Technical Support Data Notebook

DFIRM Update for Fort Bend County, Texas, Part 1

Tasks 45 and 47

Hydraulic Analyses and Floodplain Mapping

Oyster Creek and Lower Oyster Creek

Prepared by

CF3R Joint Venture

Comprehensive Flood Risk Resources and Response

Riverine Flood Insurance Studies Throughout FEMA Region VI

Contract No. EMT-2002-CO-0049

Task Order 016

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I. TASK SUMMARY

A. Hydraulics and Floodplain Mapping Report Introduction

The Comprehensive Flood Risk Resources & Response Joint Venture (hereinafter referred to as CF3R, a joint venture) has completed the hydraulic analyses and floodplain mapping in accordance with Task Order 016, Task 45 and Task 47, for Fort Bend County, Texas. The hydraulic analysis consists of developing the flood profiles and floodway limits for Oyster Creek and Lower Oyster Creek. Flood elevation data was then used to map the floodplain for the 1% and 0.2% events. Details of both tasks are discussed in this report.

B. Project Work Statement (Task 45 and Task 47)

CF3R has completed hydraulic analysis and floodplain mapping in accordance with Task Order 016, Tasks 45 and 47, for Fort Bend County, Texas. The Statement of Work for Task 45 and Task 47 is provided below:

<u>Task 45 Scope:</u> Hydraulic analyses shall be completed for an approximate reach of flooding sources identified in the contract task order. The modeling shall include the annual chance events based on peak discharges computed under Task 42 of this SOW (recurrence intervals shall be identified in contract task order). The hydraulic methods used for this analysis shall be identified in each contract task order. Cross sections and field data collected under Task 39 of this SOW shall be used to prepare the hydraulic analyses. The hydraulic analyses shall be used to establish flood elevations, and if required floodways, for the subject flooding sources. In addition, the Contractor shall address all concerns or questions regarding this task raised during the QASP review.

If GIS-based modeling is performed, automated data processing and modeling algorithms for GIS-based modeling shall be documented and provided to FEMA to ensure they are consistent with the standards outlined in the Guidelines and Specifications for Flood Hazard Mapping Partners, as amended. Digital data sets shall be documented and provided to FEMA for approval prior to performing the analyses to ensure they meet minimum requirements. If non-commercial (i.e. custom-developed) software is used for the analysis, then full user documentation, technical algorithm documentation, and the software shall be provided to FEMA for review prior to performing the scope of work.

<u>Task Order 016 Specific Task Scope:</u>

- Perform hydraulic analysis for about 40 miles of streams, using HEC-RAS and GeoRAS to develop profiles for the 10-, 2-, 1- and 0.2-percent annual chance storm events based on the peak discharges computed in Task 42
- Estimate the Manning's n-values and establish the starting water surface elevations for each hydraulic model.
- Incorporate the field surveyed section, hydraulic structure data, and terrain data collected in Task 39 and 40.
- Establish base flood elevations and regulatory floodways.
- Prepare the Floodway Data Table.
- Prepare acquired data in a format consistent with FEMA DCS guidelines and upload it to the MIP once it becomes available. This service is based on the Draft DCS with the assumption that uploading will be a simple transmission process.

- Perform QA/QC in accordance with the approved QAP and prepare the appropriate QAP certification.

Standards: All work conducted under this task shall conform to the standards specified for this task in Section 5, "Applicable Standards" of this SOW. In the event of any contradictions between the SOW and the standards, the standards shall control.

Deliverables: Upon completion of hydraulic modeling for flooding sources, the results shall be submitted to the FEMA Regional Project Officer for the QASP review in accordance with the delivery dates specified in task orders.

