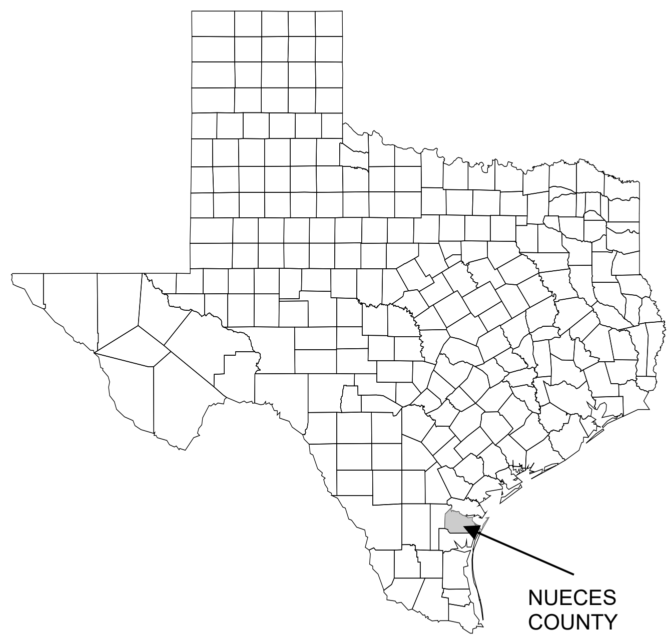
FLOOD INSURANCE STUDY

NUECES COUNTY, TEXAS,

AND INCORPORATED AREAS
VOLUME 1 OF 3

Community Name	Community Number
AGUA DULCE, CITY OF	480504
ARANSAS PASS, CITY OF	485453
BISHOP, CITY OF	480505
CORPUS CHRISTI, CITY OF	485464
DRISCOLL, CITY OF	480507
NUECES COUNTY (UNINCORPORATED AREAS)	485494
PETRONILA, CITY OF	480560
PORT ARANSAS, CITY OF	485498
PORTLAND, CITY OF	480559
ROBSTOWN, CITY OF	485503



EFFECTIVE DATE:
OCTOBER 13, 2022

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
48355CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross-sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X
C	X

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: October 13, 2022

TABLE OF CONTENTS

Volume 1 - October 13, 2022

TABLES

FIGURES

Volume 2

EXHIBITS

Volume 3

Exhibit 2 – Coastal Transect Profiles (Continued from Volume 2)

Exhibit 3 – Flood Insurance Rate Map Index

FLOOD INSURANCE STUDY
NUECES COUNTY, TEXAS AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports and Flood Insurance Rate Maps (FIRMs) in the geographic area of Nueces County, including the Cities of Agua Dulce, Aransas Pass, Bishop, Corpus Christi, Driscoll, Petronila, Port Aransas, Portland, and Robstown, and the unincorporated areas of Nueces County (referred to collectively herein as Nueces County).

Please note that the City of Portland is geographically located in both Nueces and San Patricio Counties. The City of Port Aransas is geographically located in both Nueces and Aransas Counties. The City of Aransas Pass is geographically located in Nueces, San Patricio, and Aransas Counties. See the separately published FIS reports and FIRMs for the countywide map dates and flood hazard information outside of Nueces County.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Nueces County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in Title 44 of the Code of Federal Regulations Section 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include all jurisdictions within Nueces County in a countywide FIS. The authority and acknowledgments prior to this countywide FIS were compiled from the previously identified FIS reports for flood prone jurisdictions within Nueces County and are shown below:

<u>City of Aransas Pass</u>: The hydrologic and hydraulic analyses for the original study were performed by Espey, Huston & Associates, Inc. (study contractor) for the Federal Emergency Management Agency (FEMA) under Contract No. 4786. That work was completed in June 1992 (Reference 1).

City of Bishop: The hydrologic and hydraulic analyses for the original study were performed by Espey, Huston & Associates, Inc. (study contractor) for the Federal Insurance Administration, under Contract No. H-4786. That work was completed in July 1979 (Reference 2).

City of Corpus Christi: The hydrologic and hydraulic analyses for the original study were prepared by Espey, Huston & Associates, Inc. (study contractor), for FEMA under Contract No. 4786. That work was completed in August 1983 (Reference 3).

A revision to incorporate updated hydraulic analyses and updated topographic information on Oso Bay Tributary No. 2 was performed by Ogletree Engineering, Inc., and completed in May 1988 (Reference 3). That work incorporated a channelization project and the addition of a bridge.

The September 17, 1992, revision incorporated updated hydraulic and erosion analyses and updated topography for the coastal barrier island and was prepared by Dewberry & Davis (study contractor) for FEMA, under Contract No. EMW-89-C-2906. That work was completed in March 1990 (Reference 3).

City of Driscoll: The hydrologic and hydraulic analyses for the original study were performed by Espey, Huston & Associates, Inc. (study contractor) for the Federal Insurance Administration, under Contract No. 4786. That work was completed in December 1979 (Reference 4).

City of Port Aransas: The hydrologic and hydraulic analyses for the original study were prepared by Espey, Huston & Associates, Inc. (study contractor) for FEMA under Contract No. 4786. That work was completed in August 1983 (Reference 5).

The September 30, 1992, revision incorporated updated hydrologic and hydraulic analyses to include the effects of erosion and was prepared by Dewberry & Davis (study contractor) for FEMA, under Contract No. EMW-89-C-2906. This work was completed in August 1991. Also, the University of Texas Bureau of Economic Geology and local engineering consultants were contacted to obtain historical flood data and recent topography (Reference 5).

City of Robstown: The hydrologic and hydraulic analyses for the original study were performed by Espey, Huston & Associates, Inc. (study contractor) for FEMA under Contract No. 4786. That work was completed in January 1980.

An updated study was prepared by Dewberry & Davis to incorporate flooding from annexed areas and was completed in March 1984 (Reference 6).

<u>Unincorporated Areas of Nueces County:</u> The hydrologic and hydraulic analyses for the original study were prepared by Espey, Huston & Associates, Inc. (study contractor) for FEMA under Contract No. 4786. That work was completed in August 1983.

In a revision to the original study, an updated hydraulic analysis for Oso Creek was prepared by Urban Engineering and was completed in July 1985 (Reference 7). That work incorporated an updated hydraulic analysis from the portion of Oso Creek from Farm-to-Market Road (FM) 2444 to State Route 286, including the backwater effects on Oso Creek Tributary No. 6.

In the May 4, 1992, revision, an updated hydraulic analysis and an erosion analysis for the Gulf of Mexico were prepared by Dewberry & Davis (study contractor) for FEMA, under Contract No. EMW-89-C-2906. That work was completed in June 1990 (Reference 7).

The authority and acknowledgments for the Cities of Agua Dulce and Portland; and the Town of San Patricio are not available because FIS reports were not previously published for these communities.

There are no previous FISs or FIRMs for the City of Petronila; therefore, the previous authority and acknowledgments for this community are not included in this FIS.

October 13, 2022 Countywide

For this first-time countywide FIS, Mapping Alliance Partnership VI (MAPVI) conducted detailed studies, for FEMA under Contract No. EMT-2002-CO-0052, on portions of Nueces River, Oso Creek, Oso Creek Tributaries in and around the City of Corpus Christi, Ditch A, and Ditch F in and around the City of Robstown. A new approximate analysis was conducted in the Nueces County unincorporated areas. Ditch C was previously studied by detailed methods, but has been converted to an approximate study. New coastal detailed analysis was conducted using new storm surge data. This study was completed by MAPVI in December 2011.

A coastal flood hazard analysis was performed under Task Order 42. The new analysis was completed on December 31, 2011. The stillwater surge data was provided to MAPVI by the U.S. Army Corps of Engineers (USACE) on November 31, 2011. The new coastal analysis revised the effective coastal zones on Padre and Mustang Islands. The analysis also revised the coastal zone in the Corpus Christi Bay and flooding in the City of Corpus Christi.

In April 2016, The City of Corpus Christi and its contractor HDR supplied additional information which revised the study along Oso Creek. These revisions were completed by Risk Assessment, Mapping and Planning Partners (RAMPP) in October 2016. RAMPP also completed Levee Analysis and Mapping Procedure (LAMP) studies behind the Corpus Christi Flood Risk Reduction System (CCFRRS) (Reference 8) and the North Caretta Creek Levee in the City of Bishop in June 2016 (Reference 9).

In October 2016, Nueces County supplied additional information to revise the study in Robstown along Ditch A and Ditch F. This information was incorporated into the study by COMPASS in June 2018.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the National Geodetic Survey, 2004, U.S. Census Bureau, 2010, U.S. Geological Survey, 1989 and 2004, National Agriculture Imagery Program (NAIP), 2014, Texas Natural Resources Information System (TNRIS), 1995 and 2010.

The projection used in the preparation of this map was Texas State Plane, South Zone (FIPS 4205). The horizontal datum was North American Datum of 1983 (NAD83), Geodetic Reference System 1980 (GRS80) spheroid. Differences in datum, spheroid, projection, or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdictional boundaries. These differences do not affect the accuracy of this FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of an FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

The dates of the pre-countywide initial and final CCO meetings held for Nueces County and the unincorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings."

Table 1 – Initial and Final CCO Meetings

Community	Initial CCO Meeting Date	Final CCO Meeting Date
City of Aransas Pass	May 4, 1978	March 22, 1984
City of Bishop	May 12, 1978	May 27, 1980
City of Corpus Christi	March 2, 1989	November 29, 1990 April 17, 1991
City of Driscoll	May 5, 1978	July 23, 1980
City of Port Aransas	May 18, 1978 November 30, 1990	March 23, 1984 January 15, 1992
City of Robstown	May 5, 1978	July 23, 1980
Nueces County Unincorporated Areas	May 3, 1978 March 2, 1989	March 22, 1984 November 29, 1990 April 17, 1991

October 13, 2022 Countywide: For this countywide FIS, an initial CCO meeting was held on August 15, 2006, and was attended by representatives of the community, the study contractor and FEMA. The final CCO meeting was held on November 17, 2015 and attended by representatives of the community, the study contractor and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

October 13, 2022 Countywide

The study analysis includes coastline flooding due to hurricane-induced storm surge. Both the open coast and inland propagation were studied; in addition, the added effects of wave heights and erosion were considered. For streams affected by both riverine and tidal flooding, a combined probability analysis was conducted to arrive at elevations created by flood occurrences caused by both types of flooding. The new coastal analysis revised the effective coastal zones on Padre and Mustang Islands. The analysis also revised the coastal zone in the Corpus Christi Bay and flooding in the City of Corpus Christi.

All or portions of the flooding sources listed in Table 2, “Scope of Study,” were previously studied by detailed methods. The limits of detailed study are indicated on the flood profiles (Exhibit 1) and on the FIRM (Exhibit 3). All flooding sources that had been previously studied by detailed methods and not subsequently restudied were redelineated. This process consisted of updating the floodplain boundaries based on the most current topographic data. New hydrologic and hydraulic analyses were not performed on the redelineated flooding sources. As part of this process MAPVI converted both the FIS and FIRMs for Nueces County, TX and all jurisdictions to a countywide format.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of the numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Nueces County. These sources are also shown in Table 2.

Due to the presence of de-accredited levees (Reference 10), LAMP analyses were conducted behind the CCFRRS and the North Caretta Creek Levee in the City of Bishop.

Table 2 – Scope of Study

Table 2.a – Coastal Analysis

Stream Name	Downstream Limit	Upstream Limit
Corpus Christi Bay (including Redfish Bay, Nueces Bay, Oso Bay, Industrial Canal)	Entire Bay	
Gulf of Mexico	Aransas County Boundary	Kleberg County Boundary

Table 2.b – New Detailed Riverine Analysis

Stream Name	Downstream Limit	Upstream Limit
Ditch A	Confluence with Oso Creek	Approximately 900 feet upstream of Bosquez Street
Ditch F	Confluence with Ditch A	Approximately 1 mile upstream from County Road 42
Drainage Creek	Confluence with Oso Creek Tributary No. 10	Texas Mexican Railway
North Carretta Creek	Intersection of East 1st Street and North Hackberry Avenue	Intersection of FM-70 and FM-83
Nueces River	Approximately 7 miles above the confluence with Nueces Bay	Approximately 9.6 miles upstream from FM-666
Oso Creek	Approximately 2 miles above Yorktown Blvd	Approximately 4,000 feet upstream from County Road 44
Oso Creek Trib No. 2	Confluence with Oso Creek	Approximately 1,300 feet upstream of Holly Road
Oso Creek Trib No. 5	Confluence with Oso Creek	County Road 49
Oso Creek Trib No. 6	Confluence with Oso Creek	Approximately 0.6 mile upstream of Philppine Drive
Oso Creek Trib No. 10 (La Volla Creek)	Confluence with Oso Creek	Horne Road
Oso Creek Trib No. 14	Confluence with Oso Creek	Approximately 500 feet downstream of Carolina Road
Overland Runoff behind CCFRRS	Salt Flats Levee	CCFRRS Seawall
Robstown Flowpath	Confluence with Ditch A	Divergence from Ditch F
Turning Basin	Confluence with Corpus Christi Bay (Industrial Canal)	Turning Basin Tributary

Stream Name	Downstream Limit	Upstream Limit
Turning Basin Tributary	Confluence with Turning Basin	West Broadway Street

Table 2.c – Redelineated Flooding Sources

Stream Name	Downstream Limit	Upstream Limit
Airport Drainage Ditch	Confluence with Drainage Creek	Approximately 1,040 feet upstream of Joe Mireur Road
Banquete Flow Path No. 1	Confluence with Banquete Creek	U.S. Highway 77
Carretta Creek	Approximately 120 feet downstream of U.S. Highway 77 Bypass	Approximately 450 feet upstream of Avenue J
Ditch B	Confluence with Ditch BN	Approximately 2 miles upstream
Ditch BN	Approximately 75 feet downstream of County Road 36	Approximately 50 feet upstream of State Highway 44
Ditch E	Confluence with Ditch C	Approximately 100 feet upstream of U.S. Highway 77
Matamoros Swale	Shallow flooding near the City of Driscoll	
Navigation Boulevard Drainage Ditch	Approximately 1,800 feet downstream of Old Brownsville Road	Approximately 150 feet upstream of Old Brownsville Road
North Carretta Creek	Approximately 1,500 feet upstream of County Road 4	Intersection of FM-70 and FM-83
Oso Bay Tributary No. 2	Approximately 3,575 feet below Lake Placid Drive	Approximately 50 feet upstream of Wooldridge Road
Oso Bay Tributary No. 3	Approximately 60 feet downstream of South Padre Island Drive	Rodd Field Road
State Highway 44 East of Drainage Ditch	Confluence with Drainage Creek	Approximately 1,720 feet above Hopkins Rd
State Highway 44 West of Drainage Ditch	Confluence with Drainage Creek	Approximately 1,330 feet above Bronco Road
Turning Basin Tributary	West Broadway Street	Approximately 240 feet above Winnebago Street
Yankey Swale Tributary 1	Confluence with Yankey Swale Tributary 2	Jim Wells County Boundary
Yankey Swale Tributary 2	Confluence with Yankey Swale Tributary 1	Approximately 1,300 feet upstream of confluence with Yankey Swale Tributary 1

Table 2.d – Approximate Study Flooding Sources

Stream Name	Downstream Limit	Upstream Limit
Agua Dulce Creek	Confluence with Banquete Creek	Jim Wells County Boundary
Banquete Creek	Confluence with Petronilla Creek	Jim Wells County Boundary
Ditch C	Confluence with Oso Creek	US Highway 77
Petronila Creek	Confluence with Gertrude Lubby Lake	Confluence with Agua Dulce Creek
Pintas Creek	Confluence with Petronilla Creek	Jim Wells County Boundary
San Fernando Creek	Kleberg County Boundary	Jim Wells County Boundary
West Oso Creek	Confluence with Oso Creek	Approximately 1,800 feet upstream of County Road 30
Yankey Swale	Confluence with Agua Dulce Creek	Approximately 800 feet upstream of confluence with Yankey Swale Tributary 1
Yankey Swale Tributary 1	Confluence with Yankey Swale	Confluence with Yankey Swale Tributary 2

2.2 Community Description:

Nueces County: Nueces County is located along the Texas Gulf Coast; the county's coastline extends from the Nueces River and the western tip of St. Joseph Island to a point approximately 10 miles south of Corpus Christi Bay. The central portion of the county, near the county seat of Corpus Christi, is approximately 145 miles southeast of San Antonio and approximately 210 miles southwest of Houston. The estimated 2010 population is 340,223 (Reference 11).

The county has an area of 1,120 square miles, of which 838 square miles are land. It is drained by the Nueces River, which feeds into Nueces Bay and Corpus Christi Bay, and by Petronila Creek, San Fernando Creek, and Oso Creek. Nueces Bay and Corpus Christi Bay lie within the county and are protected from the open Gulf by Mustang Island, while Laguna Madre south of Corpus Christi is sheltered by Padre Island. The total bay area within the county is 285 square miles. The Cities of Corpus Christi, Bishop, Driscoll, Dulce, and Robstown are completely surrounded by the unincorporated areas of the county. The Cities of Aransas Pass and Port Aransas are located along the northeast county boundary.

The topography of Nueces County is generally flat, with elevations ranging from sea level to 180 feet above mean sea level (MSL). The county lies within the Gulf Coast Prairies natural region, where the predominant types of vegetation are prairie and tidal grasses, with scattered stands of timber along the Nueces River. Average temperatures range from 47 to 97 degrees Fahrenheit (° F), and the average annual rainfall is approximately 27 inches.

City of Agua Dulce: The City of Agua Dulce is located on the Texas Mexican Railway at the intersection of Farm Road 70 and State Highway 44 in west central Nueces County. The name, Spanish for "sweet water," refers to a nearby creek. The estimated 2009 population is 715 (References 12 and 13).

Based on records from 1971 to 2000, average maximum temperatures range from 57.2° F in January to 96.3° F in June. Average minimum temperatures range from 32.9° F in January to 72.0° F in July. Precipitation averages about 9.4 inches per year (Reference 14).

City of Aransas Pass: The City of Aransas Pass is a waterfront community located on the eastern shore of the peninsula that forms the northern boundary of Corpus Christi Bay. Approximately 4 miles of beach fronting on Redfish Bay are within the corporate limits. The City of Aransas Pass takes its name from the natural tidal pass, which separates Mustang and St. Joseph barrier islands. When the Port Aransas Causeway was dredged through the barrier islands tidal pass from the Gulf, the City of Aransas Pass became a deepwater port on the Intercoastal Canal. The estimated 2010 population is 8,204 (References 1 and 11).

The city was incorporated in 1910. Portions of the city are within the territorial jurisdictions of Aransas, San Patricio, and Nueces Counties. Principal traffic arteries include U.S. Highway 181 and State Highway 35, which converge inside the city limits. A spur of the Texas-New Orleans Railroad runs through the community near the waterfront.

The City of Aransas Pass is in what is known as "the Marsh Belt of the Great Coastal Prairie." The predominant natural vegetation is seashore salt grass. The topographic relief within the city limits is substantial relative to its incorporated acreage and location along the coast. The maximum elevation is 25 feet MSL on the western edge of the city, falling to sea level along the Redfish Bay shoreline to the east. West of Avenue A, the western corporate limit, the land slopes away to near sea level at McCampbell Slough, a drainage lateral approximately 2 miles from the center of the city. The natural drainage pattern within the city limits breaks along Avenue A and flows eastward into Redfish Bay.

Within the city limits, the soil is moderately permeable, fine Galveston sand with a percolation rate of from 2 to 20 inches per hour, depending on elevation. The water table is very shallow, within a few inches of the surface near the shoreline, and limits the ability of the soil to absorb ponded runoff.

Based on records from 1971 to 2000, average maximum temperatures range from 62.5° F in January to 90.3° F in August. Average minimum temperatures range from 49.7° F in January to 79.6° F in August. Precipitation averages about 31.6 inches per year (Reference 14).

City of Bishop: The City of Bishop is in the southwest corner of Nueces County, Texas. Bishop is approximately 6 miles northeast of the City of Kingsville in Kleberg County along U.S. Highway 77, and approximately 15 miles southwest of the City of Robstown in Nueces County along U.S. Highway 77. The estimated 2009 population is 3,127 (References 2 and 13).

The city was incorporated in 1912. Since incorporation, the main commercial activities that support the economic life of the city are farming and industry. Cotton and sorghum grain are the main farm products of the city, and the Celanese Chemical Corporation and Celanese Plastic Company are the two supporting industries. Currently, the city limits encompass an area of approximately 1,550 acres.

The topography of the city is very flat. Elevations within the city vary from a high of 62 feet National Geodetic Vertical Datum of 1929 (NGVD) to 55 feet NGVD. Most of the area within the Bishop limits is between 61 and 58 feet NGVD.

Based on records from 1971 to 2000, average maximum temperatures range from 68.3° F in January to 95.6° F in August. Average minimum temperatures range from 43.4° F in January to 73.2° F in August. Precipitation averages about 29.0 inches per year (Reference 14).

City of Corpus Christi: The City of Corpus Christi, the seat of government for Nueces County, is the largest incorporated area in the 13-county Coastal Bend Region of South Texas. A port site for almost 500 years, the community's location on the sheltered southern side of Corpus Christi Bay has contributed to its emergence from a frontier trading post to a nationally prominent deepwater port, second only to Houston in tonnage in 1973. Surrounded by estuarine bays, Corpus Christi first developed around the higher ground on the peninsula that divides Nueces Bay to the northwest from Corpus Christi Bay to the north. A causeway, U.S. Route 181, now spans this neck of water to link Corpus Christi with the City of Portland 5 miles to the northeast. Total area within the current corporate limits of the city is approximately 1,526 square miles. The estimated 2010 population is 305,215 (References 3 and 10).

