundwater and backwater influences from the Rio Grande are realized. This riverine habitat is a narrow non-continuous band within the channel.

In the upper reaches of the creek, some stretches of stream channel become shallow and wider, with thick stands of cattail *(*Typha spp.) and could be considered as herbaceous wetlands. Three additional areas that could be considered palustrine wetlands also occur in the study area. They are characterized by at least some herbaceous emergent vegetation, such as spike rush, along the channel edges and persistent stems of inundated woody vegetation within areas of open water. Although these high value aquatic habitats persist in the study area, poor water quality, human caused disturbance, scour during high flows, sedimentation, and infestation of invasive species has contributed to their degradation.

The enhancement of three wetland sites, totaling 16.75 acres, would increase the quantity and quality of wetland habitat, as well as increase water quality. These permanent wetlands would provide a water source for wildlife, including migrating ocelot and jaguarundi (Figure 2).

b. Aquatic Species

In October 2006, a fisheries survey was conducted on Chacon Creek in Laredo, Webb County, Texas, by the USFWS and City Environmental Services Department personnel. The purpose of this survey was to determine baseline fish-community structure within the area of Chacon Creek. Three sites were selected to sample fish. Table 3 lists the species and numbers collected. For the full baseline fisheries survey report, see the Study Appendix B "Ecosystem Restoration" (Environmental).

Table 3. Chacon Creek Fish Species Collected October 2006

Family	Species	Count
Atherinidae	Inland Silverside (*Menidia beryllina*)	113
Centrarchidae	Bluegill Sunfish (*Lepomis macrochirus*)	9
Characidae	Mexican Tetra (*Astyanax mexicanus*)	19
Cichlidae	Rio Grande Cichlid (*Cichlasoma cyanoguttatum*)	1
	Blue Tilapia (*Tilapia aureus*)	9
Clupeidae	Gizzard Shad (*Dorosoma cepedianum*)	33
Cyprinidae	Blacktail Shiner (*Cyprinella venusta*)	68
	Sand Shiner (*Notropis stramineus*)	3
Poeceliidae	Western Mosquitofish (*Gambusia affinis*)	102
	Sailfin Molly (*Poecillia latipinna*)	65
Total		**442**

The fisheries survey and an index of biotic integrity (IBI) were used to assess the aquatic habitat in the study area. An IBI provides a means to assess aquatic life use within a given water body using multiple metrics and incorporates these metrics to define species richness, trophic composition, and abundance. The IBI for this ecoregion incorporates 11 metrics to assess fish assemblages. Each metric is scored by Environmental Protection specialists with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric's score for a total score. An IBI can then be converted to a habitat index by dividing the IBI score by the maximum IBI score possible. For the full HEP and IBI reports, see the Study Environmental Appendix B.

c. Aquatic Habitat Value

The IBI score for existing aquatic habitat is 27, which when converted to an HSI, is .49. Table 4 provides the existing acres and habitat units of the riverine system on Chacon Creek.

Table 4. Existing Aquatic Habitat Value

Cover Type	Acres	HSI	HU
Aquatic	.96	0.49	.47

d. Water Quality

The Rio Grande is the City's primary source for public water supply. Non-point source (NPS) pollution, which comes from many diffuse sources and is caused by precipitation runoff moving over and through the ground, is the main issue confronting Rio Grande water quality. The Texas Commission on Environmental Quality (TCEQ) assessed the water quality of the Rio Grande downstream from Texas Mexican International Railway Bridge and found that it does not support either recreational use or fish consumption due to elevated levels of fecal coliform bacteria.

Although no direct water quality measurements are available for Chacon Creek, there is substantial illegal dumping and a CAFO are located within the floodplain. Additionally, there is considerable urban development both encroaching on the floodplain and immediately adjacent to Chacon Creek. Storm water runoff that collects in residential areas is concentrated in roadways and in most places enters the study area without any man-made diversions or natural buffers. Further, runoff transports oil, grease, pesticides, and other natural and human-made pollutants, finally depositing them into Chacon Creek and wetlands, as well as underground sources of drinking water. The placement of flow control devices or the creation of natural vegetative buffers could improve habitat conditions in aquatic, wetland, and terrestrial habitats.