In accordance with the TSDN format referenced in Task 54 of this SOW, the Contractor shall submit the following products to the FEMA Regional Project Officer in accordance with the delivery dates specified in task orders:

- Digital profiles of the 10-, 2-, 1- and .02-percent-annual-chance water-surface elevations representing existing conditions;
- Floodway Data Table(s) for each subject flooding source;
- Digital copies of all hydraulic modeling (input and output) files;
- All backup or supplemental information used in the analysis shall be provided for the QASP.
- For GIS-based modeling, deliverables include all input and output data, intermediate data processing products, GIS data layers, and final products in the format of the DFIRM database structure.
- A QA/QC report that includes a description and the results of all automated or manual QA/QC steps taken during the Hydraulic Analyses. This report shall be certified in accordance with contractor's QAP Plan.
- NSP Format Hydraulic Database or Intermediate Data Delivery consistent with the NSP Data Capture Standards and Guidelines.

Task 47 Scope: Digital floodplain boundaries and floodway boundaries (if required) shall be delineated for the flooding sources listed in Tasks 42, 43 and 45 of this SOW. The mapping shall incorporate all revised modeling and newly acquired topographic information. The floodplain boundaries for the recurrence intervals (identified in the contract task order) and a floodway (if required) shall be delineated on a digital work map based on topographic data developed under Task 40 of this SOW. In addition, the Contractor shall address all concerns or questions regarding this task raised during the QASP review.

Task Order 016 Specific Task Scope:

- Based on the hydraulic profiles calculated in Task 45, delineate the 1- and 0.2-percent annual chance boundaries for each flooding source on the topo data from Task 40.
- Prepare the floodway hydraulic model and delineate the regulatory floodway boundaries (if required).
- Include the cross sections, Base Flood Elevations, and flood insurance risk zone designation labels.
- Incorporate the results of all effective Letters of Map Change as appropriate.

- Prepare acquired data in a format consistent with FEMA DCS guidelines and upload it to the MIP once it becomes available. This service is based on the Draft DCS with the assumption that uploading will be a simple transmission process.
- Perform QA/QC in accordance with the approved QAP and prepare the appropriate QAP certification.
- Incorporation of existing data studies provided by the communities will be done according to the FEMA Region VI guidelines.

Standards: All work conducted under this task shall conform to the standards specified for this task in Section 5, "Applicable Standards" of this SOW. In the event of any contradictions between the SOW and the standards, the standards shall control.

Deliverables: Upon completion of floodplain mapping for flooding sources, the results shall be submitted to the FEMA Regional Project Officer for the QASP review in accordance with the delivery dates specified in task orders.

In accordance with the TSDN format referenced in Task 54 of this SOW, the Contractor shall submit the following products to the FEMA Regional Project Officer in accordance with the delivery dates specified in task orders:

- Digital work maps with the 1- and 0.2-percent-annual chance floodplain boundaries and floodway boundaries (if required) delineated. These maps should also include cross sections, Base Flood Elevations (BFE's), and flood insurance risk zone designation labels.
- A QA/QC report that includes a description and the results of all automated or manual QA/QC steps taken during the preparation of the work maps. One QA/QC report shall be submitted for tasks 47 and 47B.
- Any backup or supplemental information used in the mapping required for the government QASP review shall be included. This report shall be certified in accordance with contractor's QAP Plan.
- Intermediate Format Mapping Database or Intermediate Data Delivery consistent with the NSP Data Capture Standards and Guidelines.

C. Location and General Description

Figure 1: Fort Bend County

Fort Bend County is located in the southeastern portion of Texas, as shown in **Figure 1** above. It is bordered by Waller County to the north, Wharton County to the south and west, Harris County to the north and east, Brazoria County to the south and east, and Austin County to the west. The county is approximately 886 square miles in size and had a population of 419,772 people at the time of the 2003 census. Richmond is the county seat and is located in the central part of the county approximately twenty-eight miles west-southwest of Houston. Sugar Land, located in the northeastern region of the county, is the largest city. The hydraulic analysis activities for this task occurred primarily in the vicinity of Sugar Land, Missouri City and the levee improvement districts of First Colony LID #1 and Fort Bend County LID #2, as shown in **Figure 2** below.