The City of Corpus Christi is bordered by San Patricio County to the north; the City of Aransas Pass, the City of Port Aransas, and Aransas County to the northeast and east; Kleberg County to the south; and the unincorporated areas of Nueces County to the southwest and west.

Cayo del Oso, into which Oso Creek empties, is an inland body of water covering about 10 square miles, with outfall into Corpus Christi Bay at the foot of Ocean Drive to the east of the Corpus Christi central business district. Cayo del Oso separates the Encinal Peninsula from the northern tip of Padre Island, one of the chains of barrier islands, which line the Texas Coast. Thus, the City of Corpus Christi is surrounded by estuarine-type bays while being somewhat protected from the open ocean by an island barrier. A lengthy beach, approximately 17 miles long and fronting on Corpus Christi Bay, is the community's most prominent feature.

The topographic relief of the City of Corpus Christi is substantial in some areas relative to its incorporated acreage and location along the coast. The natural land surface is very flat in most areas, with steep bluffs along Nueces Bay, Corpus Christi Bay, and Oso Creek. The differences in topography surface and immediate subsurface soils and groundwater conditions between the downtown business district near the Ship Channel and the eastern sections of the city near the Cayo del Oso are marked. Elevations range from a maximum of 75 feet MSL in the northwestern portions of the city along U. S. Route 77, to less than 15 feet MSL along the beachfronts. In some areas, this variation in elevation results in a slope of as much as 12 feet per mile. Existing slopes of drainage into the Nueces River and Nueces Bay are generally relatively steep in comparison to other areas of the city and flow velocities may exceed 10 feet per second in the larger channels. Isolated pockets of extremely low land, containing several hundred acres each, are scattered throughout the center of the city. Although most of these low areas lack natural outfall drainage, much of this land has been heavily developed already.

The City of Corpus Christi is located on what is known as the Marsh Belt of the Great Coastal Gulf Prairie. The predominant natural vegetation is seashore salt grass, but vegetation changes to a mixture of short prairie grasses such as Andropogon, Paspalum, and Panicum within a mile of the beachfront, although these species have nearly disappeared under intensive agricultural cultivation.

Within the city limits, the soil is moderately permeable fine Galveston sand along the waterfronts, shading to heavy sandy loams within a mile of the waterfront in most areas. In sandy locations, the surface is moderately permeable with a percolation rate of 2 to 20 inches per hour, depending on elevation. However, the water table is very shallow within a few inches of the surface along the shoreline and limits the ability of the soil to absorb runoff, which ponds in low places. The topsoil shades to black clay with a relatively high organic content in the southern portion of the city. The loamy clay areas have yellow clayey subsurface layers and a high shrink-swell capacity, and are very slowly permeable, from 0.1 to 0.2 inch per hour. Sand is generally encountered at depths of 10 to 15 feet under these clays; however, this varies from point to point. Because of this layered soil structure, the bluffs along Corpus Christi Bay, Nueces Bay, and Oso Creek have been preserved from erosion.

Climatological conditions in the community are heavily dependent on marine conditions. Summers are warm, winters are mild, and the humidity is generally high year round. Based on records from 1971 to 2000, average maximum temperatures range from 66.0° F in January to 93.4° F in August. Average minimum temperatures range from 46.2° F in January to 74.5° F in August. Precipitation averages about 32.3 inches per year (Reference 14).

<u>City of Driscoll</u>: City of Driscoll is located in the southwest corner of Nueces County in the Coastal Bend area of South Texas. The city is approximately 9.5 miles south of the City of Robstown and 13 miles north of the City of Kingsville. The junction of U.S. Highway 77 and State Highway 665 is within the incorporated area of the city. A line of the Missouri-Pacific Railroad parallels U.S. Highway 77 immediately west of the city (Reference 4).

The current Driscoll corporate limits enclose an area of approximately 820 acres. Principal commercial activities that support the economic life of the community include petroleum production and agribusiness in the surrounding countryside. The Clara and North Clara Driscoll oil fields as well as the Minnie Bock oil field are in the immediate vicinity. The principal area of future growth is projected to be to the southeast of the center of the city. The estimated 2009 population is 805 (Reference 13).

The topography of the city is nearly flat, characteristic of the Gulf Coastal Prairie. Elevations within the city vary from about 65 feet NGVD on the northwest side of the city to 60 feet NGVD on the southeast side. Soils in and around Driscoll are clayey and very slowly permeable (less than 0.6 inch per hour.).

Based on records from 1971 to 2000, average maximum temperatures range from 68.3° F in January to 95.6° F in August. Average minimum temperatures range from 43.4° F in January to 73.2° F in August. Precipitation averages about 29.0 inches per year (Reference 14).

City of Petronila: The City of Petronila is at the intersection of County Road 69 and County Road 22, approximately 5 miles to the south of the City of Robstown. The city has total area of 1.8 square miles and all of it is land. The estimated 2009 population is 79 people, 30 households, and 24 families residing in the city (Reference 13).

City of Port Aransas: The City of Port Aransas is at the convergence of Mustang, St. Joseph, and Harbor Islands, part of the longest chain of barrier islands in the world, extending along the south Texas Coast from Galveston to Brownsville. The Corpus Christi Channel, the Aransas Channel, and the Lydia Ann Channel converge at the eastern end of the corporate limits to form the Aransas Pass, a major shipping lane that opens directly into the Gulf of Mexico (Reference 5). The estimated 2009 population is 3,905 (Reference 13).

Topographically, the City of Port Aransas is almost featureless. Elevations range from sea level on the waterfront to approximately 26 feet MSL on scattered knolls and sand dunes within the corporate limits. The barrier island upon which the community is built is composed of fine shifting Galveston sand. Percolation rates are moderate, 2 to 20 inches per hour, depending on elevation. The dune line along the beach has natural vegetation of salt grass and sea oats.

Climatological variations in the community are heavily dependent on marine conditions. Based on records from 1971 to 2000, average maximum temperatures range from 62.5° F in January to 90.3° F in August. Average minimum temperatures range from 49.7° F in January to 79.6° F in August. Precipitation averages about 31.6 inches per year (Reference 14).

City of Portland: The City of Portland is in Nueces and San Patricio Counties. The city has total area of 9.6 square miles, 7 square miles of it is land and 2.6 square miles of it is water. The city is located approximately 5 miles northeast of City of Corpus Christi on State Highway 181. The estimated 2010 population is 15,099 in Nueces County and 64,804 in San Patricio County (Reference 11).

City of Robstown: The City of Robstown is approximately 7 miles west of the corporate limits of Corpus Christi in the northwest part of Nueces County. U. S. Route 77, running northeast to southwest, and State Route 44, running east to west, intersect within the corporate limits. Most of the incorporated area of the city is west of U. S. Route 77 and north of State Route 44. Many residents of

Robstown commute to work in Corpus Christi. Nearby oil fields, farming, and ranching activities contribute to the economic life of the community. The estimated 2010 population is 11,487 (References 6 and 11).

Climatological variations in the community are heavily dependent on marine conditions. Based on records from 1971 to 2000, average maximum temperatures range from 65.9° F in January to 95.1° F in August. Average minimum temperatures range from 45.1° F in January to 75.0° F in August. Precipitation averages about 32.8 inches per year (Reference 14).

2.3 Principal Flood Problems

Nueces County is subject to both coastal and riverine flooding. Precipitation comes either through brief but very intense local rainstorms or in long-duration periods of high total precipitation in association with tropical storms.

Coastal flooding occurs when the natural forces of wind, tide, and rain combine to force seawater above normal high tide lines and onto low-lying coastal areas. The storm surge tide that accompanies tropical storms and hurricanes is particularly severe along the Gulf Coast because of the shallowness of the coastal shelf, imperiling even those communities sheltered behind the coastal barrier islands.

Riverine flooding results when rivers, streams, and creeks exceed their carrying capacity and overflow their banks, spilling onto adjacent land. Riverine flooding in Nueces County is usually localized, while coastal flooding is more widespread and is associated with higher economic losses. The most serious flooding conditions occur when storm surge tides combine with riverine overbank flooding as the result of torrential rains over a wide area of the coast.

Descriptions of both coastal and riverine flooding are provided below.

Coastal Flooding

Historical descriptions of past hurricanes and related damage are plentiful for this area. Figure 1, "Historical Storm Tracks (1900-1971)" shows the tracks of some of the more significant storms to enter the Gulf of Mexico since 1900. Descriptions of the most significant storms follow.

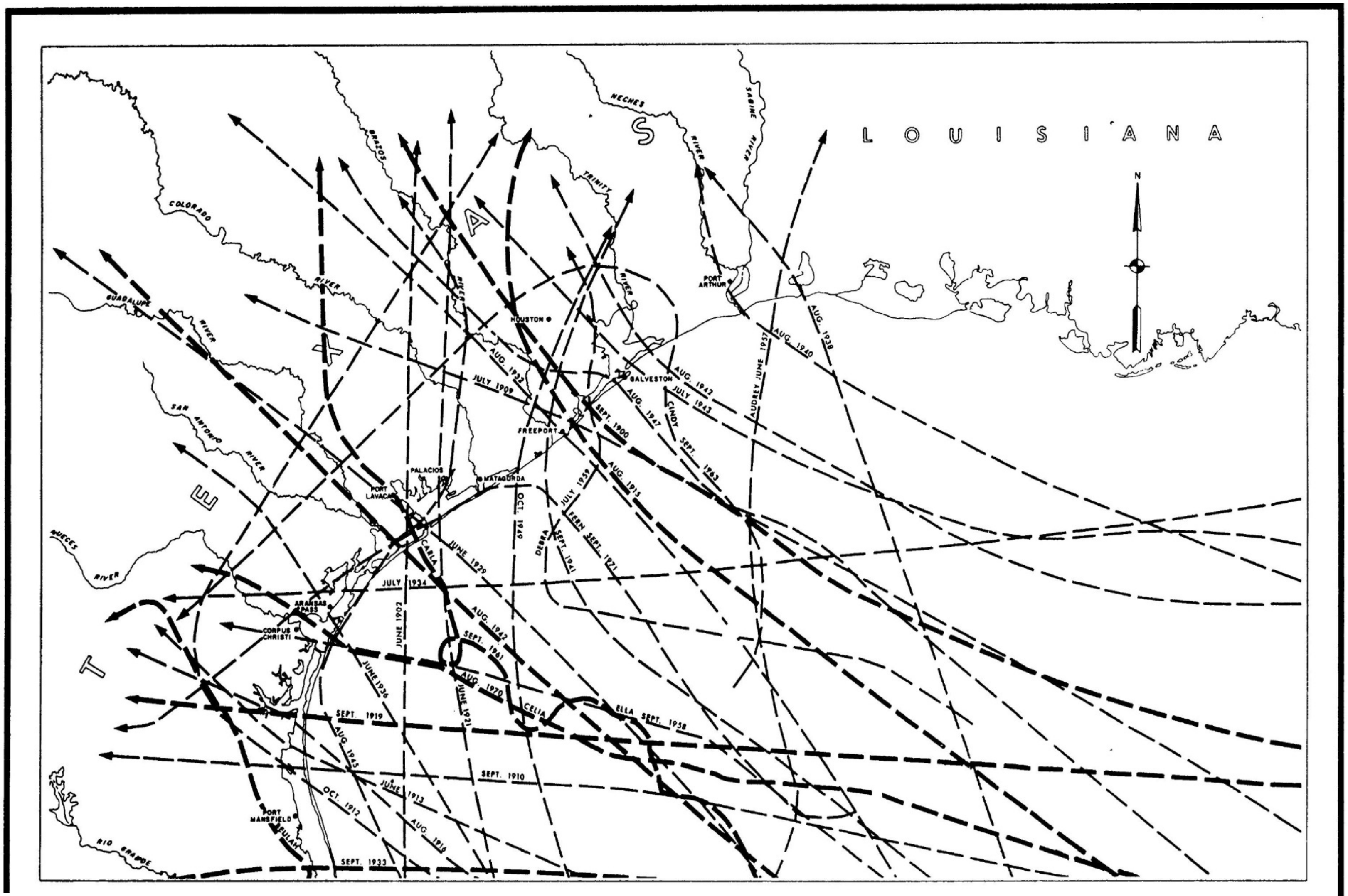


Figure 1 – Historical Storm Tracks (1900 – 1971)

Storm of September 2-15, 1919

This storm was first noticed in the tropical storm stage in the extreme eastern portion of the Caribbean Sea. It was moving in a generally northwesterly direction toward the eastern portion of the Dominican Republic. From there it moved into the Atlantic Ocean before turning to a more westerly course, passing between the tip of Florida and Cuba, and entered the Gulf on a generally westerly course before striking the Texas coast in the vicinity of Baffin Bay. The eye of the storm moved inland over Kingsville and then turned west northwestward towards Laredo. Prior to Hurricane Carla in 1961, the 1919 storm was the largest known hurricane to strike the Texas coast. Based on observations from various locations along the coast, the 1919 storm mass had an unusually large diameter as did Carla. Inadequate data for the 1919 storm prevents conclusive comparisons between the big storms.

Maximum sustained wind velocity recorded at Corpus Christi was 80 miles per hour. Surge elevations of up to 16 feet were recorded as the storm surge swept across the barrier islands and through the passes, piling water on the landward shores of Corpus Christi and Nueces Bays. Highest recorded surge elevations along the coast were approximately 11.1 feet. Surges of 6.6 feet or greater were experienced along almost the entire Texas coast. The Town of Port Aransas on the north end of Mustang Island was entirely destroyed. The Corpus Christi Beach, or North Beach as it was known, was swept clean of all but three badly battered buildings. A section of Corpus Christi located below the 35-foot-high bluff and having ground elevations ranging from 4 to 7 feet was almost totally destroyed. This area was about 3 blocks wide and 10 blocks long and contained warehouses, business, hotels, the electric power and light plant, two ice plants, and many residences. All of the development was destroyed except two one-story brick buildings, the upper floor and power plant of the six-story Nueces Hotel, and some machinery of the city power and light plant. The storm left 350 people dead, and the damages exceeded $20 million.

Storm of August 24-29, 1945

This storm originated in the Gulf of Mexico off the southern Mexican coast on August 24. The storm moved in a northerly direction to within about 40 miles of Port Isabel by August 25 and continued northward, skirting the Texas coast before moving inland in the vicinity of San Jose Island on the morning of August 26. The storm continued to move northeastward along the coastal area, across Matagorda Bay, and then toward Bay City.

The storm was unusual in the coastal path it maintained, raking essentially the entire Texas coast, and also because of its slow forward movement, traveling at less than 5 miles per hour. The area between Port Aransas and the mouth of the Colorado River received the maximum force of the hurricane.

The maximum storm surge varied considerably along the coast with about 3 feet recorded at Port Isabel, 3.7 feet at Port Aransas, 3.2 feet at Corpus Christi, 6.6 feet at Olivia, 8 feet at Port O'Connor, 14.5 feet at Port Lavaca, and 7 feet at Palacios. Maximum wind velocities were estimated at 76 miles per hour at Port Isabel, 100 to 125 miles per hour at Port Aransas, 85 miles per hour at Palacios, and 135 miles per hour at Seadrift, Olivia, Port O'Connor, and Port Lavaca. The storm killed 3 people, injured 25, and caused damages exceeding $20 million.

Hurricane Celia (July 30 – August 5, 1970)

Celia originated as a tropical depression in the northwestern Caribbean Sea on July 30. The depression developed into a hurricane on August 1 after entering the Gulf of Mexico. The relatively small storm mass moved moderately fast and erratically across the Gulf toward the Texas coast. Celia lost strength on the morning of August 3 as the storm rapidly increased in size, but as Celia neared the coast, the eye of the storm became smaller and more concentrated and the wind speeds increased. When Celia was about 30 miles east-southeast of Corpus Christi, the storm had regained strength with highest winds estimated at 115 miles per hour. The storm continued to intensify as it moved inland across Mustang Island and into Corpus Christi Bay at a forward speed of 17 miles per hour. The anemometer at the weather station in Aransas Pass was blown away after measuring wind gusts of 150 miles per hour. Subsequent peak gusts were estimated to have reached 180 miles per hour. Maximum gusts of 160 mph were recorded at the Corpus Christi National Weather Service Office.

The metropolitan area of Corpus Christi, the Cities of Robstown, Port Aransas, and Aransas Pass, and the small towns along Corpus Christi Bay suffered the most damage. Although considerable damage resulted from storm surge, the majority of the destruction resulted from high winds. A surge of 9.2 feet was recorded on the Gulf Beach at Port Aransas, and a surge of 11.4 feet was recorded on the south side of Aransas Pass. At Corpus Christi, the stillwater surge elevation ranged from 3.9 to 5.6 feet.

Celia was the costliest storm in the State's history at the time, having caused an estimated total damage of $470 million. Wind damage accounted for $440 million of this total. Thirteen people were killed and over 450 injured. More than 9,000 homes were destroyed and 14,000 others were damaged; 250 businesses and 300 farm buildings were also damaged or destroyed.

Hurricanes Gilbert (September 16, 1988) and Jerry (October 15, 1989)

Hurricane Gilbert struck the Texas coast on September 16, 1988, causing flooding and damage to the area. High water marks for this hurricane were at approximately 3.7 feet.

Hurricane Jerry hit the Texas coast on October 15, 1989. The flood elevations along the Gulf Coast at the Galveston Point Pleasant gage station No. 8771510 were comparable to a 10-year flood. The elevations observed on the bay side of the barrier island at the Galveston gage No. 8771450 and Sabine Pass, North gage No. 8770570 were comparable to 5-year and 2-year flood elevations, respectively.

Hurricane Bret (August 18-25, 1999)

Bret was a small hurricane that made landfall along a sparsely populated section of the south Texas coast with sustained winds up to 100 knots. Bret's center crossed the Texas coast over the central portion of Padre Island, midway between

Brownsville and Corpus Christi on August 23. After moving inland, Bret's movement became more westward with a slow forward speed. Bret continued to weaken as it moved across south Texas and into the high terrain of north central Mexico where it dissipated on August 25 (Reference 15).

The Port Aransas C-MAN station reported maximum sustained winds of 41 knots. Despite Bret's intensity, damage was generally reported to be fairly light. This level of damage can be attributed to its landfall over a sparsely populated region in south Texas and its small size. The nearest population centers, Brownsville and Corpus Christi, were spared the brunt of the hurricane's core.

Property insurance damage claims totaled $30 million as reported by the Property Claims Services Division of the Insurance Services Office. Multiplying by a factor of 2.0 gives an estimated damage total of $60 million. No loss of life was reported.

Hurricane Claudette (July 8-17, 2003)

Hurricane Claudette made landfall in Texas as a Category 1 hurricane on the Saffir-Simpson Hurricane Scale and on the northeastern Yucatan Peninsula of Mexico as a tropical storm. It maintained tropical storm status for more than 24 hours after landfall in Texas (Reference 16).

Damage surveys were conducted by the staffs of National Weather Service (NWS) forecast offices in Corpus Christi and Houston in order to help define the surface winds at landfall. These surveys concluded the damage was consistent with Category 1 sustained winds. Claudette is responsible for three deaths and caused $90 million in damage to insured property. The total damaged estimate is $180 million (Reference 16).

Hurricane Dolly (July 20-25, 2008)

Dolly made landfall in extreme southern Texas as a Category 1 hurricane on the Saffir-Simpson Hurricane Scale and caused significant wind and flood damage. As is typical for a slow-moving tropical cyclone, Dolly deposited heavy rains along its track. Rainfall totals of 5 to 10 inches or more were recorded over portions of the lower Rio Grande Valley, with a maximum total of 15 inches at Harlingen, TX. These rains resulted in extensive inland flooding over the Rio Grande Valley region (Reference 17).

In Texas, two weak tornadoes were reported in Cameron County. Two tornadoes were also observed in San Patricio County and a tornado was reported in Jim Wells County. None of these tornadoes produced much damage. A waterspout was sighted over Corpus Christi Bay. Dolly caused $525 million in insured losses in Cameron and Willacy Counties. No damage was reported in Nueces County (Reference 17).

Hurricane Ike (September 1-14, 2008)

Ike was a long-lived Cape Verde hurricane that caused extensive damage and many deaths across portions of the Caribbean and along the coasts of Texas and Louisiana. It reached its peak intensity as a Category 4 hurricane (on the Saffir-

Simpson Hurricane Scale) over the open waters of the central Atlantic, directly impacting the Turks and Caicos Islands and Great Inagua Island in the southeastern Bahamas before affecting much of the island of Cuba. Ike, with its associated storm surge, then caused extensive damage across parts of the northwestern Gulf Coast when it made landfall along the upper Texas coast at the upper end of Category 2 intensity. Building midlevel high pressure over the western Atlantic caused the hurricane to turn to the west late on September 4. The high was strong enough to induce an unclimatological west-southwesterly motion by September 6. In fact, Ike is only the fifth tropical cyclone to reach a similar position in the Atlantic (near 24°N 60°W) and later move into the Gulf of Mexico, the last being Hurricane Andrew (1992). Ike went farther south and west than any of these other storms, ultimately making landfall in Cuba and Texas (Reference 18).

Higher-than-normal water levels affected virtually the entire U.S. Gulf Coast. As the hurricane grew in size, the large wind field pushed water towards the coastline well before Ike's center made landfall near Galveston, TX. Ike caused $24.9 billion in damage and 20 people died in Texas, Louisiana, and Arkansas. Three other drowning deaths were reported across Texas; one person drowned in the water off Corpus Christi (Reference 18).

Hurricane Alex (June 25-July 2, 2010)

Alex, one of the most intense June tropical cyclones in the Atlantic basin record, made landfall in northeastern Mexico as a strong Category 2 hurricane. Nine tornadoes were reported in Texas: two in Cameron County, one in Willacy County, two in Refugio County, one in Nueces County, one in Kleberg County, and two in Aransas County. All were rated as 0 on the Enhanced Fujita Tornado scale (EF0) and caused only minor damage. No damage was reported in Nueces County (Reference 19).