The increase of impervious surfaces in the western and lower Chacon Creek watershed contributes to the rapid flooding and high flow volumes characteristic of Chacon Creek after high rainfall events. The sediment and pollution in turn contributes to turbidity in the stream and wetlands. High turbidity leads to increased water temperature and limits growth of aquatic plants, both of which reduce dissolved oxygen in the aquatic system.

The enhancement of three wetland sites, totaling 16.75 acres, would increase the quantity and quality of wetland habitat, as well as increase water quality.

e. Aquatic Habitat Goals, Success Criteria, and Monitoring Components

The goals related to aquatic resources include improving the quantity and quality of wetland habitat which is expected to improve water quality and aquatic habitat for native fish species. Based upon these goals, success criteria and related monitoring components are noted in Table 5 below. Specific monitoring component methods are described in Section 3.0.

Table 5. Aquatic Habitat Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Components
Create and Maintain Wetland Habitat	Maintain wetland area created by weir/riffle structures	Measure total wetland area and wetland vegetation and compare to previous year
Maintain integrity of weir/riffle structures	Functional weir/riffle structures that create wetland habitat	Monitor weir/riffle structures for function and integrity.
Improve water quality	Decrease in turbidity nutrient concentrations and increase in DO	Monitor water samples for turbidity, dissolved oxygen, and nutrients. Measure stream channel depth, flow and substrate. Compare to previous year
Improve IBI and HSI values	Improved species richness and abundance	Measure IBI and HIS values and compare to 2006 data

2.3 THREATENED AND ENDANGERED SPECIES

The USFWS lists seven Federally endangered species that are known to occur in Webb County (see Table 6); three of which are identified as potentially occurring in the vicinity of the study area.

Table 6. Federally Listed Threatened and Endangered Species, Webb County, Texas

Common Name	Scientific Name	Status	Study Area Potential
Ocelot	*Leopardus pardali*	Endangered	Minimal
Gulf Coast Jaguarundi	*Herpailurus yagouaroundi cacomitli*	Endangered	Minimal
Texas Hornshell	*Popenaias popeii*	Endangered	Minimal

No Federally designated critical habitats for these species occur within Webb County.

The Fort Worth District engaged in initial formal consultation with USFWS as required as a condition of Section 7 of the Endangered Species Act (ESA) if a proposed action is likely to adversely affect a listed species. A Biological Assessment, which determines whether a proposed action is likely to adversely affect listed species, proposed species, or designated critical habitat, would be submitted to USFWS and a draft is included in the study documentation (Appendix E). A Biological Opinion, prepared by USFWS and documents whether the proposed action will jeopardize the continued existence of a listed species, would be included in the final study documentation.

a. Ocelot

In 1982, the ocelot was designated as an endangered species under the ESA, a status that extended U.S. protections to the species throughout its range in 22 countries, including Texas, Mexico, and Central and South America. No critical habitat has been designated for this species.

The ocelot is a medium-sized cat, measuring up to three feet in body length and weighing as much as 35 pounds. It is slender and covered with attractive, irregular-shaped rosettes and spots that run the length of its body. Historically, the ocelot occurred in Arkansas, Arizona, southern California, Texas, Mexico and southward through Central and South America to Peru, Uruguay, and northern Argentina (Navarro-Lopez 1985). Today it ranges from southern Texas and northern Sonora, Mexico to Central America, Ecuador and northern Argentina, but in reduced numbers (Tewes and Everett 1986; Emmons 1990; Murray and Gardner 1997). In the U.S. habitat for the species consists of Tamaulipan brushland, which is a unique ecosystem only found in south Texas and northeastern Mexico. The species is primarily nocturnal, although some diurnal activity has been documented. The reproductive season is year-round, with spring or autumn breeding peaks noted in Texas and Mexico.