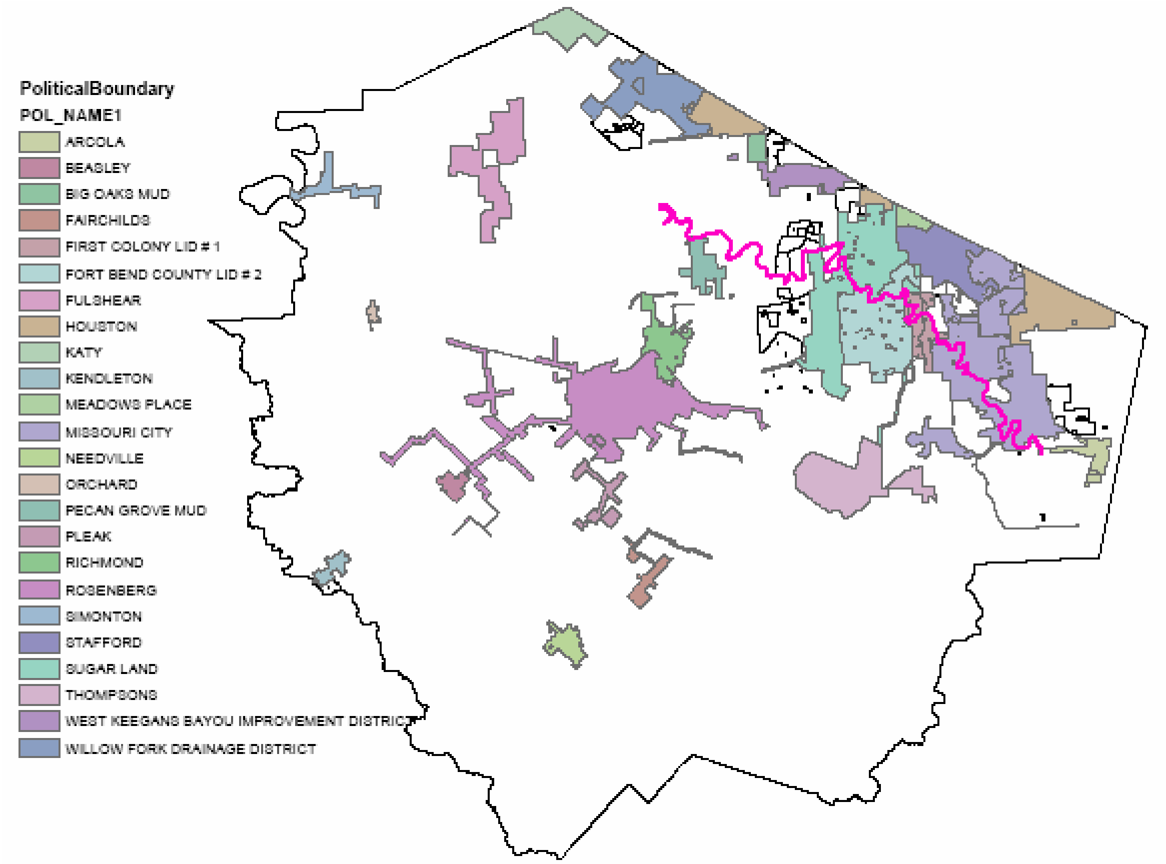

Figure 2: Lower Oyster Creek and Oyster Creek Detailed Study Reaches

II. METHODOLOGY

A. Hydraulic Analysis

Detailed information is provided in the report entitled "Oyster Creek and Lower Oyster Creek Hydraulic Analysis and Work Maps, CF3R Joint Venture, May 2006" submitted separately. A summary of the methodology is provided below.

The Oyster Creek study limits are from the junction with Jones Creek 8 miles west of Sugar Land and ends at McKeever Road north of the Sienna Plantation levee. The study reach is divided into 3 sections:

- Upper Oyster Creek from Jones Creek to the Gulf Coast Water Authority (GCWA) Dam 3 in Sugar Land,
- Middle Oyster Creek from the GCWA Dam 3 to the Flat Bank diversion channel in Missouri City,
- Lower Oyster Creek from the Flat Bank diversion channel to the Sienna Plantation levee diversion channel at McKeever Road.