City of Aransas Pass: The seawall, protecting the City of Aransas Pass from flooding caused by hurricane storm tides, has itself become a cause of flooding problems during localized rainfall events. Outlets to relieve accumulated stormwater runoff from behind the seawall were installed when the structure was built. Continued urban development has rendered these outlets insufficient to drain the land behind the seawall quickly enough to prevent water from rising in the streets of the city. The low-lying area between the railroad embankment, which parallels Euclid Street, and the seawall is particularly vulnerable, and it is currently ineffective because the potential for flooding from surface runoff or tidal surges is so great.

The topography and soil conditions in Aransas Pass combine to create flood control problems unique to seashore communities. The generally fine beach sand upon which the community is built is very unstable and erodes easily unless protected by established vegetation. The shallow water table causes continuous low flow problems during heavy rainfall events. The sides and bottom widths of open channels in and around the City of Aransas Pass are constantly widening as the light soils characteristic of the area are eroded away by surface runoff.

Not all of the drainage problems within the city limits of Aransas Pass originate within the corporate area. The volume of sheet runoff entering the municipal system from areas north and west of the city can be so great during periods of intense rainfall as to overload the city's municipal drainage systems and block proper drainage from areas within the city limits.

Riverine Flooding

City of Bishop: Natural drainage in the vicinity of Bishop occurs from northwest to southeast following the natural ground slope. North Carretta Creek runs along the north edge of Bishop and drains much of the area north and west of the city. Carretta Creek flows along the south and southwest edges of Bishop and drains agricultural lands to the west. The major flooding experienced by the city is the result of poor drainage of storm waters and not the high water from Carretta Creek and North Carretta Creek. This problem is aggravated by the flat topography, which causes rainwater to pond and drain slowly.

City of Corpus Christi: Drainage patterns in Corpus Christi vary according to locale. Before extensive development altered natural drainage basins in many areas of the city, major rainfalls resulted in runoff in broad, shallow, relatively unconfined channels. Much of the area drained very slowly, and ponding was widespread. Only evaporation and infiltration over an extended period of time removed this ponded water.

As the City of Corpus Christi grew, this natural pattern of shallow overland flow, ponding, and resultant evaporation and infiltration became less and less acceptable as a system of stormwater removal.

The natural drainage of the most heavily developed areas of the city is primarily directed into Corpus Christi Bay, with a small amount into the Ship Channel and Nueces Bay and a small amount into the Cayo del Oso.

Padre Island Drive runs east to west through the city and forms the dividing line between the areas of older and more recent urban development. In the areas north and northeast of Padre Island Drive, the existing underground storm sewers generally drain north into Corpus Christi Bay. The areas south of Padre Island Drive, which are served by both underground storm sewers and open drainage ditches, discharge into Oso Creek to the south. However, Oso Creek outfalls into Cayo del Oso in the far eastern part of the city and ultimately drains into Corpus Christi Bay.

The natural drainage pattern in the area north of Padre Island Drive is actually away from the shoreline, because the land elevation rises slightly on the bay front, causing surface runoff to flow southward. This condition has been solved by using a reverse slope in the design of existing underground storm sewers, permitting discharge into the bay. The elevated shoreline, rising to a small bluff near the western end of the seawall, is a particular problem in the downtown area (between the Flour Bluff and T-Head area). This section frequently experiences high levels of ponded runoff, and pumps must be used to force the water over the rise and into the bay.

The natural drainage pattern for the areas of Corpus Christi south of Padre Island Drive is into Oso Creek, which currently receives stormwater discharge at several points from drainage ways serving developments along the south and southeastern portions of the city as well as overland sheet flow during heavy rainfall events from agricultural areas within the drainage basin of this waterway.

On the west side of the city, the major drainage divide is generally parallel to the alignment of Leopard Street but may vary as much as one mile south at some points. The area to the north drains into the Nueces River with outfall into Nueces Bay, and the area to the south drains into the headwaters of Oso Creek. Existing slopes of drainage into the Nueces River and Nueces Bay are generally relatively steep in comparison to other sections of the city. Flow velocities may exceed 10 feet/sec in the larger channels. The area along the drainage divide between the Nueces River and Oso Creek is quite flat. Local drainage problems and inter-basin flow occur due to poorly defined natural drainage patterns and insufficient slope. The Oso Creek drainage basin generally slopes to the south and southeast at a very gentle rate. The existing natural drainage basins are quite broad. Peak runoff rates characteristically flood lateral areas along these drainage ways.

In the Flour Bluff area, the major drainage divide runs southwest to northeast along the approximate center of the peninsula. Areas to the north and west are in the Cayo del Oso drainage basin and areas to the south and east drain into Laguna Madre. Surface soils are very fine, uniformly graded sands underlain by clay at varying depths. Heavy marine clay is encountered at sea level along the Laguna Madre shore. Naturally ponded areas are characteristic of the Flour Bluff area. These ponded areas usually indicate a bowl-like clay structure, either partially or fully overlain by sand. Although considerable gas and oil production has already occurred in the local field, no active faults or subsidence are currently known to exist on this peninsula.

Loss of elevation as the result of land subsidence within the city limits of Corpus Christi further compounds the drainage situation in the community. This subsidence is active and the current rate appears to be the greatest recorded. That area of active subsidence that cuts diagonally from southwest to northeast between the new International Airport and Clarkwood is clearly evident on contour maps and has occurred since 1938. The current area extends from approximately 1 mile south of State Highway 44 to north of State Highway 9 and from 0.5 mile west of Clarkwood to within approximately 0.25 mile of the airport on the east. Further settling in this area can be logically predicted to occur in the near future and must be taken into consideration in the initial design of any further drainage facilities in the area.

City of Driscoll: Natural drainage in the vicinity of Driscoll runs from northwest to southeast following the natural ground contours. Petronila Creek, which rises in Jim Wells County about 25 miles to the northwest and drains into Alazan and Baffin Bays to the east, flows along the north edge of Driscoll. Much of the area north and east of the city drains into this creek.

Principal causative factors of localized flooding in Driscoll are poor natural drainage compounded by inadequate structural systems, not overbank flooding from Petronila Creek. The nearly flat topography and clayey soils contribute to slow runoff rates and cause rainwater to pond on the surface of the land in and around Driscoll.

City of Port Aransas: The City of Port Aransas is located on the tip of a barrier island only a few hundred yards from the open Gulf. These barrier islands are sandbars, which have been built up by the action of storm waves carrying sand from the ocean floor. The resulting beaches, dunes, and mudflats are unstable and extremely susceptible to erosion and storm induced washover and flooding.

City of Robstown: Flood problems in the City of Robstown are the result of sheet runoff from the agricultural fields northwest of the city. This is compounded by the absence of adequate outlets for accumulated stormwater. Recent urban development has further restricted runoff. Few storm sewers are in the incorporated area, and surface runoff generally follows the streets and existing roadside ditches.

There are no definable creeks within the corporate limits. A number of drainage ditches carry floodwaters away from the city. Ditches A and F drain areas north and west of the city, Ditches C, D, and E drain the south and east areas, and Ditch BN drains the western areas near Robstown. The headwaters of Oso Creek rise approximately 3 miles to the east, and West Oso Creek starts less than one mile southeast of Robstown. These two shallow banked streams slowly conduct water from Robstown and the surrounding countryside in an eastern direction towards Corpus Christi Bay. Most of the surface runoff from the incorporated areas of Robstown is carried into the Oso Creek drainage system. The remaining runoff flows into the Petronila Creek watershed to the south. Some farmlands north and west of the city also drain into Petronila Creek via a small drainage ditch.

The city has a history of serious flooding. The southwest section of the city, from the Texas-Mexican Railroad embankment to Ruben Chaves Street, has the least grade variation and, consequently, the worst drainage. The contrasting raised grades for street and railroad lines create barriers to overland flow. Existing channels and ditches are silted in and contain heavy weed growth in places, indicating a maintenance problem that contributes to urban flooding. Drainage problems are particularly acute where the two railroad lines cross because of the elevation of their embankments and the inadequate flow capacity of the existing culverts.

2.4 Flood Protection Measures

For purposes of the NFIP, FEMA only recognizes levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with comprehensive floodplain management criteria. The Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) describes the information needed for FEMA to determine if a levee system reduces the risk from the 1-percent-annual-chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate FIRM flood zone.

FEMA coordinates its programs with USACE, who may inspect, maintain, and repair levee systems. The USACE has authority under Public Law 84-99 to supplement local efforts to repair flood control projects that are damaged by floods. Like FEMA, the USACE provides a program to allow public sponsors or operators to address levee system maintenance deficiencies. Failure to do so within the required timeframe results in the levee system being placed in an inactive status in the USACE Rehabilitation and Inspection Program. Levee systems in an inactive status are ineligible for rehabilitation assistance under Public Law 84-99.

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levees that exist within Nueces County. Table 3, "Levees," lists all accredited levees, Provisionally Accredited Levees, and de-accredited levees shown on the FIRM for this FIS Report. Other categories of levees may also be included in the table. The Levee ID shown in this table may not match numbers based on other identification systems that were listed in previous FIS Reports.

Please note that the information presented in Table 3 is subject to change at any time. For that reason, the latest information regarding any USACE structure presented in the table should be obtained by contacting USACE and accessing the USACE National Levee Database. For levees owned and/or operated by someone other than the USACE, contact the local community.

Table 3 – Levees

Community	Flooding Source	Levee Location	Levee Owner	USACE Levee	Levee ID	Covered Under PL84-99 Program?	FIRM Panel(s)
City of Bishop, Nueces County Unincorporated Areas	North Carretta Creek	Right Bank	City of Bishop	No	1605679001	No	48355C0635G
City of Corpus Christi	Turning Basin Tributary	Right Bank	City of Corpus Christi	No	1605994329	No	48355C0320G
City of Corpus Christi	Corpus Christi Bay	Seawall	City of Corpus Christi	No	1605679002	No	48355C0320G

Nueces County: Numerous channels have been dredged throughout the study area, connecting coastal and inland communities with bay and Gulf shipping routes. The Gulf Intracoastal Waterway, extending from Apalachee Bay, FL, to the Rio Grande at an approximate 12-foot depth, is the most prominent waterway in the study area. The last link in the main channel was completed in 1949, with many tributary and feeder channels added in recent years. Other major channels within the study area include the Aransas Channel (project depth of 10 feet) and the Corpus Christi Channel (project depth of 45 feet), which serve the Aransas and Corpus Christi Bay areas, respectively.

Various private industries near the coast have built levees. Refineries in the Corpus Christi area have constructed 6- to 10-foot-high levees around storage tanks primarily to contain potential spills; however, these levees also afford some protection against hurricane surge waters. Similarly, the DuPont Company, and to a lesser extent, Brown and Root in Aransas Pass have constructed 5- to 7-foot-high earthen and concrete dikes around storage tanks and equipment areas. Most industries along the waterfront operate under hurricane protection plans when necessary.

City of Aransas Pass: A 2.5-mile long earthen seawall was constructed in 1927 to protect the city from tidal surges. Composed of local dredged material, the height level ranges from 16 to 21 feet MSL. The commercial district is protected behind this wall, which extends from McCampbell Street southeast to the beach, then northeast along the waterfront to Stapp Avenue. However this seawall is not shown to meet the NFIP regulation 65.10 regarding its ability to provide protection from the 1% annual chance flood event.

A number of underground and open channel type drainage structures carry runoff to stormwater pump stations and outlets in the seawall. A comprehensive Master Drainage Plan for the City of Aransas Pass was initiated in 1965 and has been the guide for subsequent capital improvement plans. This plan recommends the installation of a major underground sewer through the central part of the city. The general route would run from 15th Street southeastward along Harrison Boulevard to an outfall into Redfish Bay. Another major line has been recommended along Lott and Wheeler Avenues to the Bay.

City of Bishop: The North Carretta Creek Levee is a riverine levee designed to reduce flood risk in the City of Bishop, in Nueces County, Texas from flooding from North Carretta Creek The levee is privately owned and operated, and minimal information is available. The levee acts as a training dike, diverting runoff from a nearby farm field into the channelized portion of North Carretta Creek. Roadside ditches and culverts on the land side of the levee divert internal drainage away from the levee or through a channel parallel to the levee. However this levee is not shown to meet the NFIP regulation 65.10 regarding its ability to provide protection from the 1% annual chance flood event.

City of Corpus Christi: The continued growth of the City of Corpus Christi has been predicated on an active program of stormwater abatement throughout the history of the community's development. In addition to the construction of an approximately 3-mile seawall along the northern bay-front to reduce the threat of tidal surge in urban areas, a structure that was completed in 1940, Corpus Christi also has installed an extensive system of underground storm sewers and pumps to facilitate the removal of urban runoff. A street system of curb and gutter drainage serves most of the downtown business district and many of the residential areas of the city. Most of the residential area drainage laterals have been sized to accommodate a 5-year storm, while the main trunk lines are sized to carry runoff from a 25-year storm. Streets laid out in newer subdivisions have been cut below grade to function as temporary conduits during periods of intense rainfall.

The CCFRRS was built between 1939 and 1942 and consists of the CCFRRS seawall, a backwater levee (Salt Flats Levee, also called Turning Basin Tributary Levee), museum buildings, a floodwall near the museum, a United States Army Corps of Engineers (USACE) seawall, and a port coastal structure. It protects 486 acres of the City of Corpus Christi. Neither the Salt Flats Levee nor the Museum Floodwall are shown to meet the NFIP regulation 65.10 regarding its ability to provide protection from the 1% annual chance flood event. There are several closure structures along both the levee and the floodwall. In addition, the CCFRRS has two stormwater pump stations which are automatically activated based on water depth. In addition, the seawall does overtop in the 1% annual chance flood event.

Broad channels have been constructed as well to serve as primary collection systems for storm water in many of the newer residential developments. These "greenbelt" waterways also provide additional open space and recreational areas when they are not serving their primary function as floodways.

Some of the older sections of the central urban area of the City of Corpus Christi still rely on open shallow ditches along the roadsides for primary drainage. Other suburban areas, many of which were considered to be outlying or rural areas 10 years ago before rapid urban expansion brought them within the city limits, are still served by an open roadside ditch system.

Severe erosion has occurred along these ditches where vegetative cover has been removed and the channel banks have remained unprotected. This is especially true in areas where channels have been incised so deeply as to cut into the sandy layers underlying the superficial clays. In some cases, adjacent properties are in danger because of excessively high rates of erosion in nearby drainage channels.

In the study area, land currently developed or in the process of imminent development tends to be concentrated in the upper ends of the drainage basins. Four drainage ways have been excavated to the west of Corpus Christi in the Oso Creek drainage basin, with the City of Robstown as the main beneficiary. Other ditches have been excavated along Clarkwood and McKenzie Roads to remove encroaching salt water. These ditches are of insufficient size and depth to handle current volumes of flow and are undesirably located adjacent and parallel to major roadways.

Allocations for drainage improvements to continue construction in the problem areas are a regular inclusion in Corpus Christi city bond elections. Protection of property has required that surface drainage be confined to relatively small channels in areas where the natural drainage patterns have often been indefinite. Naturally low and ponded areas have been drained. The per capita costs for these improvements have been relatively high and future improvements are projected to be increasingly more expensive.

Although no up-to-date map currently exists illustrating all of the underground and surface drainage systems in Corpus Christi, both the location as well as the description of existing facilities are on file separately, according to city officials.

A detailed comprehensive Master Drainage Plan for the City of Corpus Christi was completed in 1970 to update the 1961 Master Drainage Plan. Drainage recommendations indicated by this study are regularly reviewed by city officials in developing 3- to 5-year capital improvement plans.

The City of Corpus Christi has built a seawall along the Gulf shore of the coastal barrier island near Windward Drive to help reduce the effects of flooding from storm surge and wave action in that area.

City of Driscoll: The Matamoros Swale, a natural swale from 1 to 2 feet deep, runs south of the corporate limits following natural ground contours. The lower reaches of the swale have been excavated to carry water into Petronila Creek to the southeast.

A drainage ditch has been excavated along State Highway 665 to the railroad tracks and thence to Petronila Creek. Recent maintenance removed accumulated silt and vegetation from this ditch.

The lack of culverts beneath the railroad embankment, and the poor main maintenance of those culverts that do exist, has been pointed out by city officials as a major impediment to drainage in Driscoll. Many lawsuits have been filed against the Missouri-Pacific Railroad by citizens of Driscoll for recovery of damages due to floodwaters impounded by the railroad embankment.

City of Port Aransas: The drainage system in the city is minimal and consists of a series of open swales with only four outfalls into the Gulf. A bond issue was approved by the voters in 1977, which provided $300,000 for drainage improvements.

Washover and resultant flooding caused by storm tide surge are inevitable in the city, given the elevation of the community and its immediate proximity to the open Gulf. Current city code prohibits the construction of levees and sea walls along the beachfront.

Flood control measures now in use in the city are concentrated primarily on flood-proof methods of construction. Condominiums already completed and those now under construction all have foundations set on piling buried up to 75 feet below the surface of the sand. Living areas are elevated to or above the level required by the Federal Insurance Administration.

City of Robstown: Both the City of Robstown and the Nueces County Drainage District No. 2 are currently coordinating efforts to solve many of the drainage problems in and around the city. The Drainage District, responsible for all work in rural areas outside the limits of corporation, is planning improvements to prevent surface water from entering the city and to convey runoff away from Robstown toward Corpus Christi Bay. The objective is to conduct out-of-city projects first so that urban drainage improvements can be tied in at a later date.

Channel improvements and structures will be constructed by Nueces County along Ruben Chavez Street from Lincoln Avenue across U. S. Route 77 to State Route 44. Additional channel improvements and structures are planned from Park Street to U. S. Route 77, south along U. S. Route 77 to State Route 44, and east along State Route 44 to Violet, TX.

Inside the corporate limits of Robstown, underground storm sewers have been constructed along Avenue B between Sara and Park Streets and then along Park Street to East Avenue E. Underground storm sewers have been installed along Moore and Washington Avenues between Iowa and Ruben Chavez Streets. Improvements have been made to the existing channel along Ruben Chavez Street between Moore and Lincoln Avenues.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 2-, 1-, or 0.2-percent-chance period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the county. Distinctly different types of hydrologic analyses were performed for stream (rainfall-runoff) sources versus tidal surge related sources.

Peak discharge-drainage area relationships for riverine flooding sources studied by detailed methods are shown in Table 4, "Summary of Discharges for the October 13, 2022 Countywide."

Flood events of 100-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. The event, commonly termed the 100-year floods, has a 1 percent chance of being equaled or exceeded during a year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100 year) flood in any 50 year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). Flow paths studied using base methods or unsteady state methods calculate the 1-percent (100-year) discharges only. The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

Peak discharge-drainage area relationships for each stream studied in detail are shown in Table 4, Summary of Discharges.

Pre-Countywide Analysis

Information on the hydrologic analyses for each of the previous FISs for communities within Nueces County was compiled and is provided below.

<u>Nueces County and Incorporated Areas</u>

Flood discharges for inland streams studied by detailed methods, were based on U.S. Geological Survey (USGS) open-file report 77-110 "Technique for Estimating the Magnitude and Frequency of Floods in Texas" (Reference 20). This technique was developed by the USGS through a regression analysis of existing gaged stream flow records. These results were then further refined for six specific regions within Texas. The area of concern for this study is located within Region I. Peak discharges for the 10-, 2-, and 1-percent-annual-chance frequencies were estimated from these relationships using the drainage area and channel slope for the streams in question. Peak discharges for the 0.2-percent-annual-chance flood were determined by a straight-line extrapolation of the 10-, 2-, and 1-percent-annual-chance data on log-probability graph paper. Peak discharges for the Nueces River were estimated from a statistical analysis of the USGS flow data.

<u>City of Driscoll</u>

Flood Discharges for Matamoros Swale were based on the USGS open-file report 77-110, *Technique for Estimating the Magnitude and Frequency of Floods in Texas,* (Reference 20) which is a regional method based on regression analysis. The method related drainage area and channel slope to peak discharged by empirical equations. Peak discharges greater than the 1-percent annual chance event were determined by straight line extrapolation on log-probability paper.

City of Robstown

Peak flood discharges for developed areas of Robstown were determined using criteria developed in the USGS Water Resources Investigations 23-74, An Approach to Estimating Flood Frequency for Urban Areas in Oklahoma (Reference 21). Although derived for developed areas in Oklahoma, this methodology can be applied to other areas after the adjustment of the rainfall intensity factor to account for local rainfall conditions. The rainfall intensity factor for Robstown was derived from information contained in Technical Paper No. 40, Rainfall Frequency Atlas of the United States (Reference 22). Using this technique, flood discharges for a certain area were first estimated using the flow equations for undeveloped conditions. Peak flows for developed conditions were then determined using adjustment factors and equations to account for the degree of development. A factor of 35-percent impervious cover was used for residential areas.

October 13, 2022 Countywide

Because of the limited available historical data or previous analyses, the restudied streams identified in Table 2c were evaluated for the most appropriate methodology selection. Gage data meeting the requirement of Bulletin 17B (Reference 23) and FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners* is available for Oso Creek and Nueces River. Therefore, the Peak FQ program was used for the hydrologic analysis of the Oso Creek and Nueces River. For the remaining restudied streams identified in Table 2c, gage data was not available. Therefore, alternative 2005 "Regional Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Underdeveloped Watershed in Texas using Press Minimization" was used for these streams (Reference 24).

Corpus Christi and Bishop LAMP Hydrology

The Hydrologic analyses in this report were updated as part of a LAMP Study (Reference 10).