Fragmentation of Tamaulipan brush habitat and habitat loss due to brush clearing are primary reasons for ocelot decline. Additionally, ocelots require thick vegetation for foraging, resting, and establishing dens and corridors, such as rivers, shorelines, and natural drainages to travel between optimal habitat areas.

b. Gulf Coast Jaguarundi

The jaguarundi was listed as endangered on June 14, 1976. The jaguarundi has two distinct color phases, red and gray, although the latter phase has also been called blue. The study area provides moderate to low quality habitat for ocelot and Gulf Coast jaguarundi. These cats are not likely residents in the study area due to proximity to urban infrastructure and restricted spatial area, but are known to use the riparian zone of the Rio Grande near the mouth of Chacon Creek. These cats may forage or migrate through Chacon Creek.

The jaguarundi historically occurred in southeast Arizona, south Texas, Mexico and Central and South America as far south as northern Argentina. Today this cat has a similar distribution, but in reduced numbers, although it probably no longer occurs in Arizona (Tewes and Schmidly 1987). Habitat requirements in Texas are like those for the ocelot: thick, dense thorny brush lands or chaparral. Approximately 1.6 percent of the land area in south Texas is this type of habitat (Tewes and Everett 1986). The thickets do not have to be continuous but may be interspersed with cleared areas. Jaguarundi possibly shows a preference for habitat near streams (Goodwyn 1970; Davis and Schmidly 1994) and may be more tolerant of open areas than the ocelot.

Little is known of jaguarundi reproduction in the wild. Den sites include dense thickets, hollow trees, spaces under fallen logs overgrown with vegetation, and ditches overgrown with shrubs (Tewes and Schmidly 1987; Davis and Schmidly 1994). The jaguarundi is primarily diurnal, although some nocturnal activity has been recorded (Konecny 1989; Caso 1994). However, it appears to be less nocturnal than the ocelot. Habitat loss and alteration due to brush-clearing activities, human encroachment, and human persecution are the main cause for the decline in jaguarundi populations (USFWS 1995).

c. Texas Hornshell

The Texas hornshell was listed as endangered on March 3, 2018. The Texas Hornshell is a medium-sized freshwater mussel species approximately 3 inches in length with a laterally compressed shell. Shell color ranges from dark brown to green and individuals can be differentiated by distinct lines of color on the shell. Juvenile Texas hornshell mussels have distinct green rays on the shell (Carman 2007).

The Texas hornshell is an endemic freshwater mussel found in medium to large waterways in the Rio Grande drainage in Texas and New Mexico. The species historically ranged from the Pecos River near Roswell, New Mexico to the confluence with the Rio Grande and southeast to the Gulf of Mexico (USFWS 2016). It is thought that the species has been extirpated from the Rio Grande downstream of Laredo, however the exact upstream and downstream limits of the species are not known. The Texas hornshell primarily occurs in shallow, slow-running perennially flowing water tucked under travertine shelves and among large diameter channel bed materials, such as boulders, where soft sediment accumulates (Carman 2007).

The life history of the Texas hornshell is similar to other freshwater mussels. The species is a benthic filter feeder, subsisting on microorganisms, inorganic, and organic materials from the water (Howard and Cuffey 2006). Spawning generally takes place from March to August. Reproduction occurs when males release sperm into the water column, which is drawn into the body of female mussels. Fertilization and the development of larvae takes place in the gill chamber, or marsupial chamber, of female Texas hornshell mussels over a 4-6-week period after which glochidia, microscopic mussel larvae, are released. Glochidia are released in a sticky mucous net or string and must attach to the gills, head, or fin of a host fish. Glochidia are parasitic and will die if they do not attach to a host fish where they feed on fish body fluids. Glochidia metamorphize to juveniles in about 30 days at which point the juveniles will release from the host fish a drop into channel substrate. The lifespan of the Texas hornshell is estimated to be 20 years, however precise longevity is unknown (Carman 2007).