Since the Flat Bank diversion channel diverts all of Oyster Creek flow, the Lower Oyster Creek channel is studied as a separate channel from Upper and Middle Oyster Creek. For simplicity, Upper and Middle Oyster Creek is called Oyster Creek in this study. A map of the watersheds is shown on Figure 3.

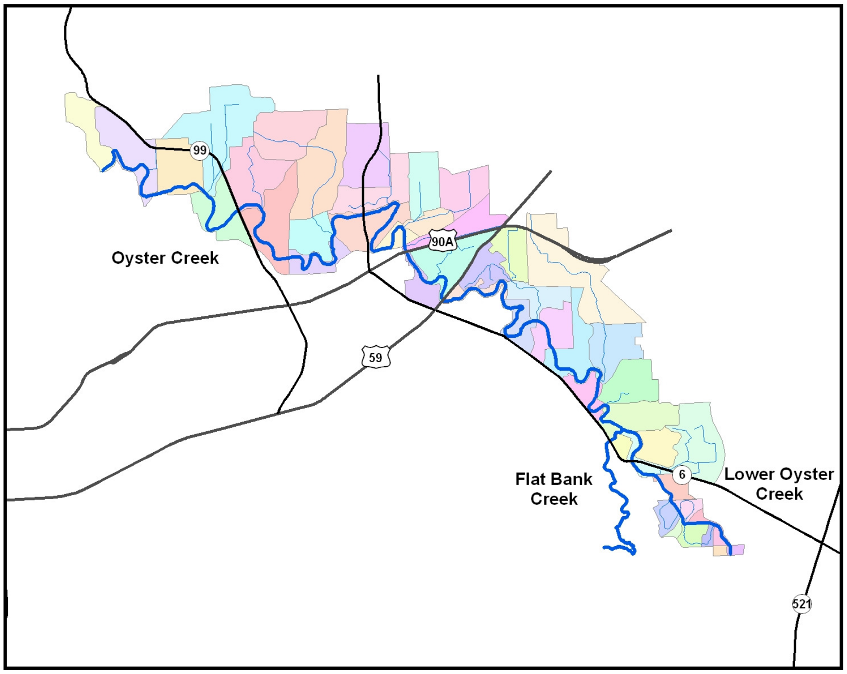

Figure 3: Oyster Creek and Lower Oyster Creek Watersheds

The study limits are described in **Table 1**.

Table 1 – Study Limits

Stream	Length (miles)	Upstream Location	Downstream Location
Oyster Creek	29.39	Approx. 2000' U/S of Skinner Lane at Jones Creek	Junction with Flat Bank Diversion Channel
Lower Oyster Creek	5.20	Junction with Flat Bank Diversion Channel	Approx. 1000' D/S of McKeever Rd. at Sienna Plantation Diversion Channel

The studies were evaluated against the previous FIS study (1977), the Upper and Middle Oyster Creek study by Brown & Gay (BGE) and Costello (2002), and the Missouri City Drainage Master Plan update by Dodson & Associates (2001).

Cross-section channels were field surveyed. The LiDAR topography data was used to cut overbank cross-section. All 63 structures (dams, bridges, culverts, pipe crossing) along the stream were also surveyed.

Manning's n values were estimated based on field investigations, field pictures, and aerial photography. The n-values and expansion and contraction coefficients followed recommendations set forth in the Hec-RAS Hydraulic Reference Manual.

Since the Dodson 2001 study included the Sienna Plantation levee diversion channel downstream of McKeever road, their water surface elevation at McKeever Road was used as starting water surface elevations for the Lower Oyster Creek model.

The Lower Oyster Creek water surface elevations at the Flat Bank junction were then used as starting water surface elevations for Oyster Creek (see Table 2).