In the Bishop LAMP and Corpus Christi Flood Risk Reduction System (CCFRRS) LAMP study, the new hydrology information came from Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model (Reference 25) study areas. A hydrograph was developed for each sub-basin for the 1-percent-annual-chance flood event. The hydrographs were entered into FLO-2D (Reference 26), a 2D hydraulic modeling program for routing and final calibration with the computed regression and gage peak flows. The study area is entirely urban, and the peak discharge reported in Table 4 was split into sub-basins and applied to the FLO-2D hydraulic model according to the appropriate sub-basin designation.

Table 4 – Summary of Discharges for the October 13, 2022 Countywide

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Airport Drainage Ditch					
Joe Mireur Road	2.60	450	700	760	1,000
Carretta Creek					
At U.S. Highway 77 Bypass located at 7,000 feet downstream of corporate limits	24.02	2,476	4,350	5,170	7,700
At Birch Avenue	22.99	2,399	4,210	5,000	7,500
North Avenue H	22.06	2,330	4,075	4,840	7,200
Approximately 0.33 miles downstream of CR-85 Bridge	5.89	554	860	1,022	1,630
Approximately 110 feet upstream of US BUS 77 Bridge	6.94	556	864	1,027	1,637
CCFRRS Levee Seclusion Area					
Overland runoff inside urban basins	1.49	-	-	1,490**	-
Ditch A[1]					
At confluence with Oso Creek	29.53	2,101	3,898	4,839	6,345
0.2 Miles upstream of State Highway 77	19.00	1,438	2,145	2,337	2,482
At North 1st Street	13.12	918	1,120	1,040	777
Ditch B					
At confluence with Ditch BN	2.83	420	590	650	860
Ditch BN					
At Airport Road	5.92	670	970	1,080	1,430
At Texas-Mexican Railroad	5.07	600	860	960	1,240
At State Route 44	2.83	420	590	650	860

**: Note: Flow includes overland runoff.

Table 4 – Summary of Discharges for the October 13, 2022 Countywide (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Ditch E					
At confluence with Ditch C	0.92	230	320	360	480
At Missouri Pacific Railroad Spur	0.75	200	280	310	390
Ditch F[1]					
At confluence with Ditch A	5.70	849	1,555	1,921	2,515
0.8 miles upstream of confluence with Ditch A	3.77	461	787	951	1,237
Drainage Creek					
Confluence with Oso Creek	24.13	2,830	4,571	5,607	6,868
Old Brownsville Road	19.08	2,100	3,414	4,178	5,110
Confluence of Airport Drainage Ditch	10.3	1,534	2,512	3,069	3,764
Joe Mireur Road	6.88	1,010	1,657	2,015	2,464
Matamoros Swale					
At U.S. Highway 77	25.20	2,220	3,720	4,360	6,250
Navigation Boulevard Drainage Ditch					
Limit of Detailed Study	1.20	180	230	240	290
Old Brownsville Road	0.94	150	190	200	240
North Carretta Creek					
Culvert on FM-70 at approximately 870 feet west of the junction of FM-70 and CR-83	26.58	1,608	2,333	2,716	4,143
Approximately 260 feet east of the junction of CR-83 and W. 1st Street.	27.58	1,607	2,332	2,714	4,141
Approximately 270 feet downstream of US-77-BR Bridge	28.19	1,607	2,331	2,714	4,141

Table 4 – Summary of Discharges for the October 13, 2022 Countywide (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
North Carretta Creek (continued)					
Approximately 500 feet upstream of N Hackberry Ave Bridge	28.73	1,607	2,331	2,714	4,141
Nueces River					
2000 feet downstream of Missouri Pacific Railroad	16,892	47,820	111,170	145,100	237,690
At Calallen Dam	16,840	47,720	110,930	144,790	237,180
Oso Bay Tributary No. 2					
Limit of Detailed Study	3.18	560	1,020	1,220	1,740
At Field Road	2.62	500	925	1,120	1,590
At Woolridge Road	1.18	330	660	1,020	1,200
Oso Bay Tributary No. 3					
S. Padre Island Drive	2.20	395	582	651	850
Lexington Road	1.95	363	530	592	770
Rodd Field Road	1.60	315	456	507	650
Oso Creek					
9000 feet downstream of confluence of Oso Creek Trib. 5	207.28	12,000	18,660	21,580	28,520
At Staple Street (FM 2444)	163.32	10,150	15,790	18,260	24,130
At FM 43 (Highway 43)	149.29	9,530	14,830	17,150	22,660
At FM 763	88.01	6,580	10,240	11,840	15,650
At State Highway 44	44.38	4,080	6,350	7,340	9,700
Oso Creek Tributary No. 2					
At confluence with Oso Creek	4.12	1,389	2,229	2,707	3,318
At Kostoryz	1.61	736	1,126	1,339	1,631

Table 4 – Summary of Discharges for the October 13, 2022 Countywide (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Oso Creek Tributary No. 5					
At confluence with Oso Creek	12.68	1,244	2,277	2,814	3,685
At FM 2244	7.61	720	1,263	1,539	2,009
At State Highway 286	7.06	720	1,263	1,539	2,009
At County Road 47	4.91	539	926	1,121	1,460
Oso Creek Tributary No. 6					
At confluence with Oso Creek	4.26	1,547	2,394	2,900	3,465
At Acushnet Road	2.71	1,231	1,767	2,092	2,478
At Congressional Drive	2.33	804	1,141	1,338	1,589
At Killarmet Drive	2.01	717	989	1,148	1,362
At U.S. Government Railroad	1.02	369	498	568	672
Oso Creek Tributary No. 10					
At confluence with Oso Creek	34.45	4,119	7,008	8,791	10,693
At Saratoga Boulevard	32.20	3,846	6,412	7,993	9,718
Oso Creek Tributary No. 10 (continued)					
Confluence with Drainage Creek	31.89	3,707	6,163	7,675	9,319
At U. S. Government Railroad	6.03	1,076	1,647	1,983	2,364
At South Padre Island Drive	5.86	1,076	1,647	1,983	2,364
At West Point Road	4.93	926	1,422	1,710	2,035
Oso Creek Tributary No. 14					
At confluence with Oso Creek	8.63	1,470	2,361	2,868	3,507
At McGolin Road	8.08	1,170	1,815	2,175	2,657
At State Highway 44	5.23	839	1,294	1,542	1,884
At limited of detailed study	3.34	755	1,186	1,416	1,742

Table 4 – Summary of Discharges for the October 13, 2022 Countywide (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Robstown Flowpath[1]					
At Confluence with Ditch A	4.59	726	1,788	2,516	3,870
State Highway 44 East Drainage Ditch					
Confluence with Drainage Ditch	3.24	500	730	820	1,060
Hopkins Road	1.59	340	510	580	780
State Highway 44 West Drainage Ditch					
Confluence with Drainage Ditch	3.24	500	730	820	1,060
Airport Access Road	2.59	420	620	690	900
Bronco Road	1.43	280	390	430	530
Turning Basin Tributary					
Harbor Street	2.27	570	960	1,110	1,600
East Port Avenue	2.20	560	930	1,090	1,550
West Broadway	2.12	540	910	1,060	1,500
Nueces Street	1.82	490	810	940	1,350

1. Flows for Ditch A, Ditch F, and Robstown Flowpath reflect final discharges from the hydraulics analysis, which accounted for flow exchange between the three reaches.

3.2 Hydraulic Analyses

Pre-Countywide Analysis

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the flood profiles or in the floodway data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross-sections for the backwater analyses of streams were obtained by field survey using third-order accuracy. Dimensions of all bridges and culverts were determined by field measurement or were field checked to verify structural geometry from construction plans.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed, selected cross-sections locations are also shown on the FIRMs (Exhibit 3).

Water-surface elevations of riverine floods of the selected recurrence intervals were computed using the USACE Hydrologic Engineering Center's HEC-2 step-backwater computer program (Reference 27). Starting water-surface elevations were calculated using the slope-area methods. Areas affected by the 1- and 0.2-percent-annual-chance floods were outlined by using the width and water-surface elevation at each surveyed cross-section and interpolating the width and elevation between sections using water-surface profiles and USGS topographic quadrangle maps (Reference 28).

The hydraulic analyses for this study are based on the effect of unobstructed flow. The flood elevations are thus considered valid only if hydraulic structures in general remain unobstructed and do not fail.

Roughness coefficients (Manning's "n" values) were obtained by field inspection and engineering judgment.

October 13, 2022 Countywide

<u>City of Bishop</u>

The flooding extent from North Carretta Creek and Carretta Creek was revised using 2-foot light detection and ranging (LiDAR) (Reference 29) as the best available terrain data. The vertical datum conversion was applied to the effective flood profiles, and the floodplains were mapped using 2-foot LiDAR. Cross-sections were obtained from the effective map, and no new cross-sections were added.

The North Carretta Creek levee, within the City of Bishop is not shown to meet the NFIP regulation 65.10 regarding its ability to provide protection from the 1% annual chance flood event.

City of Corpus Christi

Oso Bay Tributary No. 2, Oso Bay Tributary No. 3, State Highway 44 West Drainage Ditch, State Highway 44 East Drainage Ditch, Turning Basin Tributary, and Airport Drainage Ditch were restudied using redelineation methodology. The vertical datum conversion was applied to the flood profiles, and the flooding extents for these streams were mapped using 2-foot LiDAR. Cross-sections were obtained from the effective map, and no new cross-sections were added.

The Turning Basin Tributary levee, within the City of Corpus Christi is not shown to meet the NFIP regulation 65.10 regarding its ability to provide protection from the 1% annual chance flood event.

The flooding source of Oso Creek Tributary 2, Oso Creek Tributary 5, Oso Creek Tributary 6, Oso Creek Tributary 10, Oso Creek Tributary 14, and Drainage Creek were restudied using detailed methods for this revision. The cross-sections and structures were surveyed and imported into the Hydrologic Engineering Center's River Analysis System (HEC-RAS version 4.1.0) model (Reference 30). The Manning's n values were developed by field inspection and engineering judgment.

City of Driscoll

The water surface elevations of the 1-percent annual chance flood for Matamoros Swale were computed using HEC-2, step-backwater program (Reference 31). Cross Sections for the backwater analysis were obtained by filed measurement. Dimensions of all bridges and culverts were obtained by field measurement and field checked to verify structural geometry. The starting water-surface elevation was calculated using the slop-area method. The backwater profile indicated that most of the 1-percent annual chance flood was contained in the overbank areas and not in the channel, and the flood moved overland in a sheet, therefore it was determined that this area can be considered a shallow flooding area. The Manning's n values were developed by field inspection and engineering judgment.

City of Robstown

Ditch E was restudied using redelineation methods. The effective flood profiles of Ditch E were shifted based on the vertical datum conversion, and the flooding extents were mapping using 2-foot LiDAR (Reference 29). Cross-sections were obtained from the effective map, and no new cross-sections were added.

Ditch C was restudied using approximate methods.

The flooding source of Ditch A and Ditch F were restudied using detailed methods for this revision. The cross-sections and structures were surveyed and imported into the hydraulic model (Reference 30). The Manning's n values were developed by filed inspection and engineering judgment.

The downstream reach boundary condition for streams in Nueces County cannot be estimated by calculating the slope between the downstream-most cross-sections because of the county's naturally flat terrain. Reach boundary conditions were estimated by manually adjusting the normal depth value until the downstream water surface elevation did not decrease significantly. For Ditch F, the most upstream known water surface elevation from Ditch A was used for the downstream reach boundary condition.

Nueces County and Unincorporated Areas

Ditch B and Ditch BN were restudied using redelineation methods. The effective flood profiles of Ditch B and Ditch BN were shifted based on the vertical datum conversion, and their flooding extents were mapping using 2-foot LiDAR (Reference 29). Cross-sections were obtained from the effective map, and no new cross-sections were added.

Oso Creek and Nueces River were restudied using detailed methods. The cross-sections and structures were surveyed and imported into the HEC-RAS model (Reference 30). The Manning's n values were developed by field inspection and engineering judgment. Other flooding sources in the unincorporated area of Nueces County were restudied using approximate methods. Manning's n values were determined based on aerial photo inspection and engineering judgment. Cross-sections were placed at 500 feet, and structures were not modeled.

The downstream reach boundary condition for streams in Nueces County cannot be estimated by calculating the slope between the downstream-most cross-sections because of the county's naturally flat terrain. Reach boundary conditions were estimated by manually adjusting the normal depth value until the downstream water surface elevation did not decrease significantly.

Roughness coefficients (Manning's n values) were obtained by field inspection and engineering judgment. Table 5 lists Manning's n values that were used for streams restudied by detailed methods for this countywide revision. For stream studies using redelineation, the same Manning's n values as previous studies were selected.

LAMP Hydraulics

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness coefficients are provided in Table 5. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation

Corpus Christi Flood Risk Reduction System

In this study, the Corpus Christi Flood Risk Reduction System (CCFRRS) was analyzed using LAMP methods (Reference 8). The storm surge and riverine hydrology from the coastal analyses were used, with the addition of internal drainage runoff within the study area computed using HEC-HMS. Inputs include storm surge from Corpus Christi Bay, wave runup and overtopping of the seawall fronting Corpus Christi Bay, storm surge in the Turning Basin, combined storm surge and riverine flooding in the Turning Basin Tributary, and the internal drainage computed for this study. All of these hydrographs were used as input in a FLO-2D 2-dimensional hydraulic flood routing model (Reference 26).

Bishop

The LAMP (Reference 9) procedure was applied to the North Carretta Creek in Bishop. A FLO-2D (Reference 26) model was built to compute the 1-percent-annual-chance flood. Hydrographs from all sub-basins were applied to the FLO-2D model. Two scenarios were set up for the LAMP, the Natural Valley scenario and the with-levee scenario.

Table 5 – Manning's "n" Values for Streams Studied by Detailed Methodology

Flooding Source	Previous Study Date	Roughness Coefficients	
		Channel	Overbank
Airport Drainage Ditch	1992	0.045	0.06
Caretta Creek	1980	0.03 – 0.05	0.05 – 0.08
Ditch A	2017	0.03 – 0.048	0.045 – 0.10
Ditch B	1992	0.045	0.06
Ditch BN	1985 / 1992	0.04 – 0.06	0.06 – 0.10
Ditch E			
Ditch F	2017	0.03 – 0.045	0.05 – 0.1
Drainage Creek	2006	0.025 – 0.033	0.035 – 0.15
Matamoros Swale	1979	0.040 – 0.060	0.065
Navigation Boulevard Drainage Ditch	1992	0.045	0.06
North Carretta Creek	2016	0.033 – 0.04	0.02 – 0.13
Nueces River	2006	0.035	0.1 – 0.17
Oso Bay Tributary No. 2	1992	0.045	0.06
Oso Bay Tributary No. 3	1992	0.045	0.06
Oso Creek	2017	0.03 – 0.07	0.035 – 0.17
Oso Creek Tributary No. 2	2006	0.03	0.035 – 0.1
Oso Creek Tributary No. 5	2006	0.025 – 0.035	0.035 – 0.15
Oso Creek Tributary No. 6	2006	0.022 – 0.035	0.03 – 0.15
Oso Creek Tributary No. 10	2006	0.017 – 0.04	0.03 – 0.15
Oso Creek Tributary No. 14	2006	0.03	0.035 – 0.15
Overland Runoff in CCFRRS Levee Seclusion Area	2019	N/A	0.12
Robstown Flowpath	2017	0.05-0.1	0.05-0.1
State Highway 44 East Drainage Ditch	1992	0.045	0.06
State Highway 44 West Drainage Ditch	1992	0.045	0.06
Turning Basin Tributary	1992	0.045	0.06

3.3 Coastal Hazard Analysis

The hydraulic characteristics of coastal flood sources were analyzed to provide estimates of flood elevations for selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown in the coastal data tables and flood profiles provided in the FIS report.

October 13, 2022 Countywide

3.3.1 Storm Surge Analysis and Modeling

For areas subject to coastal flood effects, the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations were taken directly from a detailed storm surge study documented in *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* prepared by the USACE (Reference 32). This storm surge study was completed in November 2011.

The Advanced Circulation (ADCIRC) model for coastal ocean hydrodynamics developed by the USACE was applied to calculate stillwater elevations for coastal Texas. The ADCIRC model uses an unstructured grid and is a finite element long wave model. It has the capability to simulate tidal circulation and storm surge propagation over large areas and is able to provide highly detailed resolution in areas of interest along shorelines, open coasts, and inland bays. It solves three-dimensional equations of motion, including tidal potential, Coriolis effect, and non-linear terms of the governing equations. The model is formulated from the depth-averaged shallow water equations for conservation of mass and momentum that result in the generalized wave continuity equation.

In performing the coastal analyses, nearshore waves were required as inputs to wave runup and overland wave propagation calculations, and wave momentum (radiation stress) was considered as a contribution to elevated water levels (wave setup). The Steady State Spectral Wave (STWAVE) model was used to generate and transform waves to the shore for the Texas Joint Storm Surge (JSS) Study. STWAVE is a finite difference model that calculates wave spectra on a rectangular grid. The model outputs zero-moment wave height, peak wave period (Tp), and mean wave direction at all grid points and two-dimensional spectra at selected grid points. STWAVE includes an option to input a spatially variable wind and storm surge field. Storm surge significantly alters wave transformation and generation for the hurricane simulations in shallow-flooded areas.

STWAVE was applied on five grids for the Texas JSS: NE, CE, SW, NEn, and CEn. Three large grids (NE, CE, and SW) with offshore boundaries at depths near 100 feet (30 meters) encompassed the entire coast of Texas and applied the efficient half-plane version of STWAVE (which must approximately align with the shoreline). Two nested grids (NEn and CEn) covered Galveston Bay and Corpus Christi Bay and applied the fullplane version of STWAVE to allow generation of wind waves in all directions. Notably, memory requirements for the full-plane model precluded its use for the large grids with offshore boundaries. The input for each grid includes the bathymetry (interpolated from the ADCIRC domain), surge fields (interpolated from ADCIRC surge fields), and wind fields (interpolated from the ADCIRC wind fields, which apply land effects to the base wind fields). The wind and surge applied in STWAVE are spatially and temporally variable for all domains. STWAVE was run at 30-minute intervals for 93 quasi-time steps (46.5 hours).

The ADCIRC model computational domain and the geometric/topographic representation developed for the Joint Coastal Surge effort was designated as the

TX2008 mesh. This provides a common domain and mesh from the Texas-Mexico border to western Louisiana, extends inland across the floodplains of Coastal Texas (to the 30- to 75-foot contour North American Vertical Datum of 1988 [NAVD88]), and extends over the entire Gulf of Mexico to the deep Atlantic Ocean. The TX2008 domain boundaries were selected to ensure the correct development, propagation, and attenuation of storm surge without necessitating nesting solutions or specifying ad-hoc boundary conditions for tides or storm surge. The TX2008 computational mesh contains more than 2.8 million nodes and nodal spacing varies significantly throughout the mesh. Grid resolution varies from approximately 12 to 15 miles in the deep Atlantic Ocean to about 100 feet in Texas. Further details about the terrain data as well as the ADCIRC mesh creation and grid development process can be found in *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* (Reference 32).

3.3.2 Statistical Analysis

The Joint Probability Method (JPM) is a simulation methodology that relies on the development of statistical distributions of key hurricane input variables such as central pressure, radius to maximum wind speed, maximum wind speed, translation speed, track heading, etc., and sampling from these distributions to develop model hurricanes. The resulting simulation results in a family of modeled storms that preserve the relationships between the various input model components, but provides a means to model the effects and probabilities of storms that historically have not occurred.

Due to the excessive number of simulations required for the traditional JPM method, the JPM-Optimum Sampling (JPM-OS) was utilized to determine the stillwater elevations associated with tropical events. JPM-OS is a modification of the JPM method and is intended to minimize the number of synthetic storms that are needed as input to the ADCIRC model. The methodology entails sampling from a distribution of model storm parameters (e.g., central pressure, radius to maximum wind speed, maximum wind speed, translation speed, and track heading) whose statistical properties are consistent with historical storms impacting the region, but whose detailed tracks differ. The methodology inherently assumes that the hurricane climatology over the past 60 to 65 years (back to 1940) is representative of the past and future hurricanes likely to occur along the Texas coast.

A set of 446 storms (two sets of 152 low frequency storms + two sets of 71 higher frequency storms) was developed by combining the “probable” combinations of central pressure, radius to maximum winds, forward speed, angle of track relative to coastline, and track. Tracks were defined by five primary tracks and four secondary tracks. Storm parameters for synthetic storms are provided in the *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* (Reference 32). The estimated range of storm frequencies using the selected parameters was between the 10%- and 0.2%-annual-chance storm events. The ADCIRC-STWAVE modeling system was validated using five historic storms: Hurricanes Carla (1961), Allen (1980), Bret (1999), Rita (2005), and Ike (2008).

3.3.3 Stillwater Elevations

The results of the ADCIRC model and JPM-OS provided 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations which include wave setup effects. Stillwater elevations are assigned at individual ADCIRC mesh nodes throughout the Texas coast. Triangular Irregular Networks (TINs) and raster datasets were built from these nodes for use in wave analysis and floodplain mapping.

An Independent Technical Review (ITR) was performed on the overall storm surge study process. This review process was performed in accordance with USACE regulations. The ITR team was composed of experts in the fields of coastal engineering and science, and was engaged throughout the study. Appendix K of *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* includes all comments received from the ITR panel, as well as responses to those comments (Reference 32).

3.3.4 Wave Height Analysis

Using storm surge study results, a wave height analysis was performed to identify areas of the coastline subject to overland wave propagation or wave runup hazards. Figure 2 shows a cross-section for a typical coastal analysis transect, illustrating the effects of energy dissipation and regeneration of wave action over inland areas. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Figure 2 also illustrates the relationship between the local stillwater elevations, the ground profile, and the location of the VE/AE Zone boundary at the limit of 3-foot breaking waves. This inland limit of the coastal high hazard area is delineated to ensure that adequate insurance rates apply and appropriate construction standards are imposed, should local agencies permit building in this coastal high hazard area.