Freshwater mussels such as the Texas hornshell are considered the most rapidly declining group of aquatic organisms in North America (Winemiller et al. 2010). The primary threats to species viability are related to accumulations in fine sediment, reduction in surface water flows, and water quality impairments (USFWS 2016). The entire range of the Texas hornshell has been fragmented by large dams and reservoirs, effectively precluding recolonization of the species in channel segments where it was extirpated, leading to reduced dispersal and fragmented populations. Additionally, the presence of dams has diminished or removed periodic flood pulses from river ecosystems. Dams may also reduce habitat due to excessive silt deposition upstream of dam features. Conservation of mussel species also requires to the conservation of their host fish species (Carman 2007).

d. Threatened and Endangered Species Goals, Success Criteria, and Monitoring Components

Goals for threatened and endangered species are directly related to the Riparian and Aquatic resource goals. Habitat quantity and quality must be improved to increase threatened and endangered species use and occupation of the project location. Increased habitat quantity and quality could possibly also increase threatened and endangered species survival and potentially reproductive output. Based upon these goals, success criteria and related monitoring components are noted in Table 7 below. Specific monitoring component methods are described in Section 3.0.

Table 7. Threatened and Endangered Species Goals, Success Criteria, and Monitoring Components

Goal	Success Criteria	Monitoring Component
Improve potential ocelot habitat	Establishment, increase and survival of potential habitat for the ocelot	Measure vegetation composition, size of stand, height, density, nearness to water and compare to previous year
Improve potential jaguarundi habitat	Establishment, increase and survival of potential habitat for the jaguarundi	Measure vegetation composition, size of stand, height, density, nearness to water and compare to previous year
Improve potential Texas hornshell habitat	Establishment, increase and survival of potential habitat for the Texas hornshell	Monitor water quality, stream characteristics, and wetland acreage as described in section 3.2

3.0 METHODS AND IMPLEMENTATION

Reporting would occur by December 31 of the first-year post-construction and October 31 of each Target Year (TY) thereafter during which monitoring occurs. It is assumed that all restoration measures would be sustainable with minimal maintenance following the 10-year establishment period after which only maintenance of exotic plants and weir/rifle structures would be required. Monitoring of all restoration measures would occur during each year of the establishment period, during the growing season, to quantify and report the status of success criteria. The restoration of wetlands, control of salt cedar, buffelgrass, Arundo cane, and other invasives treated during implementation would each be monitored at 2-year intervals following successful treatments. Monitoring for debris accumulation-periodic maintenance is included for each measure. The findings of the monitoring reports would be used to determine the sustainability of the restoration measures. Bi-annual monitoring would continue until all success criteria are met or City coordination with resource agencies determines that the measures are self-sustaining. If success criteria are not met, adaptive management measures would be implemented as described below for each restoration measure.

All initial soil preparation, planting, and temporary best management practices (BMPs) would be completed during TY1. The following information would be reported for each restoration site at the end of TY1:

- Qualitative description of the restoration sites with photographs
- Qualitative and quantitative description of any temporary BMPs installed
- Volume, location, and area of herbicide application, as recorded using Global Positioning System (GPS) or similar navigation system

3.1 RIPARIAN HABITAT

a. Evaluation of % weed or % exotic woody and herbaceous plant species

Monitoring would occur during TY1, TY3 and every two years thereafter or until it is determined that the project has met the success criteria. Monitoring components requiring geographic location information will be recorded in EPSG:26914 NAD83/UTM Zone 14N using a Global Navigation Satellite Systems (GNSS) device such as a GPS or similar navigation system. The following information would be reported:

- Percent cover and height of woody and dominant herbaceous plants by species, as quantified using pre-defined 10-meter line intercept transects situated perpendicular to the nearest shoreline and passing through the widest part of the restoration site; at least one line-intercept transect would be surveyed every 100 meters (or part thereof) of the restoration site (as measured parallel to the river). The same transect would be surveyed during subsequent monitoring years.
- Percent cover and height of exotic woody and herbaceous plants, particularly salt cedar, castor bean, Arundo cane, and buffelgrass.
- Any areas that contain any of the State-listed noxious weeds shall also be noted, including geographic coordinates to indicate the location, area, and percentage cover.
- Presence and acreage of suitable habitat for the ocelot and jaguarundi and proximity to water.
- Qualitative description of the restoration sites with photographs taken at defined points and directions.
- The geographic location of herbicide treatments, including the volume and date of application shall be recorded.