Table 2 – Starting Water Surface Elevations

Stream	Method	Condition
Oyster Creek	Known WSEL	1% event D/S WSEL equal to U/S WSEL from Lower Oyster Creek Model = 60.76 ft
Lower Oyster Creek	Known WSEL	1% event D/S WSEL equal to WSEL at McKeever Rd in Dodson Model = 58.80 ft

Most of the 63 structures along Oyster Creek and Lower Oyster Creek were modeled as single structures except for the multiple bridges at US 90A. These bridges were combined into one structure due to the short distance separating them. The GCWA Dams 2 and 3 were modeled as inline structures with the gates fully open. Ineffective flow areas were carefully analyzed and included as needed at bridges and culverts.

There was no recorded high water mark for calibration of the hydraulics models. The models were validated through comparison with previous studies as discussed below.

Modeling Results Comparison

Oyster Creek

The modeling results from this study were compared to of the original 1977 Flood Insurance Study and the 2002 BGE study. The comparison is provided in Figure 4. When compared to the BGE profile, the current study profile tracks lower in elevation and at a more consistent slope between Lake Olympia Parkway and Dulles Avenue. The difference is due to geometric differences between the two models.

Upstream of Dulles Avenue, this study profile tracks the BGE profile with a consistent difference in WSEL through GCWA Dam 2. Upstream of GCWA Dam 2 the current profile again tracks fairly well with the BGE model although there are some profile slope differences between the models most likely due to flow differences.

This study profile is lower than the effective profile at the downstream end, probably due to the added channel capacity provided by the Flat Bank creek diversion improvement. At the upstream end, it is about 2 to 3 ft higher than the effective profile.

Lower Oyster Creek

Similarly, the results from the Lower Oyster Creek hydraulic model were compared to results of the Dodson 2001 study for Missouri City. The results from this study model are lower than the Dodson model results especially from Watts Plantation Road to the Flat Bank Diversion. The difference in this upstream region is probably due to 3 ft of head loss computed by Dodson at the Watts Plantation Road culvert. The Dodson entrance loss coefficient appears to be excessively large.

Figure 4 below details the modeling results comparison for both Oyster Creek and Lower Oyster Creek.