Laboratory tests and field investigations have shown that wave heights as little as 1.5 feet can cause damage to and failure of typical Zone AE construction. Therefore, for advisory purposes only, a Limit of Moderate Wave Action (LiMWA) boundary has been added in coastal areas subject to wave action. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave.

The effects of wave hazards in the Zone AE between the Zone VE (or shoreline in areas where VE Zones are not identified) and the limit of the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot breaking waves are projected during a 1-percent-annual-chance flooding event.

In areas where wave runup elevations dominate over wave heights, such as areas with steeply sloped beaches, bluffs, and/or shore-parallel flood protection structures, there is no evidence to date of significant damage to residential structures by runup depths less than 3 feet. However, to simplify representation, the LiMWA was continued immediately landward of the VE/AE boundary in areas where wave runup elevations dominate. Similarly, in areas where the Zone

VE designation is based on the presence of a primary frontal dune or wave overtopping, the LiMWA was also delineated immediately landward of the Zone VE/AE boundary.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the Technical Support Data Notebook – Coastal Analysis FIRM and FIS Updates (Reference 33).

The USACE 1- and 0.2-percent-annual-chance storm surge stillwater elevation data was provided to MAPVI in October 2011. The regional wave setup was included in the surge data. The Watershed Information System (WISE) software package (Reference 34) was used to import the 1- and 0.2-percent-annual-chance stillwater elevation data into each Wave Height Analysis for Flood Insurance Studies (WHAFIS) station of each transect (Reference 35).

The starting wave condition data was provided to MAPVI in September 2011. The data contained the significant wave height (Hs) and significant wave period (Ts) for the 1-percent-annual-chance storm. The starting wave condition data was not provided for the 0.2-percent-annual-chance storm. Starting wave condition was applied to transects originating along the open coast (transect 1-26). For transect originating in sheltered waters and other bodies of water other than the open coast (transect 27-45), starting wave conditions will be determined using fetch analysis within WHAFIS.

FEMA's coastal guidelines (Reference 36) required modelers to consider adjustments to transect ground profiles resulting from storm-induced erosion of sand dunes and ridges, including the primary frontal dune. Dune toe, face, peak, and heel are identified for the erosion model run within the WISE Coastal Module, which uses a storm-induced erosion function that has been reviewed and approved for use by FEMA.

There are two possible results of the dune erosion model: dune removal and dune retreat. To make the removal or retreat determination, the 540-square-foot rule is applied to the sand reservoir above the 1-percent-annual-chance stillwater elevation plus wave setup. The inclusion of wave setup in the water surface elevation for erosion calculations reflects a forthcoming Procedure Memorandum from FEMA; though the guidance is not final as of the writing of this document, the method will be employed for this study. If the dune has a cross-sectional area of at least 540 square feet above the 1-percent-annual-chance stillwater elevation plus wave setup, then the dune is modeled as a retreat case. If the cross-sectional area above the 1-percent-annual-chance stillwater elevation is less than 540 square feet, the dune is modeled as a removal case. For a 0.2-percent-annual-chance storm, the frontal dune must have a cross-sectional area of at least 1,030 square feet above the 0.2-percent-annual-chance stillwater elevation plus wave setup. The erosion-adjusted profile was then used to model wave propagation with WHAFIS and for runup calculations, where applicable. Storm-induced erosion was not considered for transects that have a concrete seawall or other hardened structure.

Wave height was computed using the Coastal Hazard Analysis Modeling Program (CHAMP), version 2.0, which includes the wave height analysis (WHAFIS 4.0) model (Reference 35). WHAFIS is capable of calculating the effects of open fetches and obstructions on the growth and attenuation of wave heights. The following section outlines the application of the WHAFIS model to determine wave crest elevation along the Nueces County coastline.

A primary input to the WHAFIS model is the ground profile consisting of station (distance in feet) and elevation (in feet above NAVD88 datum) pairs that represent the bare-earth ground elevation along the transect, accompanied by the stillwater elevation. For each of the 45 transects, detailed ground profiles were extracted from the high-resolution terrain. As these ground profiles contain thousands of data points, the first step in wave height modeling was to generalize the transects in the WHAFIS profile to eliminate redundancy and negligible variations.

The building (BU) card contains information on the number of rows of buildings and the open space ratio of each row. The number of rows and open space ratios were determined using the field reconnaissance notes. Where building descriptions in the field notes were insufficient to determine these parameters, aerial imagery was used to count rows of buildings and to determine the ratio of open area. BU cards were used where the building type is slab-on-grade or garage-on-grade, and buildings were treated as obstructions to wave propagation. In areas of high development density, some additional BU cards with 100-percent open space were used to model changes in the topography while not allowing the increase in waves that would accompany an inland fetch (IF) / overwater fetch (OF) card or decrease in waves that would come with the rigid vegetation (VE) card. With transects facing the Gulf of Mexico (transects 1–26), the first row of buildings along the coast was considered lost during a storm event and was excluded from the row count. For transects originating on sheltered waters (transects 27–45), the first row of buildings was included in the row count.

The VE card contains information for dry and thick vegetation, such as bushes, trees, and shrubs. Field reconnaissance information for vegetation was used to determine parameters such as average diameter, average height, average spacing, and drag coefficient. Where field notes are unavailable, information from the nearest rigid vegetation area was consulted with use of aerial imagery to determine vegetation parameters.

The marsh vegetation (VH) card contains information on wetland vegetation. This includes parameters such as region, plant type, drag coefficient, coverage ratio, unflexed stem height, density of plants, stem diameters (base, mid, top), and frontal area ratio. The primary region of the study area is South Texas, based on Figure D-22 in the *Guidelines and Specifications for Flood Hazard Mapping Partners*, Appendix D. According to Appendix D, Tables D-11 and D-12, there is no dominant marsh plant and insignificant amounts of marsh plant data in the South Texas region. Based on the field reconnaissance and aerial imagery, medium saltmeadow cordgrass (*Spartina alterniflora*) and black needlerush (*Juncus roemerianus*) were found to dominate in many different low elevation areas, below 1.5 feet. These marsh plants were used for the VH cards for all transects. The collected plant parameters (mid-stem diameter, base-stem diameter, density, etc.) from the field notes were comparable to the *Guidelines and Specifications for Flood Hazard Mapping Partners,* Appendix D, Table D-11, so their use is appropriate. Because most marsh areas are inaccessible in the field, an equal distribution of these two plants was assumed and a 50-percent coverage factor was used for both plant types. If significant differences were observed among various areas upon examining the aerial imagery and field reconnaissance notes, a different type of marsh grass and appropriate set of parameters were used.

The OF card is used along the open coast before reaching a primary frontal dune or in open water areas with depths greater than 10 feet. The IF card is used in the locations where buildings and significant vegetation are not present and waves are allowed to regenerate. Using IF cards is common for isolated inland bodies of water where wind speeds are not as high as open water wind speeds. For this study, the OF/IF cutoff is at the Primary Frontal Dune for transects 1–9 and 14–26. At these locations the waterway between the barrier island and mainland is relatively narrow and shallow. OF cards were used to describe the Corpus Christi Bay to reflect the possibility of higher wind speeds over the large bay.

Starting wave conditions for the 1-percent-annual-chance storm that were provided by the FEMA Region VI were applied to transects originating along the open coast (transects 1-26). For transects originating on sheltered waters (transects 27-45), starting wave conditions were determined using fetch based analysis (WHAFIS). WHAFIS requires fetch length and wind speed as inputs. The fetch lengths were measured parallel to the transects across the flooding water body. The maximum effective fetch length that can be used within WHAFIS is 24 miles.

Because no starting wave condition for 0.2-percent-annual-chance storm was provided by FEMA Region VI, the 1-percent-annual-chance wave period was used for computing wave heights for the 0.2-percent-annual-chance event.

The default wind speeds contained in the CHAMP program were used. For the 1-percent-annual-chance storm, the default wind speeds are OF=80 miles per hour, IF=60 miles per hour, and VH=60 miles per hour. For the 0.2-percent-annual-chance storm, the default wind speeds are OF=100 miles per hour, IF=75 miles per hour, and VH=75 miles per hour.

Using fetch length and default wind speed for WHAFIS input, the output contains the controlling wave height (Hcont) and spectral peak wave period (Tp). According to the *Guidelines and Specifications for Flood Hazard Mapping Partners,* Appendix D, and USACE Shore Protection Manual (SPM), the significant wave height (Hs) is equal to Hcont/1.6, and the significant wave period (Ts) is effectively the same as Tp.

FEMA requires consideration of both wave height and wave runup hazards. The current FEMA guidance requires calculation of the 2-percent runup elevation. The 2-percent runup is the value exceeded by 2-percent of the successive waves that would occur during the 1-percent-annual-chance event. FEMA's RUNUP model computes both the mean wave runup and the 2-percent runup.

For this study, runup was performed using Technical Advisory Committee for Water Retaining Structure (TAW) methodology, FEMA's RUNUP 2.0 and SPM methodology. The TAW methodology is only applicable for slopes between 1:1 and 1:8. RUNUP 2.0 implements the Stoa (1978) and Goda (1970) runup curves and is applicable for slopes flatter than 1:8 and steeper than 1:15. Runup computations for vertical walls were performed using graphical methods outlined in the SPM.

Runup computations were performed on open coast structures or open coast natural beach that has slopes steeper than 1:15. The criteria triggered the need to calculate runup for about 22 transects. Of these, 17 were modeled with the TAW method, 3 with RUNUP 2.0, and 2 with the SPM method for vertical walls. For detailed information on runup methodology, refer to the Coastal Technical Support Data Notebook.

The LiMWA is the inland limit of the area affected by waves greater than 1.5 feet high. Since the wave crest is 70 percent of the controlling wave height above the stillwater plus setup surface, the LiMWA is the location where the wave crest is approximately 1 foot (0.7*1.5) above the mean water elevation (stillwater including wave setup). The mapping was conducted by identifying the LiMWA location(s) along each transect using the WHAFIS output and connecting those points between transects using the gutter lines as guides. In areas where runup elevations dominate over WHAFIS wave height, such as areas with steeply sloping beaches or high bluffs, there is no need to delineate the LiMWA. However, to retain continuous LiMWA lines, in runup areas the LiMWA will be placed immediately landward or coincident with the mapped VE/AE Zone boundary, and occasionally it will be coincident with the 1-percent-annual-chance floodplain boundary.

The combined effects of the surge plus riverine runoff were determined in accordance with the procedures in Guidelines and Specifications for Flood Hazard Mapping Partners. Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update. February, 2007 (Reference 36). The combined probability was determined graphically at lettered cross-sections for affected streams. The probability was used to map the water elevations that would tie-in between the riverine and coastal flooding.

Table 6, Parameter Values for Surge Elevation Computation, lists 1 percent annual chance stillwater elevations and maximum 1-percent annual chance wave crest elevations.

3.3.5 Corpus Christi LAMP Coastal Analysis

No separate coastal analyses were performed as part of this LAMP study (Reference 8). Peak 1%-annual-chance stillwater levels were taken from the coastal analyses. Stillwater elevations in the vicinity of the study area, derived from the coastal analyses are reported in the Table 7. Wave runup and overtopping calculations along the CCFRRS seawall were taken from comments submitted by the City of Corpus Christi (References 38 and 39), which was incorporated into the preliminary FIRM.

No new overland wave analysis was performed as part of this LAMP study. Wave regeneration is negligible in the urban study area in Corpus Christi

Table 6 – Parameter Values for Surge Elevation Computation

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
1[2]	The transect starts from the Gulf of Mexico shoreline, 13,000 feet south of the Nueces - Kleberg County boundary (27.544001° N, 97.238998° W), and extends inland across Matanza Windmill	9.8	11.16[3]
2[2]	The transect starts from the Gulf of Mexico shoreline, 4,100 feet southeast of the Nueces-Kleberg County boundary (27.566° N, 97.227203° W), and extends inland across Waldron Road	9.9	10.91[3]
3	The transect starts from the Gulf of Mexico shoreline, 2,270 feet southeast of Bob Hall Pier (27.5809° N, 97.220001° W), and extends inland to approximately 220 feet short of Waldron Road	9.6	14.76
4	The transect starts from the Gulf of Mexico shoreline, 3,860 feet southeast of State Highway Park Rd. 22 (27.5921° N, 97.214699° W), and extends inland to approximately 2,450 feet past Waldron Road	9.6	14.76
5	The transect starts from the Gulf of Mexico shoreline, 1,200 feet southeast of Windward Dr. (27.6035° N, 97.208504° W), and extends inland across to approximately 290 feet past Flour Bluff Dr.	10	15.38

* North American Vertical Datum of 1988
[1] Includes wave setup
[2] Transect begins outside of Nueces County; consequently, the starting stillwater is from outside of the county
[3] Maximum 1 percent annual chance wave crest inside the county

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
6	The transect starts from the Gulf of Mexico shoreline, 150 feet southeast of Windward Dr. (27.608601° N, 97.205498° W), and extends inland to approximately 380 feet past Flour Bluff Dr.	9.9	15.22
7	The transect starts from the Gulf of Mexico shoreline, 5,750 feet southeast of State Highway 361 (27.621099° N, 97.199402° W), and extends inland to approximately 415 feet past Military Dr.	9.8	15.06
8	The transect starts from the Gulf of Mexico shoreline, 4,910 feet southeast of State Highway 361 (27.632099° N, 97.193298° W), and extends inland to approximately 2,875 feet past Waldron Rd.	9.5	14.61
9	The transect starts from the Gulf of Mexico shoreline, 4,950 feet southeast of State Highway 361 (27.651899° N, 97.1819° W), and extends inland to approximately 875 feet past Lexington Blvd.	9.4	14.45
10	The transect starts from the Gulf of Mexico shoreline, 3,835 feet southeast of State Highway 361 (27.675301° N, 97.167° W), and extends inland to approximately 5,250 feet past North Shoreline Blvd.	9.3	14.3

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
11	The transect starts from the Gulf of Mexico shoreline, 3,324 feet southeast of State Highway 361 (27.708799° N, 97.1465° W), and extends inland to approximately 5,500 feet inland of Nueces Bay	8.8	13.54
12	The transect starts from the Gulf of Mexico shoreline, 2,830 feet southeast of State Highway 361 (27.7409° N, 97.124199° W), and extends inland to approximately 1,430 feet inland of Nueces Bay.	9.2	14.1
13	The transect starts from the Gulf of Mexico shoreline, 3,350 feet southeast of State Highway 361 (27.762199° N, 97.108902° W), and extends inland to U.S. Highway 181	8.7	13.39
14	The transect starts from the Gulf of Mexico shoreline, 3,475 feet southeast of State Highway 361 (27.7806° N, 97.094704° W), extending inland across Farm to Market 1069 (across Redfish Bay).	9.2	14.15
15	The transect starts from the Gulf of Mexico shoreline, 3,350 feet southeast of State Highway 361 (27.787001° N, 97.089401° W), and extends inland to approximately 1,675 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.2	14.16

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
16	The transect starts from the Gulf of Mexico shoreline, 3,315 feet southeast of State Highway 361 (27.7943° N, 97.083199° W), and extends inland to approximately 1,125 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.2	14.16
17	The transect starts from the Gulf of Mexico shoreline, 1,030 feet southeast of Port Aransas Beach Road (27.801901° N, 97.076599° W), and extends inland to approximately 1,220 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.3	14.31
18	The transect starts from the Gulf of Mexico shoreline, 1,015 feet southeast of Port Aransas Beach Road (27.806101° N, 97.072899° W), and extends inland to approximately 1,250 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.3	14.31
19	The transect starts from the Gulf of Mexico shoreline, 1,150 feet southeast of Port Aransas Beach Road (27.809799° N, 97.069603° W), and extends inland to approximately 1,260 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.2	14.15
20	The transect starts from the Gulf of Mexico shoreline, 1,140 feet southeast of Port Aransas Beach Road (27.8137° N, 97.0662° W), and extends inland to approximately 1,300 feet past Farm-to-Market Road 2725 (across Redfish Bay).	9.4	14.46

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

		ELEVATION (feet NAVD88*)	
TRANSECT	LOCATION	1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
21	The transect starts from the Gulf of Mexico shoreline, 1,000 feet southeast of Port Aransas Beach Road (27.818399° N, 97.061996° W), and extends inland to approximately 1,336 feet past South Commercial Street (across Redfish Bay), north of 2725/361 intersection at Beasley Avenue.	9.3	14.3
22	The transect starts from the Gulf of Mexico shoreline, 1,005 feet southeast of Port Aransas Beach Road (27.8209° N, 97.059601° W), and extends inland to approximately 1,425 feet past South Commercial Street (across Redfish Bay), near Rhodes Avenue.	9.3	14.31
23	The transect starts from the Gulf of Mexico shoreline, 1,040 feet southeast of Port Aransas Beach Road (27.824301° N, 97.056198° W), and extends inland to approximately 1,785 feet past South Commercial Street (across Redfish Bay), just north of Johnson Avenue and RV park runway extension.	9.3	14.31
24	The transect starts from the Gulf of Mexico shoreline, 2,525 feet southeast of Port Aransas Beach Road (27.8293° N, 97.050903° W), extends inland across to approximately 2,210 feet past South Commercial Street (across Redfish Bay), near Pelican Cove.	9.3	14.29

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
25	The transect starts from the Gulf of Mexico shoreline, 2,990 feet southeast of Univ. of Texas Marine Science Institute (27.8323° N, 97.047203° W), extends inland across to approximately 3,022 feet past South Commercial Street (across Redfish Bay), near Cove Harbor.	9.3	14.28
26[2]	The transect starts from the Gulf of Mexico shoreline, 1,600 feet southeast of San Jose Island (27.8631° N, 97.035202° W), and extends inland to approximately 2,700 feet past North Commercial Street (across Redfish Bay), just north of Jacoby Lane.	9.5	10.89[3]
27	The transect starts from the Gulf of Mexico shoreline, 1,460 feet northeast of Seaplane Ramps (27.7026° N, 97.274101° W), and extends inland to approximately 480 feet past Corpus Christi Naval Air Station.	7.5	11.26
28	The transect starts from the Corpus Christi Bay shoreline, 2,300 feet west of the mouth of Oso Bay (27.7094° N, 97.305901° W), extends inland across to approximately 2155 feet past Oso Creek.	7.6	11.43
29	The transect starts from the Corpus Christi Bay shoreline, 2,240 feet northeast of University of Corpus Christi (27.715401° N, 97.321404° W), extends inland across to just north of Oak Hollow Ct.	7.6	11.42

* North American Vertical Datum of 1988
[1] Includes wave setup
[2] Transect begins outside of Nueces County; consequently, the starting stillwater is from outside of the county
[3] Maximum 1 percent annual chance wave crest inside the county

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
30	The transect starts from the Corpus Christi Bay shoreline, 1,670 feet northeast of Ocean Dr. (27.7206° N, 97.335999° W), extends inland across to McArdle Road	7.8	11.5
31	The transect starts from the Corpus Christi Bay shoreline, 1,855 feet northeast of Ocean Dr. (27.729601° N, 97.349403° W), extends inland across 120 ft past Novel Dr.	7.9	11.87
32	The transect starts from the Corpus Christi Bay shoreline, 1,870 feet northeast of Ocean Dr. (27.741301° N, 97.368301° W), extends inland across to South Staples St.	8.2	12.3
33	The transect starts from the Corpus Christi Bay shoreline, 1,350 feet northeast of Ocean Dr. (27.762899° N, 97.3797° W), extends inland across to 225 feet past South Alameda.	8.3	12.44
34	The transect starts from the Corpus Christi Bay shoreline, 1,545 feet northeast of Ocean Dr. (27.773199° N, 97.388298° W), extends inland across Price Street.	8.4	12.59
35	The transect starts from the Corpus Christi Bay shoreline, 1,200 feet east of Spoil Island (27.8071° N, 97.389503° W), extends inland across 225 ft past Nueces Blvd.	8.3	12.43

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
36	The transect starts from the Corpus Christi Bay shoreline, 2,515 feet southeast of Surfside Blvd (27.819799° N, 97.387802° W), extends inland across to approximately 4,040 feet past West Causeway Blvd.	8.4	12.8
37	The transect starts from the Nueces Bay shoreline, 2,515 feet southeast of Surfside Blvd (27.8253° N, 97.420601° W), extends inland across to approximately 4,040 feet past West Causeway Blvd.	8.8	12.87
38	The transect starts from the Nueces Bay shoreline, 950 feet northeast of Avery Point (27.8235° N, 97.466003° W), extends inland across Huisache St.	9.5	13.69
39	The transect starts 4,530 feet from the Nueces Bay shoreline, (27.865801° N, 97.517998° W), extends inland to approximately 3,825 feet past County Road 77.	9.8	14.21
40	The transect starts from the Nueces Bay shoreline, 4,530 feet from of Nueces Bay shoreline (27.865801° N, 97.517998° W), extends inland across to approximately 3,825 feet past Cty Rd 77.	10.5	15.77
41	The transect starts from the Corpus Christi Bay shoreline, 1,515 feet northwest of Pelone Island (27.8188° N, 97.1017° W), extends inland across 680 feet northeast of Horace Caldwell Pier	7.8	11.79

* North American Vertical Datum of 1988

[1] Includes wave setup

Table 6 – Parameter Values for Surge Elevation Computation (Continued)

TRANSECT	LOCATION	ELEVATION (feet NAVD88*) 1-PERCENT ANNUAL CHANCE STILLWATER[1]	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
42	The transect starts from the Corpus Christi Bay shoreline, 6,430 feet northwest of State Highway 361 (27.7885° N, 97.120598° W), extends inland across approximately 2,240 ft southeast of State Highway 361.	7.7	11.43
43	The transect starts from the Corpus Christi Bay shoreline, 3,935 feet northwest of State Highway 361 (27.7337° N, 97.148003° W), extends inland across approximately 1,215 ft southeast of State Highway 361.	8.0	12.1
44	The transect starts from the Corpus Christi Bay shoreline, 7,086 feet northwest of State Highway 361 (27.7026° N, 97.180099° W), extends inland across approximately 990 ft southeast of State Highway 361.	7.5	11.33
45	The transect starts from the Laguna Madre shoreline, 560 feet northwest of the barrier islands (27.615499° N, 97.247902° W), extends inland across approximately 585 ft southeast of Windward Dr.	7.3	10.68

* North American Vertical Datum of 1988

[1] Includes wave setup

The stillwater elevations have been determined for the 10, 2, 1, 0.2-percent-annual-chance flood for the flooding source studied by detailed methods and are summarized in Table 7 below.