Since the goal is to maintain a level of no more than 25 percent weeds or exotic herbaceous plants, areas that contain greater than 25 percent shall be flagged and the geographic location recorded. The goal is to maintain a level of no more than 15 percent exotic woody vegetation. Any areas that contain more than 15 percent exotic woody vegetation shall also be flagged. Areas containing greater than 25 percent weeds or greater than 15 percent non-natives shall be treated as described under Section 4.1 Adaptive Management.

b. Survival of Planted Trees and Shrubs and establishment of Native Vegetation (not planted)

Monitoring would occur during TY1 and TY3 and every two years thereafter, to determine if goals are being met. The following information would be reported: Monitoring components requiring geographic location information will be recorded in EPSG:26914 NAD83/UTM Zone

14N using a Global Navigation Satellite Systems (GNSS) device such as a Global Positioning System (GPS) or similar navigation system. The following information would be reported:

- Percent cover and height of trees and shrubs by species, as quantified using a densitometer pre-defined 10-meter line intercept transects situated perpendicular to the nearest shoreline and passing through the widest part of the restoration site; at least one line-intercept transect would be surveyed for every 100 meters (or part thereof) of the restoration site (as measured parallel to the river). The same transect would be surveyed during subsequent monitoring years.
- Percent mortality of planted trees and shrubs, as quantified by enumerating up to 80 live and 20 dead specimens following the transect within the restoration site. GPS location of area with more than 20% mortality will be recorded.
- Number, percent cover, and height of natural establishing native trees and shrubs will also be quantified along the transect.
- Qualitative description of the restoration sites with photographs at defined points and locations

The goal is to maintain less than 20 percent mortality of planted trees and shrubs Areas containing greater than 20 percent mortality shall be treated as described under Section 4.1 Adaptive Management.

c. Survival of Planted Grass Seed

Monitoring would occur during TY1, to determine if goals are being met. The following information would be reported:

- Percent cover of herbaceous plants by species, as quantified using three randomly located 1-square-meter quadrats within every 0.5 acre of restoration site or any part thereof.
- Qualitative description of the restoration sites with photographs.

Native grass seed was planted in disturbed areas such as staging areas and areas not planted with trees and shrubs. The success criteria are to ensure a growth rate of 1-plant per ft^2 for planted native seed. Within each planting area, a 60-foot north to south transect shall be established. The transect would then be marked every 10 feet. A two-foot square grid shall be placed along every 10-foot increment with the middle of the grid at the 10-foot increment mark. One quarter of the grid (1 foot by 1 foot) shall be randomly chosen to be inventoried for grass species present within that sub-plot. The species and quantity of each sub-plot shall be analyzed. The sub-plots shall be added and averaged in order to determine if the criteria of 1 plant per square foot has been met. Grass monitoring should be conducted annually.

If the native grass seed planting does not meet the criteria, then measures shall be taken as described under Section 4.1 Adaptive Management to meet the criteria.

3.2 AQUATIC RESOURCES

a. Creation and Maintenance of Wetland Habitat and Improved Water Quality

Monitoring would occur during TY1 and TY3 and every two years thereafter, to determine if goals are being met. The following information would be reported:

- The total area of the shallow pools of water created by the weirs would be measured and compared to the previous years.
- Within pools created by the weirs, the presence of wetland vegetation species and percent cover would be recorded and compared to the previous year to determine development of wetlands.
- Monitor weir/riffle structures for function and integrity.
- Using infield monitoring equipment (i.e. probes, test kits) monitor water quality for turbidity, depth, flow, oxygen, and note channel substrate at each location (sand, gravel, cobble etc.) at representative points along the stream reach downstream of each weir/riffle structure. At these same locations take one water sample for nutrient analysis (ammonia, total kjeldahl nitrogen, nitrate, nitrite, ortho phosphate, total phosphate) to be analyzed using in-field test kits or at an approved laboratory. This data will be compared to the previous year's data.
- Qualitative description of the restoration sites with photographs

If the goals of increased wetland habitat and improved water quality are not being met then Adaptive Management as described in Section 4.2 would be implemented.

b. Improve IBI and HSI Values

To assess IBI and HSI values fish monitoring would be conducted at the same locations and following the protocols used by USFWS and City Environmental Services Department in the 2006 study. IBI and HSI values would be calculated and compared to the 2006 data.

If the goals of improved IBI and HSI values are not being met then Adaptive Management as described in Section 4.2 would be implemented.

3.3 THREATENED AND ENDANGERED SPECIES

Threatened and endangered species monitoring would consist of potential habitat surveys. Habitat for the ocelot and jaguarundi is described as Tamaulipan brushland, consisting of thick, dense thorny brush lands or chaparral. The thickets do not have to be continuous but may be interspersed with cleared areas. Jaguarundi possibly shows a preference for habitat near streams (Goodwyn 1970; Davis and Schmidly 1994) and may be more tolerant of open areas than the ocelot. The Texas hornshell primarily occurs in shallow, slow-running perennially flowing water tucked under travertine shelves and among large diameter channel bed materials, such as boulders, where soft sediment accumulates.

During Riparian Habitat and Aquatic Resources monitoring as described in Section 3.1 and 3.2, information would be gathered on attributes associated with suitable habitat for the listed species. For the ocelot, and jaguarundi, these attributes would include vegetation species composition, size of vegetation stands, height, density, proximity to water, and presence, and cover of non-native and invasive species. For the Texas hornshell monitoring would include monitoring water depth, velocity, and noting presence of travertine shelves and type of channel substrate. During vegetation and wetland surveys it would be noted if the current vegetation and wetland/stream channel are meeting suitable habitat requirements for the listed species. Each year this data would be compared to previous year to track the progress of habitat development. Any changes to the proposed measurements or methodology as dictated by the project Biological Opinion, would be incorporated into this Plan.

4.0 ADAPTIVE MANAGEMENT

The ecosystem restoration component includes restoration of three wetland, as well as riparian measures that would restore 401 acres of riparian habitat. The proposed action would require regular/annual maintenance, including invasive and exotic vegetation management, and repair/maintenance of wetland weir structures.

4.1 RIPARIAN HABITAT

a. Weeds and exotic woody and herbaceous plant species

Based upon monitoring results, if there are 25% or greater weeds or 15% or greater exotic woody or herbaceous species within the project area, management actions should be implemented. It is expected the following species could occur on any of the sites: buffelgrass, Arundo cane, castor bean, Kleberg bluestem, salt cedar, guineagrass, Russian thistle, and white leadtrees.

Vegetation management would consist of exotic and invasive species control consisting of selective removal of salt cedar resprouts and treating buffelgrass and salt cedar cut stems with herbicides glyphosate and/or imazapyr. Since initial treatment of invasive species occurred at all sites, treatment would entail resprout management. Resprouts should be treated using a whip or stump application. Whips are less than three feet tall and less than four inches in diameter. Herbicide (Garlon ® 3A or similar) should be applied directly to the stem between 2-18 inches above the ground. Resprouts larger than a whip should be cut and the stump should be treated with herbicide. When possible, plants should be uprooted and all material removed. Seeding with native species after mowing can also aid in competition against weed species.

Treatments would be documented in terms of size, species treated, and treatment methods. These areas would specifically be looked at during monitoring of the following year.