Table 7 – Summary of Stillwater Elevations

FLOODING SOURCE AND LOCATION	ELEVATION[1] (feet NAVD88*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
GULF OF MEXICO				
Coastline from Nueces-Kleberg County boundary to Packery Channel	4.9 - 5.0	7.5 - 7.7	9.2 - 9.7	12.2 - 13.2
Coastline from Packery Channel to north of New Port Pass Road	4.9 - 5.0	7.5 - 7.7	9.2 - 9.6	12.2 - 12.7
Coastline from north of New Port Pass Road to Water Exchange Pass spanning across Mustang Island State Park	4.9 - 5.0	7.5 - 7.7	9.1 - 9.6	12.0 - 12.7
Coastline from Water Exchange Pass in Mustang Island State Park to south of E Avenue G in Port Aransas	4.9 - 5.0	7.5 - 8.0	9.1 - 9.5	11.6 - 12.0
Coastline from south of E Avenue G to Aransas Pass South Jetty	4.7 - 5.0	7.6 - 8.0	9.0 - 9.5	11.1 - 11.6
LAGUNA MADRE				
East shoreline from Nueces-Kleberg County boundary to John F. Kennedy Causeway	3.7 - 4.1	6.3 - 6.5	7.3 - 7.5	9.2 - 9.4
Northwest shoreline from John F. Kennedy Causeway to the bridge of State Highway 361 along Packery Channel	4.1 - 4.8	6.5 - 7.5	7.5 - 8.8	9.4 - 11.3
East shoreline from the bridge of State Highway 361 over the Packery Channel to Corpus Christi Pass	4.2 - 4.8	6.9 - 7.5	8.1 - 8.8	10.1 - 11.3
West shoreline from the Nueces-Kleberg County boundary to south of Pita Island	4.0 - 4.1	6.1	7.2 - 7.4	9.5 - 9.9
West shoreline from Pita Island to the intersection of Laguna Shores Road and Gadwell Street	4.0 - 4.5	6.1 - 6.6	7.2 - 7.9	9.5 - 10.3

* North American Vertical Datum of 1988
** Includes combined probability riverine + coastal storm surge
1 Includes wave setup

Table 7 – Summary of Stillwater Elevations (Continued)

FLOODING SOURCE AND LOCATION	ELEVATION[1] (feet NAVD88*)			
	10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
LAGUNA MADRE (Continued)				
West shoreline from John F. Kennedy Causeway to the east seaplane ramps of Corpus Christi Naval Air Station	4.3 - 4.6	6.3 - 6.6	7.3 - 7.8	9.2 - 10.0
South shoreline of Demit Island in Corpus Christi Naval Air Station	4.2 - 4.3	6.3 - 6.4	7.3 - 7.4	9.0 - 9.2
CORPUS CHRISTI BAY				
East shoreline from Corpus Christi Pass to a water exchange pass spanning over Mustang Island State Park	4.2 - 4.3	6.8 - 6.9	7.8 - 8.1	9.6 - 10.1
East shoreline from a water exchange pass spanning over Mustang Island State Park to Croaker Hole	4.2 - 4.3	6.6 - 6.8	7.5 - 7.8	9.2 - 9.6
East shoreline from Croaker Hole to Shamrock Point	4.2	6.4 - 6.6	7.4 - 7.5	9.0 - 9.2
East shoreline from Shamrock Point to East Flats	4.2 - 4.3	6.4 - 6.7	7.4 - 7.9	9.0 - 9.9
Shoreline from East Flats to Point of Mustang	4.1 - 4.3	6.2 - 6.7	7.2 - 7.9	9.0 - 9.9
North shoreline from Point of Mustang to Turtle Cove	4.1 - 4.4	6.2 - 6.9	7.2 - 8.1	9.0 - 9.9
Shoreline from Turtle Cove to Port Aransas Park through the Aransas Pass	4.4 - 4.8	6.9 - 7.6	8.1 - 9.0	9.9 - 11.0
South shoreline from Highway 361 Ferry station to the confluence of Corpus Christi Channel and Aransas Channel	4.4 - 4.5	6.8 - 7.0	8.0 -8.2	9.7 - 10.1
North shoreline from the confluence of Corpus Christi Channel and Aransas Channel to Stedman Island through Aransas Channel	4.0 - 4.5	6.1 - 7.0	7.2 - 8.2	8.9 - 10.1

* North American Vertical Datum of 1988
** Includes combined probability riverine + coastal storm surge
1 Includes wave setup

Table 7 – Summary of Stillwater Elevations (Continued)

FLOODING SOURCE AND LOCATION	ELEVATION[1] (feet NAVD88*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
CORPUS CHRISTI BAY (Continued)				
Shoreline along the Aransas Channel from Stedman Island to Sea Mist Drive along the Port Aransas Causeway	4.0 - 4.2	6.1 - 6.5	7.2 - 7.7	8.9 - 9.5
North shoreline from the east end of Demit Island to the intersection of Ocean Drive and Saipan Street in Corpus Christi Naval Air Station	4.2 - 4.4	6.4 - 6.6	7.4 - 7.5	9.0 - 9.2
North shoreline from Ocean Drive to east of Ward Island	4.4 - 4.5	6.5 - 6.6	7.5 - 7.6	9.2 - 9.5
North shoreline of Texas A&M University of Corpus Christi	4.5 - 4.6	6.6 - 6.7	7.6 - 7.8	9.5 - 9.7
Northeast shoreline from west of Ward Island to Cole Park	4.6 - 5.0	6.7 - 6.9	7.8 - 8.4	9.7 - 10.9
North/west shoreline from Cole Park to the mouth of Corpus Christi Channel	5.0	6.9	8.4	10.9 - 11.0
West shoreline from the mouth of Corpus Christi Channel to Sea wall of North Beach	5.0	6.9	8.4 - 8.3	11.0
Southeast shoreline from the sea wall of North Beach to Corpus Christi Beach	5.0	6.8 - 6.9	8.3 - 8.5	11.0
Southeast shoreline from Corpus Christi Beach to Rincon Point	5.0	6.8	8.3	10.9 - 11.0
Shoreline from Corpus Christi Channel Main Turning Basin to Emerald Cove	5.0	6.9	8.4 - 8.5	11 – 11.1
Main Turning Basin from Corpus Christi Bay to Turning Basin Tributary	5.0	6.9	8.4 – 8.5	11 – 11.2
Turning Basin Tributary	4.8 - 7.0**	7.5 – 9.2**	8.9 – 9.8**	12.4**

* North American Vertical Datum of 1988
** Includes combined probability riverine + coastal storm surge
1 Includes wave setup

Table 7 – Summary of Stillwater Elevations (Continued)

FLOODING SOURCE AND LOCATION	ELEVATION[1] (feet NAVD88*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
NUECES BAY				
North shoreline from Rincon Point to Avery Point	5.0 - 5.4	6.8 - 7.4	8.3 - 8.9	10.9 - 11.6
North shoreline from Avery Point to mouth of Nueces River	5.4 - 6.1	7.4 - 8.1	8.9 - 9.8	11.6 - 12.7
North shoreline from the mouth of Nueces River to the mouth of Rincon Bayou	6.1 - 6.5	8.1 - 8.5	9.8 - 10.4	12.7 - 13.4
OSO BAY				
South shoreline of Ward Island	4.6 - 4.9	6.7 - 6.9	7.8 - 8.2	9.6 - 10.3
East shoreline from Ocean Drive on Corpus Christi Naval Air Station to South Padre Island Drive Bridge	4.5 - 4.9	6.6 - 7.3	7.6 - 8.5	9.4 - 10.7
East shoreline from South Padre Island Drive Bridge to Holly Rd	4.9 - 5.1	7.3 - 7.7	8.5 - 9.0	10.7 - 11.3
East shoreline from Holly Road to mud Bridge on Yorktown Boulevard	5.1 - 5.6	7.7 - 8.4	9.0 - 10.0	11.3 - 12.5
East shoreline from Mud Bridge to Tailings Pond	5.6 - 5.8	8.4 - 8.6	10.0 - 10.3	12.5 - 12.9
South shoreline from Tailings Pond to Papalote del Norte Windmill	5.8 - 6.0	8.6 - 8.7	10.3 - 10.5	12.9 - 13.2
West shoreline from Ocean Drive to McArdle Road	4.9 - 5.0	6.9 - 7.3	8.2 - 8.6	10.4 - 10.8
North shoreline from McArdle Road to South Bay Park	4.9 - 5.0	7.1 - 7.3	8.3 - 8.6	10.3 - 10.8
North/West shoreline from South Bay Park to South Padre Island Drive Bridge	4.9 - 5.0	7.1 - 7.4	8.3 - 8.6	10.3 - 10.7
West shoreline from South Padre Island Drive Bridge to Holly Road	5.0 - 5.2	7.4 - 7.7	8.6 - 9.1	10.7 - 11.3
West shoreline from Holly Road to the mouth of Oso Bay Tributary No. 2 near Saratoga Boulevard	5.2 - 5.5	7.7 - 8.0	9.1 - 9.6	11.3 - 12.1

[1] Includes wave setup

** Includes combined probability riverine + coastal storm surge

* North American Vertical Datum of 1988

Table 7 – Summary of Stillwater Elevations (Continued)

FLOODING SOURCE AND LOCATION	ELEVATION[1] (feet NAVD88*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
OSO BAY(continued)				
West Shoreline from the mouth of Oso Bay Tributary No. 2 to Mud Bridge at Yorktown Boulevard	5.5 - 5.6	8.0 - 8.4	9.6 - 10.0	12.1 - 12.5
West Shoreline from Mud Bridge at Yorktown Boulevard to Rodd Field Road	5.6 - 5.9	8.4 - 8.7	10.0 - 10.5	12.5 - 13.1
REDFISH BAY				
Shoreline from Municipal Aiport to the North side of the Sewage Disposal	4.3 - 4.4	6.6 - 6.8	7.6 - 8.4	9.8 - 10.2
East shoreline along the Bay Harbor Drive	4.2 - 4.3	6.5 - 6.6	7.6 - 7.8	9.4 - 9.6
Shoreline of Turning Basin along Canal Street	4.2	6.5	7.3 - 7.7	9.4 - 9.5

[1] Includes wave setup

** Includes combined probability riverine + coastal storm surge

* North American Vertical Datum of 1988

Table 8 “Transect Data”, is a summary of the stillwater elevations of the multiple recurrence intervals along the transects and mapping information such as flood risk zones and base flood elevations. Figure 2 shows the final layout of the coastal transects for Nueces County. Figure 3 shows across-section for a typical coastal analysis transect, illustrating the effects of energy dissipation and regeneration of wave action over inland areas.

Table 8 – Transect Data

		STILLWATER ELEVATION[1] (feet NAVD88[2])					BASE FLOOD ELEVATION
FLOODING SOURCE	TRANSECT	10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	(feet NAVD88[2])
Gulf of Mexico	1+	Padre Island Outside of Nueces County					
Laguna Madre		4.0	6.0	7.2	9.4	VE	10-11
		3.9	5.9	7.5	10.0	AE	8-9
Gulf of Mexico	2+	Padre Island Outside of Nueces County					
Laguna Madre		4.0	6.1	7.3	9.5	VE	10-11
		4.3	6.4	7.5	10.6	AE	8-9
Gulf of Mexico	3	4.9	7.6	9.4	12.8	VE	12-13
Laguna Madre, Gulf of Mexico		2.3	6.1	7.6	10.4	AE	7-10
Laguna Madre		4.0	6.1	7.3	9.4	VE	10-11
		3.7	5.9	7.5	10.4	AE	8-9

[1] Includes wave setup
[2] North American Datum 1988
+ Transect starts outside of Nueces County. Data is inside of the county

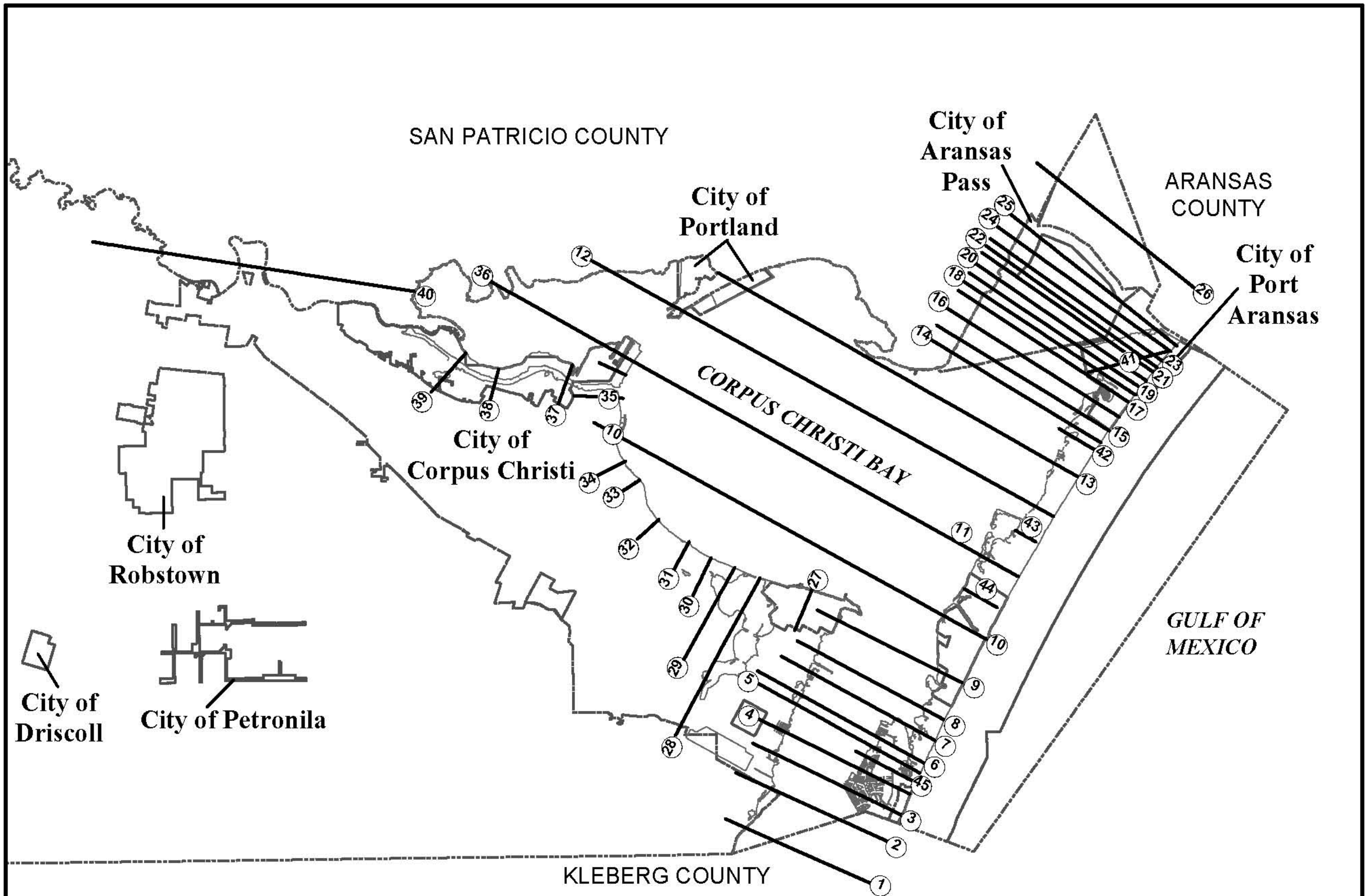


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

0 3.75 7.5 15 Miles

TRANSECT LOCATION MAP

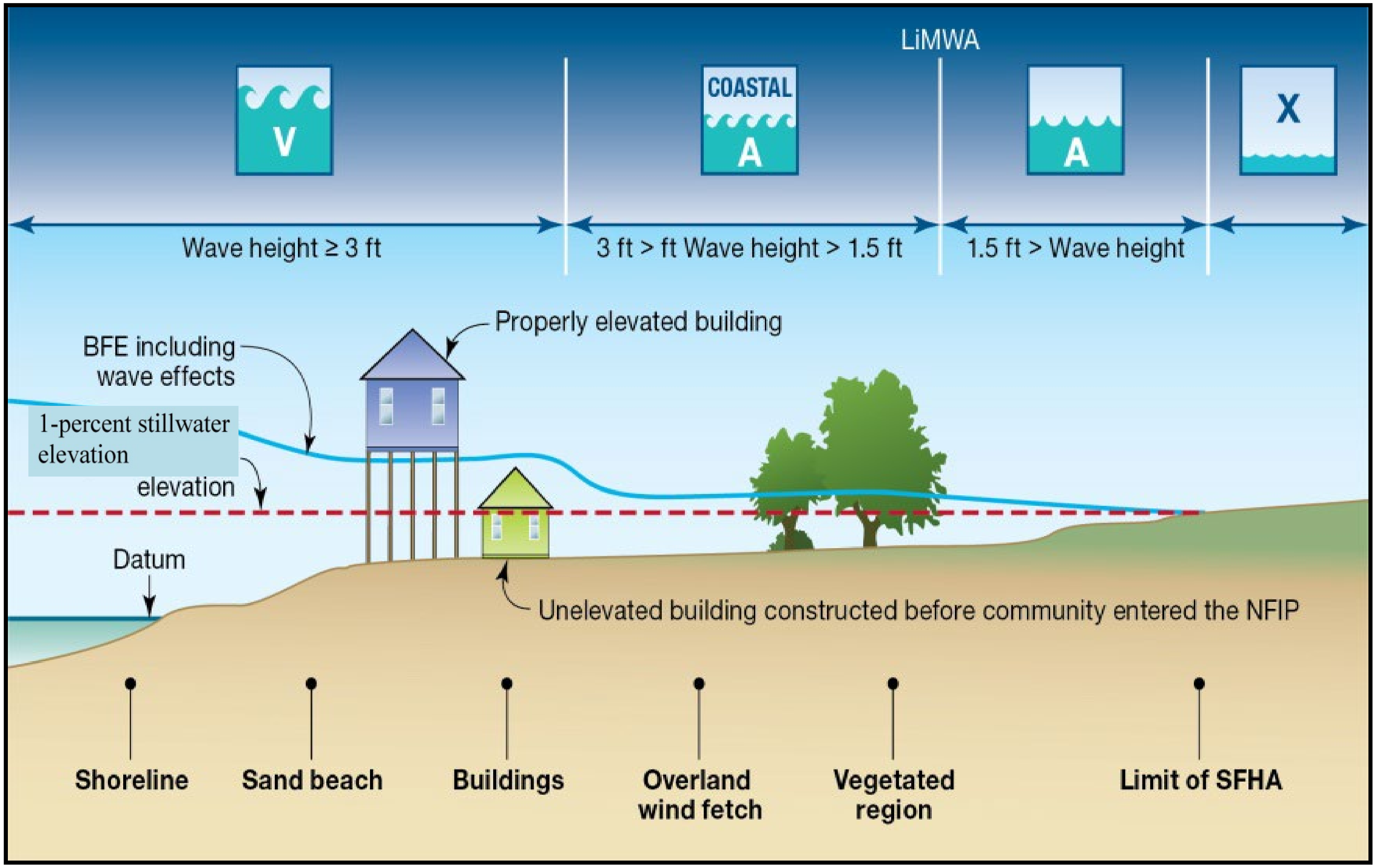


Figure 3 – Typical Transect Schematic

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Gulf of Mexico	4	5.0	7.7	9.6	13.4	VE	12-13
Laguna Madre, Gulf of Mexico		2.1	6.9	8.5	11.2	AE	8-11
Laguna Madre		4.0	6.2	7.4	9.4	VE	10-11
		0.0	5.6	6.5	10.5	AE	6-10
Gulf of Mexico	5	5.1	7.8	9.8	13.5	VE	14-15*
Laguna Madre, Gulf of Mexico		4.5	6.6	8.4	10.7	AE	8-11
Laguna Madre		4.2	6.4	7.5	9.6	VE	10-11
		4.6	6.6	8.1	10.6	AE	8-10
Gulf of Mexico	6	5.0	7.7	9.7	13.1	VE	14-15*
Laguna Madre, Gulf of Mexico		4.4	6.8	8.5	10.5	AE	8-11
Laguna Madre		4.2	6.3	7.4	9.6	VE	10-11
		0.0	6.3	8.1	11.6	AE	8-10
Gulf of Mexico	7	5.0	7.7	9.6	12.8	VE	12-13
Laguna Madre, Gulf of Mexico		4.5	7.3	8.5	10.5	AE	8-11
Laguna Madre		4.3	6.7	7.9	9.7	VE	10-11
		4.5	6.6	7.3	10.4	AE	7-9
Gulf of Mexico	8	5.0	7.3	9.5	12.6	VE	12-14
Laguna Madre, Gulf of Mexico		4.2	7.2	8.7	10.6	AE	9-10
Laguna Madre		4.3	6.5	7.4	9.6	VE	9-11
		0.0	0.0	6.5	10.3	AE	7-8
Gulf of Mexico	9	5.0	7.6	9.3	12.0	VE	12-13
Laguna Madre		4.2	6.4	8.0	10.4	AE	8-10
		4.2	6.8	7.8	9.6	VE	10-11
		4.2	6.3	7.5	9.3	AE	9-10
		4.2	6.5	7.4	9.1	VE	10
		4.2	6.4	7.3	9.0	AE	7-9
		0.0	0.0	7.1	9.0	AE	7-8