If weed species are kept to the lower percentages as defined in this plan for the one to five-year time frame, there will be a greater chance of them remaining at low levels after that time, barring any major disturbance.

b. Planted Trees and Shrubs

The success criteria for planted trees and shrubs is to maintain 80% survival. Based upon monitoring of survival of planted trees and shrubs, if this has not occurred, any planted material that has died shall be replaced to meet these criteria. Any new plantings required shall be documented and monitored during the following year as part of the annual monitoring. Native species survival would determine when to stop irrigating.

c. Planted Grass

The success criteria for planted native grass is to ensure a growth rate of 1-plant per ft^2. Based upon the annual monitoring, if this criterion has not been met, additional native grass seed shall be installed. Any new grass seed installation required shall be documented and monitored during the following year as part of the annual monitoring.

d. Naturally established native vegetation

Based upon results of initial monitoring, 80% of naturally established native vegetation should survive in the following years. If this criterion has not been met, reasons for the reduction should be explored. Depending on the reason, adaptive management should take place as appropriate. The following are potential reasons that have been previously addressed in this plan:

- *Weeds and Non-Native Invasive Species* – If weeds and/or invasive species begin to out compete the naturally established native vegetation, then adaptive management measures as described in Section 4.1 should be carried out. The success criteria triggers should be the same for weeds (no more than 20%) and non-native invasive species (no more than 15%).
- *Other potential environmental factors* - For all areas of planted or naturally established vegetation, if survival is an ongoing issue in a particular area, other potential environmental factors should be explored. These may include issues with soils, depth to groundwater, and herbivory by wildlife, etc. If this occurs, these areas should be noted during annual monitoring and recommendations for follow up monitoring should be described in the annual report.

If 80% revegetation has not occurred in the revegetation zone by the end of monitoring year 1, then revegetation methods may be augmented and supplemental reports may be required.

4.2 AQUATIC RESOURCES

a. Creation and Maintenance of Wetland Habitat and Improved Water Quality

If the weir/riffle structures are functioning properly then wetland area above the weir/riffle structures and dissolved oxygen below the structures should increase. If these goals are not met or any indication of loss of integrity to the structures is observed then maintenance to the weir/riffle structures is recommended. If nutrient analysis indicates that nutrient levels are not decreasing, then efforts to identify the source of the contaminants should be identified and best management practices employed.

b. IBI and HSI Value

The goals of improved IBI and HSI values are directly related to meeting the Vegetation and Wetland habitat goals. If IBI and HSI values are not improving then Adaptive Management as described under the previous sections such as vegetation retreatment and maintenance of the weir/riffle structures is recommended.

4.3 THREATENED AND ENDANGERED SPECIES

Improving Threatened and Endangered Species Habitat is directly dependent on meeting the Riparian Habitat and Aquatic Resource goals. If the goals of increasing and improving Threatened and Endangered Species Habitat are not being met then Adaptive Management as described under Riparian Habitat Section 4.1 and Aquatic Resources 4.2 should be implemented.

5.0 ANALYSIS AND REPORTING

Written monitoring/compliance reports will be provided to the USACE, Fort Worth District. The first monitoring report will be provided to the USACE in December following implementation of ecosystem restoration measures and the first full growing season. Monitoring will continue annually thereafter for 10 years or until 100% success of the riparian habitat and aquatic resource areas has been achieved. Written monitoring reports will include:

- The name of the responsible party contact for coordinating with the USACE regarding written reports, monitoring results, on-site inspections, restoration success, and general compliance with the terms of the permit.
- The first report shall detail the pre-construction conditions of the project area. The report would include all findings of each of the monitoring component described in Section 3.0. This first cumulative report would have initial information on each of the components. Therefore, for each item monitored (vegetation, wetland habitat, debris, water quality, etc.), the report would provide initial findings, a determination if success criteria have been met for that year, and any recommendations for adaptive management based upon those results.
- Each report shall include photographs, maps, and a description of the impacts to "waters of the United States" (WOTUS) as appropriate. Compliance reports are required even if no work is conducted during the reporting period.

If any adaptive management occurs after the first year of monitoring, these actions would be tracked so that they can be monitored in the following year. The subsequent annual reports would cover any changes from the previous year to the current year, evaluate the status of the established success criteria, and again provide any recommendations for adaptive management based upon that years' results.

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