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Gulf of Mexico	10	4.9	7.6	9.2	12.1	VE	11-14
Laguna Madre, Gulf of Mexico		4.3	7.7	8.8	11.0	AE	9-11
Laguna Madre, Corpus Christi Bay		4.3	6.9	8.0	9.9	VE	10-11
Corpus Christi Bay, Corpus Christi Channel		5.0	6.9	8.4	11.1	VE	12-15
Corpus Christi Channel		0.0	0.0	0.0	0.0	AE	9
Gulf of Mexico	11	5.0	7.6	9.0	11.2	VE	11-14*
Corpus Christi Bay		3.6	7.3	8.8	11.6	AE	9-11
		4.2	6.8	7.9	10.1	VE	10-12
		5.2	6.7	8.3	11.0	VE	10-15
		5.0	6.8	8.6	11.0	AE	9-10
Corpus Christi Bay, Nueces Bay		4.9	7.0	8.5	11.2	VE	13
Gulf of Mexico	12	5.0	7.6	9.2	11.7	VE	11-14
Corpus Christi Bay		0.0	6.8	8.5	10.9	AE	8-10
		4.2	6.6	7.6	9.5	VE	11-12
Gulf of Mexico	13	4.9	7.6	9.2	11.6	VE	11-14
		0	0	8.2	11.8	AE	9-10
Corpus Christi Bay		0.0	6.4	7.9	10.9	AE	8-10
		4.2	6.7	7.7	9.5	VE	11-12
		3.8	6.1	7.5	9.5	AE	9
		4.3	6.2	7.3	9.2	VE	11-12
Gulf of Mexico	14	5.0	7.7	9.3	11.5	VE	13-14
		0.0	6.4	8.8	12.3	AE	10
Corpus Christi Bay		0.0	5.6	7.4	10.2	AE	7-9
		4.2	6.7	7.7	9.7	VE	11-12
		4.2	6.3	7.3	9.1	VE	10-12
		0.0	0.0	7.3	8.6	AE	8

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Gulf of Mexico	15	5.0	7.7	8.8	11.5	VE	11-13
Corpus Christi Bay		0.0	6.8	8.2	10.6	AE	8-9
Corpus Christi Bay, Redfish Bay		4.2	6.7	7.8	9.8	VE	11-12
		4.2	6.3	7.3	9.1	VE	10-12
		4.3	6.5	7.7	9.6	AE	8
Gulf of Mexico	16	4.9	7.8	9.3	11.3	VE	11-13
Corpus Christi Bay		4.1	6.6	8.0	10.3	AE	7-9
Corpus Christi Bay, Redfish Bay		4.2	6.5	7.6	9.6	VE	10-12
Gulf of Mexico	17	4.9	9.3	9.3	11.6	VE	12-14*
Redfish Bay		4.2	6.7	7.8	9.6	AE	7-10
		4.2	6.6	7.8	9.8	VE	10-12
		0.0	6.2	7.9	9.7	AE	8-10
		4.2	6.3	7.4	9.2	VE	11-12
Gulf of Mexico	18	4.8	7.7	9.3	11.4	VE	11-14
Redfish Bay		0.0	6.7	7.5	10.1	AE	7-9
		4.2	6.7	7.9	9.8	VE	10-11
		0.0	5.9	7.5	9.6	AE	8-10
		4.3	6.4	7.5	9.3	VE	10-12
Gulf of Mexico	19	4.9	7.1	8.9	11.7	VE	11-14*
Redfish Bay		0.0	6.3	7.7	10.5	AE	7-9
		4.2	6.8	8.0	10.0	VE	10-11
		4.1	6.2	7.3	9.0	AE	8
		4.2	6.3	7.4	9.2	VE	10-11
Gulf of Mexico	20	5.0	7.8	9.3	11.5	VE	11-14*
Redfish Bay		0.0	6.5	8.2	10.5	AE	8-10

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Redfish Bay	21	4.3	6.9	8.1	10.2	VE	10-11
		4.1	6.3	7.6	9.6	AE	8-10
		4.2	6.4	7.4	9.3	VE	10-12
Gulf of Mexico		4.9	7.7	9.3	11.4	VE	11-14
		0.0	0.0	9.1	11.4	AE	9
Redfish Bay		4.1	6.7	7.8	9.4	AE	7-10
		4.2	6.3	7.4	9.2	VE	9-12
Gulf of Mexico	22	5.0	7.6	9.3	11.9	VE	9-14
		0.0	0.0	9.1	11.9	AE	9
Redfish Bay		4.2	6.4	7.5	9.5	AE	8-10
		4.2	6.3	7.4	9.2	VE	9-11
		4.4	6.7	7.9	9.7	AE	8-9
Gulf of Mexico	23	5.0	7.6	9.3	11.9	VE	11-14
		0.0	0.0	9.1	11.9	AE	10-11
Redfish Bay		4.2	6.5	7.7	9.8	AE	7-9
		4.2	6.3	7.4	9.3	VE	9-12
		4.4	6.7	7.9	9.7	AE	7-10
Gulf of Mexico	24	4.6	7.7	9.0	11.5	VE	10-14
		0.0	0.0	7.6	11.0	AE	8
Redfish Bay		4.3	6.7	7.8	9.5	AE	8-10
		4.2	6.4	7.5	9.4	VE	9-12
		0.0	0.0	7.4	9.3	AE	8
Gulf of Mexico	25	4.7	7.7	9.3	11.4	VE	11-14
		4.4	6.7	8.1	10.1	AE	7-9

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Redfish Bay	25	4.2	6.4	7.6	9.4	VE	9-12
		4.2	6.5	7.7	9.5	AE	8
Redfish Bay	26+	3.8	5.9	6.8	8.4	AE	9
		3.8	5.9	6.9	8.5	VE	9-11
		4.1	6.3	7.3	9.2	AE	9
Gulf of Mexico	27	4.3	6.5	7.5	9.1	VE	11
Corpus Christi Bay	28	4.5	6.6	7.6	9.4	VE	11-14*
		0.0	0.0	0.0	0.0	AO	1
Corpus Christi Bay, Oso Bay		4.6	6.7	7.8	9.7	AE	8-10
		4.8	7.0	8.2	10.2	VE	10-11
		5.4	7.9	9.4	11.9	AE	9-11
		5.5	8.2	9.8	12.2	VE	12
		5.8	8.6	10.3	12.9	AE	10-11
Corpus Christi Bay	29	4.5	6.6	7.7	9.6	VE	11-15*
Corpus Christi Bay, Oso Bay		4.9	7.0	8.3	10.3	AE	8-10
		5.0	7.1	8.4	10.6	VE	11
		0.0	0.0	0.0	0.0	AE	10
Corpus Christi Bay	30	4.6	6.7	7.8	9.8	VE	12-17*
Oso Bay		0.0	0.0	0.0	0.0	AE	9*
Corpus Christi Bay	31	4.7	6.7	7.9	10.0	VE	12
		0.0	0.0	0.0	0.0	AE	10
Corpus Christi Bay	32	4.9	6.8	8.2	10.5	VE	15*
Corpus Christi Bay	33	4.9	6.9	8.3	10.7	VE	18*

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation
+ Transect starts outside of Nueces County. Data is inside of the county

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Corpus Christi Bay	34	4.9	6.9	8.3	10.9	VE	13
		5.0	6.9	8.4	10.9	AE	9
Corpus Christi Bay	35	5.0	6.9	8.4	11.0	VE	15*
		0.0	0.0	0.0	0.0	AO	3
		0.0	6.4	8.5	12.4	AE	8-9
Corpus Christi Bay	36	5.0	6.9	8.3	11.9	VE	11-15*
		5.1	6.7	8.5	11.0	AE	8-10
Nueces Bay	37	5.4	7.3	8.8	11.5	VE	14
		5.1	7.0	8.6	11.4	AE	9-10*
Nueces Bay	38	5.9	7.8	9.5	12.2	VE	12-14*
		5.3	7.3	9.2	12.1	AE	10*
Nueces Bay	39	6.1	8.1	9.8	12.6	VE	12-14*
		0.0	0.0	8.6	13.0	AE	10-11
		5.4	7.1	9.5	13.0	AE	9-11
Nueces Bay	40	N/A	N/A	N/A	N/A		
Corpus Christi Bay	41	4.2	6.7	8.0	9.9	VE	10-12
		4.3	7.2	8.5	11.2	AE	8-10
		0.0	0.0	0.0	10.6	AE	8-10
		0.0	0.0	0.0	10.6	VE	10
Corpus Christi Bay	42	4.2	6.7	7.8	9.8	VE	11-12
		0.0	5.3	6.9	10.4	AE	8-10
		0.0	0.0	7.4	10.8	VE	13
Corpus Christi Bay	43	4.2	6.9	8.2	10.5	VE	10-12
		3.8	6.9	8.5	10.8	AE	9-11

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

Table 8 – Transect Data (Continued)

FLOODING SOURCE	TRANSECT	STILLWATER ELEVATION[1] (feet NAVD88[2]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT	ZONE	BASE FLOOD ELEVATION (feet NAVD88[2])
Corpus Christi Bay	44	4.3	6.9	7.8	9.5	VE	11
		4.3	6.5	7.7	9.7	AE	8-9*
		4.3	7.1	8.5	10.0	VE	10-11
		4.1	7.2	8.4	10.4	AE	9-11
		3.9	7.2	8.7	11.0	VE	11
Laguna Madre	45	4.0	6.3	7.3	9.1	VE	11
Corpus Christi Bay		4.3	6.9	8.5	10.7	AE	8-11*

[1] Includes wave setup
[2] North American Datum 1988
* Wave runup elevation

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the NGVD. With the completion of the NAVD88, many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the county must, therefore, be referenced to NAVD88. It is important to note that adjacent counties may be referenced to NGVD. This may result in differences in BFEs across the county boundaries between the counties.

To accurately convert flood elevations for Nueces County from the current NGVD datum to the newer NAVD88 datum, the following procedure was implemented. The vertical datum shift was calculated for each corner of the USGS 7.5-minute quadrangle maps located inside or within 2.5 miles of the county boundary using the USACE conversion program, Corpscon 6.0 (Reference 37). The conversion factors in feet that were applied to all components of the FIS that display flood elevations are shown in Table 9.

Table 9 – Vertical Datum Conversion

Stream	Conversion Factor (feet)
Airport Drainage Ditch	-0.79
Carretta Creek	-0.36
Ditch B	-0.43
Ditch BN	-0.41
Ditch E	-0.41
Matamoros Swale	-0.36
Navigation Boulevard Drainage Ditch	-0.69
North Carretta Creek	-0.35
Oso Bay Tributary No. 2	-0.54
Oso Bay Tributary No. 3	-0.54
State Highway 44 East Drainage Ditch	-0.77
State Highway 44 West Drainage Ditch	-0.66
Turning Basin Tributary	-0.64

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD should apply the stated conversion factor to elevations shown on the flood profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For more information regarding conversion between the NGVD and NAVD88, visit the National Geodetic Survey Website at www.ngs.noss.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community.

Pre-Countywide Analysis

For riverine flooding sources studied in detail, the 1-percent and 0.2-percent annual chance floodplains were originally delineated using the flood elevations determined at each cross-section. Between cross-sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 and 1:12,000, with a contour interval 2 feet (Reference 28). For the City of Driscoll, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval 5 feet (Reference 40).

For areas affected by tidal flooding, the 1-percent and 0.2-percent annual chance floodplains were delineated along transects that were perpendicular to the shoreline. Between transects, the floodplain boundaries were interpolated using engineering judgment, aerial photographs, and topographic data.

Areas studied by detailed engineering methods have base flood elevations established in AE and VE Zones. These are the elevations of the base (1-percent) flood relative to NAVD88. In coastal areas affected by wave action, base flood elevations are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in base flood elevations have been shown in 1-foot increments on the FIRMs. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. Base flood elevations shown in the wave action areas represent the average elevation within the zone. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is above the base flood elevation AE and VE Zones.

For the flooding sources studied by approximate methods, the 1-percent-annual-chance floodplain boundaries were delineated using the previously printed Flood Insurance Study for the unincorporated areas of Nueces County.

Countywide Revision: In this countywide revision, 2-foot LiDAR data provided by the community were used. These data were used to determine the floodplain boundaries of approximate analyses areas as well as to redelineate the floodplain boundaries of areas not being studied for the first time.

The boundaries of the 1- and 0.2-percent-annual-chance floods are shown on the FIRM (Exhibit 3). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of areas of special flood hazards (Zone VE, AE, AO and A); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundaries of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplains are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; given limitations of the map scale, such areas are not shown.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. New approximate analyses were conducted to delineate the 1-percent-annual-chance floodplain boundaries and were delineated using the terrain data discussed previously.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations are presented in Table 10 for certain downstream cross-sections of Nueces River, Oso Bay Tributary No.2, Oso Bay Tributary No.3, Oso Creek, Oso Creek Tributary No. 5, Oso Creek Tributary No. 6, Oso Creek Tributary No. 14 and Turning Basin Tributary.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross-sections. Between cross-sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross-sections (see Table 10, "Floodway Data Table"). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown. For North Carretta Creek along the levee a revised FLO-2D model was generated to simulate the floodway encroachment for the 1-percent-annual-chance flood. The surge in the floodway was limited within 1.0 foot of rise. The modeling results were used to delineate the regulatory floodway boundaries.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation (WSEL) of the base flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4, "Floodway Schematic."

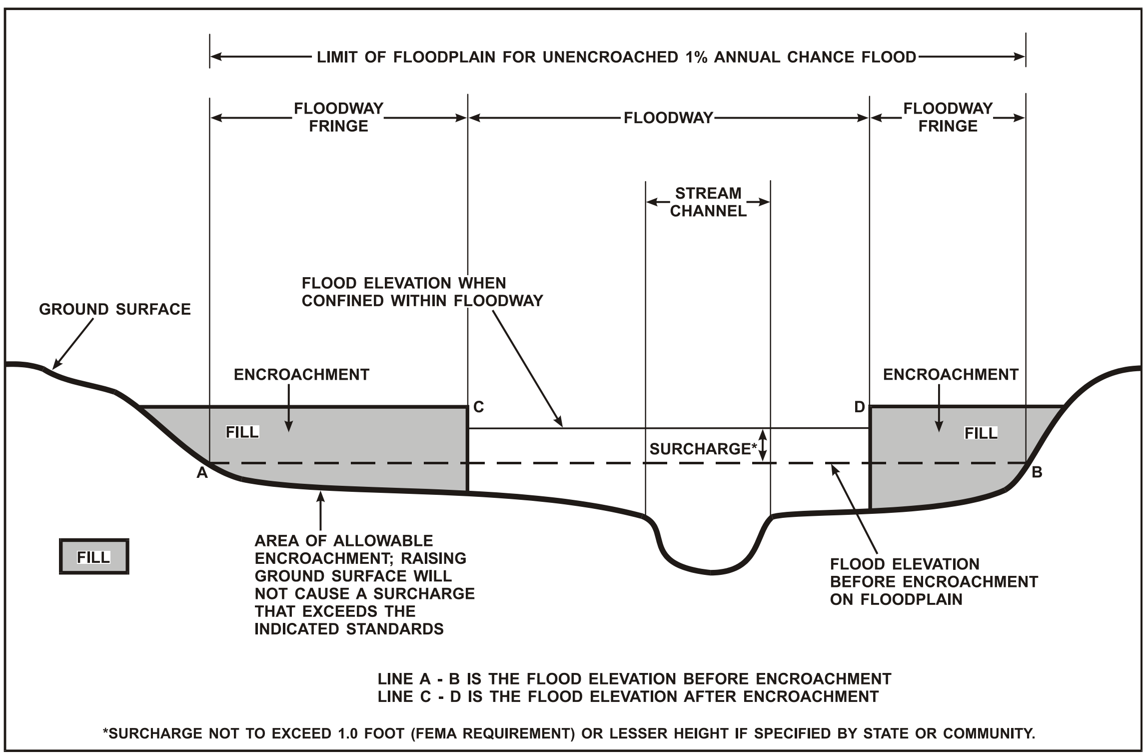


Figure 4 – Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Airport Drainage Ditch								
A	425	91	463	1.6	33.1	33.1	34.1	1.0
B	895	90	384	2.0	33.4	33.4	34.3	0.9
C	1,375	96	361	2.1	33.9	33.9	34.6	0.7

[1] Feet above confluence with Drainage Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

AIRPORT DRAINAGE DITCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Carretta Creek								
A	1,850	132	815	6.3	39.1	39.1	39.1	0.0
B	2,000	132	826	6.3	39.2	39.2	39.2	0.0
C	2,050	198	1,216	4.3	39.7	39.7	39.7	0.0
D	4,120	150	930	5.6	42.3	42.3	42.3	0.0
E	4,220	121	985	5.2	42.6	42.6	42.7	0.1
F	5,320	110	997	5.2	44.2	44.2	44.7	0.5
G	9,120	354	1,592	3.2	51.3	51.3	52.3	1.0
H	10,320	300	2,628	2.0	52.1	52.1	52.9	0.8
I	11,520	230	2,970	1.7	52.1	52.1	52.9	0.8
J	12,030	140	1,191	4.2	54.1	54.1	55.1	1.0
K	12,130	154	1,293	3.9	54.3	54.3	55.3	1.0
L	12,210	180	1,412	3.5	54.4	54.4	55.2	0.8
M	14,210	153	1,016	4.9	56.3	56.3	57.3	1.0
N	15,610	410	2,314	2.1	57.4	57.4	58.4	1.0

[1] Feet above confluence with North Carreta Creek

TABLE 10	FEDERAL EMERGENCY MANAGEMENT AGENCY NUECES COUNTY, TX AND INCORPORATED AREAS	FLOODWAY DATA CARRETTA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ditch A								
A	1,101	1,172	3,916	1.9	62.9	62.9	63.9	1.0
B	2,285	1,470	3,747	1.7	64.2	64.2	65.0	0.8
C	5,328	1,986	6,510	0.7	65.0	65.0	65.9	0.9
D	9,336	1,025	2,063	2.3	67.0	67.0	68.0	1.0
E	12,849	2,367	5,309	0.9	70.4	70.4	71.2	0.8
F	15,791	2,729	3,704	1.3	70.9	70.9	71.9	1.0
G	20,323	68	717	3.3	79.2	79.2	79.3	0.1
H	23,269	957	2,711	0.4	79.5	79.5	80.2	0.7
I	25,328	683	1,494	0.7	79.6	79.6	80.3	0.7

[1] Stream distance in feet above confluence with Oso Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

DITCH A

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ditch B								
A	1,750	41	227	2.3	79.9	79.9	80.9	1.0
B	4,416	76	272	2.3	82.1	82.1	82.8	0.7
C	7,016	682	2,223	0.3	82.5	82.5	83.2	0.7

[1] Feet above confluence with Ditch BN

TABLE 10	FEDERAL EMERGENCY MANAGEMENT AGENCY NUECES COUNTY, TX AND INCORPORATED AREAS	FLOODWAY DATA DITCH B

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ditch BN								
A	50[1]	193	242	4.5	77.6	77.6	78.6	1.0
B	2,780[1]	332	1,944	0.6	78.9	78.9	79.7	0.8
C	5,480[1]	324	1,311	0.8	78.9	78.9	79.8	0.9
D	8,530[1]	398	972	1.0	78.9	78.9	79.9	1.0
E	8,700[1]	320	1,154	0.8	79.1	79.1	80.0	0.9
F	10,410[1]	477	2,288	0.4	79.2	79.2	80.2	1.0
G	11,700[1]	677	996	0.9	79.2	79.2	80.2	1.0
Ditch E								
A	400[2]	63	676	1.3	69.8	69.8	70.8	1.0
B	1,470[2]	17	193	3.8	70.0	70.0	70.9	0.9
C	4,600[2]	21	199	3.2	72.1	72.1	72.9	0.8

[1] Feet above 75 feet downstream of County Road 36

[2] Feet above confluence with Ditch C

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

DITCH BN - DITCH E

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ditch F[2]								
A	27,596	854	3,204	0.3	79.6	79.6	80.4	0.8
B	28,403	695	2,874	0.4	79.6	79.6	80.5	0.9
C	29,702	1,006	3,439	0.6	79.6	79.6	80.6	1.0
D	31,382	1,044	2,941	0.3	79.8	79.8	80.7	0.9
E	32,928	846	1,808	0.5	79.8	79.8	80.8	1.0

[1] Stream distance in feet above Ditch A confluence with Oso Creek.

[2] The floodway for Ditch F was calculated allowing flow to exit the stream into Robstown Flowpath.

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

DITCH F

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Drainage Creek								
A	5,500	1,803	11,125	0.5	30.5	30.5	31.4	0.9
B	8,000	1,250	6,649	0.8	30.6	30.6	31.5	0.9
C	9,805	900	4,828	1.2	30.7	30.7	31.6	0.9
D	10,730	201	2,224	2.5	30.8	30.8	31.6	0.8
E	11,818	176	1,937	2.2	31.0	31.0	31.8	0.8
F	14,441	455	2,722	1.5	31.1	31.1	32.0	0.9
G	17,273	284	1,686	2.5	31.5	31.5	32.5	1.0
H	19,477	111	1,149	3.6	32.6	32.6	33.5	0.9
I	19,581	111	1,304	3.2	32.7	32.7	33.6	0.9
J	22,000	157	1,311	2.3	34.8	34.8	35.7	0.9
K	23,168	98	839	2.4	35.0	35.0	35.9	0.9
L	23,313	98	873	2.3	35.6	35.6	36.1	0.5
M	25,500	79	691	2.9	36.0	36.0	36.5	0.5
N	26,500	74	529	3.8	36.3	36.3	36.7	0.4
O	27,000	318	577	3.5	36.8	36.8	36.9	0.1
P	29,379	114	284	7.1	39.8	39.8	39.9	0.1

[1] Stream distance in feet above confluence with Oso Creek Tributary No. 10

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

DRAINAGE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Navigation Boulevard Drainage Ditch								
A	0	60	243	1.0	35.9	35.9	36.9	1.0
B	1,787	34	114	1.7	36.5	36.5	37.5	1.0

[1] Feet above 2150 feet upstream of Horne Road

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

NAVIGATION BOULEVARD DRAINAGE DITCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Carretta Creek								
A	0	185	826	2.3	46.5	46.5	47.5	1.0
B	1,500	193	903	2.1	47.7	47.7	48.2	0.5
C	2,860	156	722	2.6	48.6	48.6	48.9	0.3
D	4,300	131	648	2.9	50.2	50.2	50.3	0.1
E	5,930	146	751	2.5	51.8	51.8	51.8	0.0
F	7,130	164	659	2.3	52.3	52.3	52.3	0.0
G	8,130	150	889	1.7	52.5	52.5	52.5	0.0
H	8,330	144	873	1.8	52.6	52.6	52.6	0.0
I	9,415	129	461	3.3	52.9	52.9	52.9	0.0
J	9,665	152	802	1.9	53.1	53.1	53.1	0.0
K	9,765	138	763	2.0	53.1	53.1	53.1	0.0

[1] Feet above 1,500 feet upstream of County Road 4

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

NORTH CARRETTA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)*	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Nueces River								
A	38,121	10,800/305	73,581	2.0	11.6 [3]	8.7 [2]	9.7 [2]	1.0
B	40,698	14,870/380	132,185	1.1	12.0 [3]	10.2 [2]	11.2 [2]	1.0
C	43,521	14,821/455	132,212	1.1	12.8 [3]	11.1 [2]	11.9 [2]	0.8
D	46,465	15,550/770	143,779	1.0	13.3 [3]	11.8 [2]	12.7 [2]	0.9
E	49,483	15,050/1,950	134,737	1.1	13.7 [3]	12.5 [2]	13.3 [2]	0.8
F	52,380	14,300/3,389	133,018	1.1	14.1 [3]	13.1 [2]	14.0 [2]	0.9
G	55,691	12,000/4,752	119,619	1.2	14.6 [3]	13.9 [2]	14.8 [2]	0.9
H	58,446	10,848/2,755	128,717	1.1	16.9 [3]	16.4 [2]	17.3 [2]	0.9
I	61,771	13,200/4,228	203,532	0.7	21.7 [3]	21.7 [2]	22.4 [2]	0.7
J	65,040	13,721/1,604	219,644	0.7	22.0	22.0	22.7	0.7
K	68,163	15,500/135	273,786	0.5	22.1	22.1	22.9	0.8
L	70,676	17,205/74	301,815	0.5	22.2	22.2	23.0	0.8
M	74,247	18,792/147	305,832	0.5	22.3	22.3	23.1	0.8
N	78,278	17,025/955	277,956	0.5	22.5	22.5	23.3	0.8
O	83,713	16,667/188	255,171	0.6	22.8	22.8	23.6	0.8
P	86,927	16,790/221	223,783	0.7	23.1	23.1	24.0	0.9
Q	89,176	15,000/228	177,336	0.8	23.7	23.7	24.6	0.9
R	92,344	14,320/2,761	170,920	0.9	24.5	24.5	25.5	1.0
S	95,960	12,722/4,151	189,380	0.8	25.4	25.4	26.3	0.9
T	99,012	11,147/3,942	174,443	0.8	25.9	25.9	26.8	0.9
U	103,817	11,302/4,706	182,783	0.8	27.0	27.0	28.0	1.0
V	108,343	12,194/5,852	189,881	0.8	27.7	27.7	28.7	1.0
W	111,183	11,400/11,000	189,055	0.8	28.2	28.2	29.1	0.9
X	112,930	11,662/11,551	177,769	0.8	28.5	28.5	29.4	0.9
Y	116,838	8,961/7,620	140,548	1.0	29.3	29.3	30.2	0.9
Z	119,011	9,945/8,234	138,153	1.1	29.9	29.9	30.8	0.9

[1] Stream distance in feet above the confluence with Nueces Bay

[2] Elevations computed without consideration of storm surge from Corpus Christi Bay

[3] Combined probability storm surge from Corpus Christi Bay and Nueces River; Base flood elevations do not reflect the wave height

* Width / Width within county limits. Floodway width extends beyond county limits

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

NUECES RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)*	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Nueces River (con't)								
AA	122,542	9,500/3,954	151,366	1.0	30.8	30.8	31.7	0.9
AB	124,865	11,273/5,861	158,504	0.9	31.3	31.3	32.2	0.9
AC	129,362	10,250/5,092	158,445	0.9	32.2	32.2	33.2	1.0
AD	133,328	9,550/5,763	144,201	1.0	33.0	33.0	34.0	1.0
AE	135,623	10,402/9,113	161,432	0.9	33.5	33.5	34.4	0.9
AF	138,272	12,700/11,801	190,878	0.8	34.0	34.0	34.9	0.9
AG	141,158	10,694/10,694	150,752	1.0	34.4	34.4	35.3	0.9
AH	144,865	9,900/4,900	129,917	1.1	35.4	35.4	36.3	0.9
AI	148,721	11,301/5,574	140,163	1.0	36.4	36.4	37.4	1.0
AJ	152,124	11,600/8,449	154,437	0.9	37.3	37.3	38.3	1.0
AK	156,969	12,200/8,616	155,099	0.9	38.4	38.4	39.4	1.0
AL	159,823	10,394/7,924	147,327	1.0	41.2	41.2	41.6	0.4
AM	164,981	12,900/10,004	191,938	0.8	41.9	41.9	42.8	0.9
AN	168,831	16,813/10,340	219,257	0.7	42.3	42.3	43.2	0.9
AO	175,009	24,614/12,712	336,417	0.4	42.7	42.7	43.7	1.0
AP	179,203	16,750/4,771	159,280	0.9	43.3	43.3	44.3	1.0
AQ	185,833	12,152/1,540	123,714	1.2	45.2	45.2	46.0	0.8
AR	189,395	11,600/1,063	105,228	1.4	46.8	46.8	47.5	0.7
AS	192,239	9,571/248	81,369	1.8	48.2	48.2	48.8	0.6
AT	195,686	8,930/914	108,641	1.3	49.9	49.9	50.5	0.6
AU	197,237	9,550/1,876	119,638	1.2	50.5	50.5	51.1	0.6
AV	202,569	8,810/3,537	86,492	1.7	52.4	52.4	52.8	0.4
AW	205,082	8,560/3,231	96,056	1.5	53.4	53.4	54.1	0.7
AX	207,707	6,780/2,003	67,785	2.1	54.1	54.1	55.1	1.0
AY	209,604	6,100/754	72,271	2.0	56.6	56.6	57.1	0.5

[1] Stream distance in feet above the confluence with Nueces Bay

* Width / Width within county limits. Floodway width extends beyond county limits

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

NUECES RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Bay Tributary No. 2								
A	0	108	377	3.2	9.6[3]	4.8[2]	5.8[2]	1.0
B	1,500	284	836	1.4	9.6[3]	6.6[2]	6.8[2]	0.2
C	3,190	88	421	2.7	9.7[3]	7.4[2]	7.6[2]	0.2
D	5,183	123	497	2.3	10.8	10.8	11.8	1.0
E	7,483	44	215	4.7	14.4	14.4	15.1	0.7

[1] Feet above 3,575 feet below Lake Placid Drive

[2] Elevation computed without consideration of coastal flooding effects

[3] Combined probabilty storm surge from Corpus Christi Bay

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

OSO BAY TRIBUTARY NO. 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Bay Tributary No. 3								
A	50	64	341	3.6	8.9	4.8[2]	5.8[2]	1.0
B	261	64	299	4.1	8.9	5.1[2]	6.1[2]	1.0
C	3,535	62	283	4.1	11.0	11.0	12.0	1.0
D	6,185	63	396	2.5	14.8	14.8	15.1	0.3

[1] Feet above 60 feet downstream of South Padre Island Drive

[2] Elevation computed without consideration of coastal flooding effects

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

OSO BAY TRIBUTARY NO. 3

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek								
A	12,506	1,350	13,684	1.6	11.6[3]	10.9[2]	11.9[2]	1.0
B	15,178	1,400	14,287	1.5	11.9[3]	11.4[2]	12.2[2]	0.8
C	16,409	1,427	14,071	1.5	12.1[3]	11.5[2]	12.4[2]	0.9
D	18,054	1,455	15,729	1.4	12.3[3]	11.8[2]	12.6[2]	0.8
E	23,796	1,250	12,206	1.8	13.1[3]	12.8[2]	13.5[2]	0.7
F	24,897	1,523	13,571	1.6	13.4[3]	13.1	13.9	0.8
G	26,827	958	7,942	2.7	13.5[3]	13.4	14.2	0.8
H	28,439	748	5,664	3.8	14.2[3]	14.1	14.7	0.6
I	30,897	1,350	14,544	1.3	15.3	15.3	16.0	0.7
J	33,654	1,460	14,791	1.2	15.6	15.6	16.3	0.7
K	35,935	804	9,229	2.0	16.1	16.1	16.7	0.6
L	38,295	1,257	13,080	1.4	16.8	16.8	17.4	0.6
M	40,861	1,144	12,423	1.5	17.4	17.4	18.0	0.6
N	43,015	804	9,237	2.0	17.9	17.9	18.4	0.5
O	46,102	944	11,277	1.5	18.4	18.4	18.9	0.5
P	49,280	999	11,758	1.5	18.8	18.8	19.3	0.5
Q	52,695	679	8,235	2.0	19.1	19.1	19.7	0.6
R	54,448	630	8,262	2.0	19.8	19.8	20.3	0.5
S	57,395	626	6,884	2.5	20.7	20.7	21.3	0.6
T	59,549	700	8,706	2.0	21.6	21.6	22.3	0.7
U	62,262	655	8,628	2.0	22.3	22.3	23.2	0.9
V	64,500	700	8,142	2.1	26.5	26.5	27.1	0.6
W	67,000	700	6,162	2.8	26.7	26.7	27.3	0.6
X	69,607	700	9,473	1.8	27.0	27.0	27.6	0.6
Y	72,000	900	9,695	1.8	27.1	27.1	27.8	0.7
Z	73,897	800	5,701	3.0	27.2	27.2	27.9	0.7

[1] Feet above Yorktown Boulevard

[2] Elevations computed without consideration of backwater effects

[3] Combined probability storm surge from Corpus Christi Bay

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek (continued)								
AA	76,500	425	4,846	2.4	27.7	27.7	28.5	0.8
AB	79,500	300	3,722	3.2	28.7	28.7	29.3	0.6
AC	82,000	250	2,033	5.8	29.3	29.3	29.9	0.6
AD	84,500	300	2,135	5.6	31.0	31.0	31.4	0.4
AE	87,000	300	2,229	5.3	32.5	32.5	32.9	0.4
AF	89,000	600	3,782	3.1	34.0	34.0	34.6	0.6
AG	92,000	400	3,248	3.6	37.1	37.1	37.7	0.6
AH	93,991	775	5,463	2.2	37.6	37.6	38.4	0.8
AI	97,500	600	4,737	2.5	39.7	39.7	40.5	0.8
AJ	99,911	500	3,883	3.1	40.4	40.4	41.2	0.8
AK	102,500	600	3,433	3.5	41.6	41.6	42.3	0.7
AL	105,500	600	2,849	4.2	42.9	42.9	43.7	0.8
AM	108,000	700	3,466	3.4	44.2	44.2	45.1	0.9
AN	110,000	700	4,292	2.8	45.5	45.5	46.3	0.8
AO	113,036	500	3,225	3.7	47.8	47.8	48.6	0.8
AP	116,057	600	3,247	2.8	51.8	51.8	52.2	0.4
AQ	118,500	600	3,242	3.7	52.8	52.8	53.3	0.5
AR	121,000	750	3,970	3.0	54.8	54.8	55.3	0.5
AS	123,000	400	2,533	4.7	55.7	55.7	56.5	0.8
AT	126,000	900	6,982	1.1	61.8	61.8	62.7	0.9
AU	128,500	1,000	6,673	1.1	61.9	61.9	62.9	1.0
AV	131,500	1,000	5,369	1.4	62.2	62.2	63.1	0.9
AW	134,000	1,100	3,831	1.9	62.8	62.8	63.6	0.8
AX	136,416	2,200	7,651	1.0	66.9	66.9	67.7	0.8
AY	138,725	5,000	12,496	0.6	68.3	68.3	69.3	1.0

[1] Feet above Yorktown Boulevard

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek Tributary No.5								
A	986	764	1,846	1.5	12.9[3]	4.9[2]	5.0[2]	0.1
B	3,558	170	882	3.2	13.2[3]	13.2[2]	13.2[2]	0.0
C	9,235	309	1,300	2.2	19.9	19.9	20.4	0.5
D	12,435	369	1,390	2.0	20.8	20.8	21.7	0.9
E	13,407	535	1,696	1.7	21.1	21.1	22.1	1.0
F	15,950	540	1,586	1.8	22.1	22.1	22.9	0.8
G	18,956	605	1,352	2.1	23.3	23.3	24.0	0.7
H	20,500	605	1,413	1.1	24.7	24.7	25.2	0.5
I	21,982	686	1,382	1.1	25.1	25.1	25.6	0.5
J	24,474	630	2,205	0.7	26.4	26.4	26.7	0.3
K	27,814	603	1,490	1.0	26.9	26.9	27.3	0.4
L	30,206	433	547	3.3	29.4	29.4	29.4	0.0
M	31,717	1,942	1,266	0.9	31.0	31.0	32.0	1.0
N	33,304	947	1,051	1.1	32.1	32.1	32.7	0.6
O	35,626	660	1,033	1.1	33.1	33.1	33.7	0.6

[1] Feet above confluence with Oso Creek
[2] Elevation computed without consideration of backwater effects from Oso Creek
[3] Combined probability storm surge from Corpus Christi Bay

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK TRIBUTARY NO. 5

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek Tributary No.6								
A	165	49	552	5.3	17.6	10.7[2]	11.4[2]	0.7
B	461	49	495	5.9	17.6	10.9[2]	11.6[2]	0.7
C	1,033	51	430	6.8	17.6	14.0[2]	14.1[2]	0.1
D	2,454	52	549	5.3	17.6	16.0[2]	16.4[2]	0.4
E	4,000	59	533	5.4	17.6	16.5[2]	17.1[2]	0.6
F	5,038	59	580	5.0	18.1	18.1	18.5	0.4
G	6,533	69	530	5.5	18.6	18.6	19.1	0.5
H	7,000	61	519	4.0	20.8	20.8	21.3	0.5
I	8,500	100	676	3.1	23.2	23.2	23.6	0.4
J	9,054	125	760	1.8	24.1	24.1	25.0	0.9
K	10,150	125	733	1.6	24.3	24.3	25.3	1.0
L	12,406	75	502	2.3	24.4	24.4	25.4	1.0
M	12,704	113	733	1.6	24.6	24.6	25.6	1.0
N	13,998	130	811	0.7	24.8	24.8	25.8	1.0
O	15,431	61	455	1.3	25.0	25.0	25.9	0.9
P	17,726	35	303	1.9	25.1	25.1	26.1	1.0

[1] Feet above confluence with Oso Creek

[2] Elevation computed without consideration of backwater effects from Oso Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK TRIBUTARY NO. 6

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek Tributary No.10								
A	3,321	328	4,083	2.2	25.5	25.5	26.5	1.0
B	6,044	800	6,684	1.3	28.0	28.0	28.5	0.5
C	8,354	800	6,768	1.2	29.8	29.8	30.7	0.9
D	17,861	45	597	3.3	36.0	36.0	36.6	0.6
E	19,086	103	844	2.0	36.1	36.1	37.0	0.9
F	19,585	46	604	2.8	36.2	36.2	37.0	0.8
G	20,500	154	850	2.0	36.3	36.3	37.1	0.8
H	22,145	109	730	2.3	36.5	36.5	37.4	0.9
I	22,943	42	488	3.5	36.5	36.5	37.4	0.9

[1] Feet above confluence with Oso Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK TRIBUTARY NO. 10

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Oso Creek Tributary No.14								
A	1,818	70	436	6.6	37.3	32.7[2]	33.5[2]	0.8
B	3,418	68	507	5.7	37.3	34.3[2]	35.3[2]	1.0
C	6,500	72	590	4.9	37.3	37.2[2]	38.2[2]	1.0
D	9,500	83	774	3.7	39.0	39.0	40.0	1.0
E	12,071	85	855	2.5	41.5	41.5	42.4	0.9
F	14,805	93	854	2.6	41.9	41.9	42.9	1.0
G	17,448	72	862	2.5	42.7	42.7	43.7	1.0
H	18,500	1,750	3,997	0.5	43.1	43.1	44.1	1.0
I	19,470	950	1,939	0.8	43.2	43.2	44.1	0.9
J	19,886	350	1,434	1.1	43.2	43.2	44.2	1.0
K	24,473	40	343	4.5	44.3	44.3	45.3	1.0
L	27,442	41	333	4.3	46.0	46.0	47.0	1.0
M	28,860	41	375	3.8	46.6	46.6	47.6	1.0
N	29,688	55	405	3.5	47.9	47.9	48.8	0.9

[1] Feet above confluence with Oso Creek

[2] Elevation computed without consideration of backwater effects from Oso Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

OSO CREEK TRIBUTARY NO. 14

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
State Highway 44 East Drainage Ditch								
A	700	17	69	6.0	39.2	39.2	40.2	1.0
B	2,426	35	131	3.1	41.0	41.0	42.0	1.0

[1] Feet above confluence with Drainage Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

STATE HIGHWAY 44 EAST DRAINAGE DITCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
State Highway 44 West Drainage Ditch								
A	1,300	138	402	1.9	39.1	39.1	40.1	1.0
B	2,440	125	228	3.0	40.0	40.0	41.0	1.0
C	3,791	100	343	1.7	42.1	42.1	42.4	0.3
D	6,591	114	284	1.5	43.3	43.3	44.0	0.7
E	7,950	120	357	0.8	43.6	43.6	44.6	1.0

[1] Feet above confluence with Drainage Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

STATE HIGHWAY 44 WEST DRAINAGE DITCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS-SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Turning Basin Tributary								
A	10	32	306	6.3	8.9[3]	5.1[2]	6.1[2]	1.0
B	478	40	374	5.1	9.3[3]	7.4[2]	7.8[2]	0.4
C	1,094	58	535	3.6	9.6[3]	8.6[2]	9.1[2]	0.5
D	4,394	66	430	4.4	9.7[3]	8.7[2]	9.1[2]	0.4
E	2,200	56	481	3.9	9.7[3]	8.8[2]	9.5[2]	0.7
F	2,421	62	556	3.3	9.8[3]	8.9[2]	9.8[2]	0.9
G	3,735	58	519	3.2	9.8[3]	9.0[2]	10.0[2]	1.0

[1] Feet above Harbor Street

[2] Elevation computed without consideration of storm surge from Corpus Christi Bay/Industrial Canal

[3] Combined probabilty storm surge from Corpus Christi Bay/Industrial Canal

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

TURNING BASIN TRIBUTARY

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance risk zone that corresponds to the areas of the 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whoe-foot base flood depths derived from the detailed hydraulic analyses are shown within this zone.

Zone VE

Zone VE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, and areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications. For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains and floodways and the locations of selected cross-sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Nueces County. Previously, separate FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 11, "Community Map History."

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazard for each jurisdiction within Nueces County has been compiled into this FIS. Therefore, this FIS supersedes all previous printed FIS reports, and FIRMs for all of the incorporated and unincorporated jurisdiction within Nueces County.

This is a multiple-volume FIS. Each volume may be revised separately, in which case it supersedes the previous printed volume. User should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting:

FEMA Region VI
Federal Insurance and Mitigation Division
800 North Loop 288
Denton, Texas 76209

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE (S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE (S)
Agua Dulce, City of	June 16, 1970	None	March 26, 1971	July 1, 1974 December 12, 1975
Aransas Pass, City of	June 17, 1970	None	June 25, 1971	July 1, 1974 November 7, 1975 March 4, 1985 May 4, 1992
Bishop, City of	February 1, 1974	December 12, 1975	April 15, 1981	None
Corpus Christi, City of	June 17, 1970	None	July 23, 1971	July 1, 1974 October 31, 1975 July 18, 1985 September 17, 1992
Driscoll, City of	March 1, 1974	May 10, 1977	July 16, 1981	None
Nueces County (Unincorporated Areas)	September 27, 1972	None	September 27, 1972	November 30, 1973 June 1, 1974 September 3, 1976 March 18, 1985 June 4, 1987 May 4, 1992

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

**NUECES COUNTY, TX
AND INCORPORATED AREAS**

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE (S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE (S)
Petronila, City of *	September 27, 1972	None	September 27, 1972	November 30, 1973 June 1, 1974 September 3, 1976 March 18, 1985 June 4, 1987 May 4, 1992
Port Aransas, City of	June 26, 1971	None	June 26, 1971	September 8, 1972 November 23, 1973 July 1, 1974 August 13, 1976 December 8, 1976 March 18, 1985 September 30, 1992
Portland, City of	February 1, 1974	November 28, 1975	July 3, 1985	None
Robstown, City of	July 10, 1971	None	July 10, 1971	July 1, 1974 April 18, 1975 July 16, 1981 May 1, 1985

*This community did not have maps prior to countywide map dated October 13, 2022. Dates used are from Nueces County (Unincorporated Areas).

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

NUECES COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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