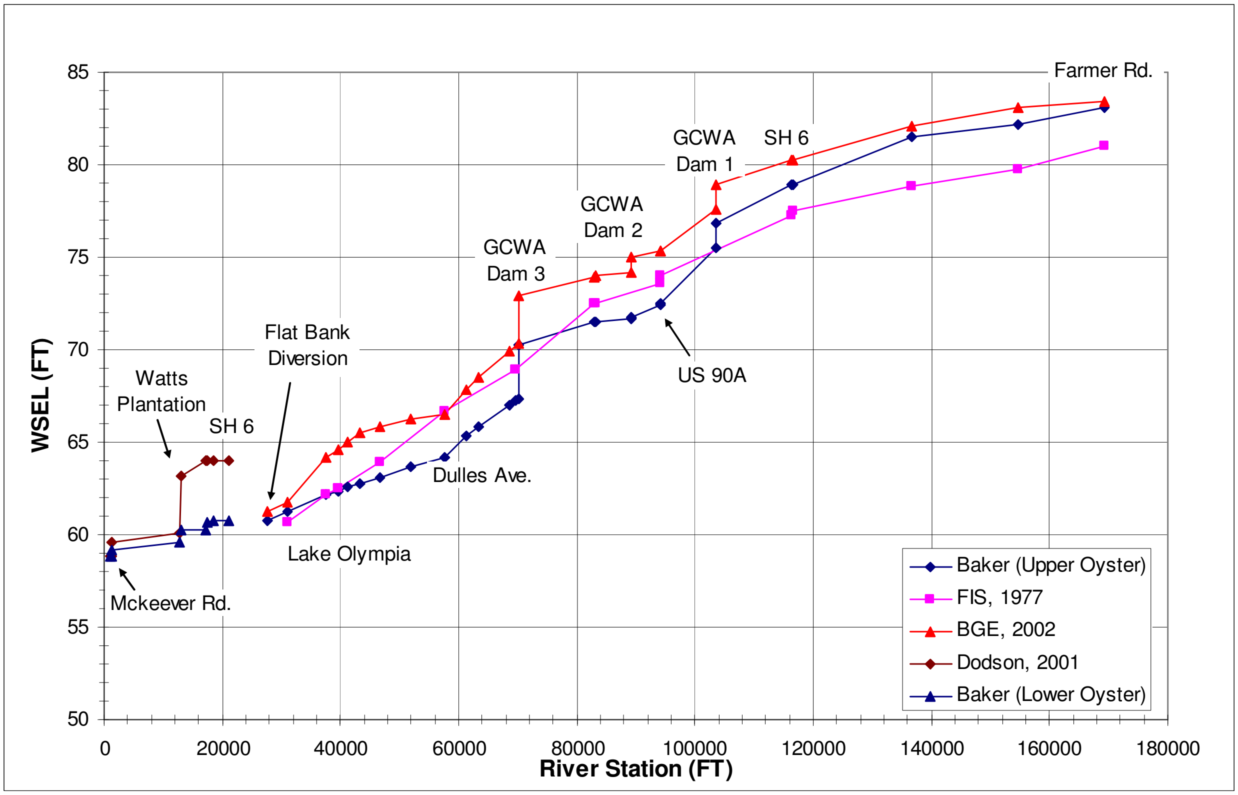

Figure 4 - Modeling Results Comparison

<u>Floodway analysis</u>

Oyster Creek has published floodway limits. In accordance with FEMA's Guidelines and Specifications, the revised hydraulic analysis maintained the effective floodway configuration wherever possible. HEC-RAS encroachment analysis methods 4 and 1 were used for floodway analysis. The resulting floodway is smaller than the effective floodway at some areas due to a better definition of the channel geometry. It is larger at other areas due to flow increase. Comparisons of the floodway widths at some selected areas are provided in **Table 3**.

Table 3 – Effective and Proposed Floodway Widths at Selected Locations

Effective		Proposed		Width Difference	Comments
XS ID	Width (ft)	XS ID	Width (ft)	Proposed - Effective	
B	240	C	143	-97	Effective Floodway exceeds banks and encroaches on existing subdivision
C	338	F	218	-120	Effective floodway does not accurately follow stream centerline and encroaches on existing subdivision
E	312	I	151	-161	Effective Floodway exceeds banks and encroaches on existing subdivision
F	314	R	232	-82	Effective floodway does not accurately follow stream centerline and encroaches on existing subdivision
K	144	AG	264	120	Effective floodway does not accurately follow stream centerline or banks
N	217	AN	136	-81	The 1% flood event is within the channel banks in this area and consequently so is the floodway. The effective floodway exceeds the channel banks.

B. Floodplain and Floodway Mapping

The results from HEC-RAS for the 1-percent and 0.2-percent chance flood events were exported back into HEC-GeoRAS for mapping on top of the LiDAR TIN topography.

Two overflow zones were identified during the hydrologic study of the watershed. These overflows occurred along the south bank of the creek east of Harlem Road, between FM 1464 and the confluence of Red Gully.

Overflow 1 has a depth less than one foot and is therefore included in the 0.2-percent chance flood plain. Overflow 2 leaves the Oyster Creek watershed and flows south to join a parallel stream network. This area is mapped as zone AO (1 foot).

There is a close agreement between the modeling results and the mapping. The 1% Oyster Creek floodplain map stays within the channel downstream of US 90A and is generally smaller than the effective floodplain due to a better definition of the channel geometry and more detailed topography. It is much wider upstream of US 90A due to overflow conditions. The Lower Oyster Creek 1% floodplain is generally confined within the channel.

Incorporation of LOMC Information

Table 4 indicates LOMR case numbers superseded due to the new hydrology and hydraulic study performed for this DFIRM update.

Table 4 – Superseded LOMR

Flooding Source	Case No.	Comment	Reason Superseded
Oyster Creek	98-06-313P	Zone A Mapping Correction Near Bulkhead lake	Revised H&H study
Oyster Creek	98-06-2022P	Mapping Revision Within First Colony LID	Revised H&H study
Oyster Creek	99-06-1743P	Mapping Revision Along Oyster Creek Near Cartwright Road	Revised H&H study

III. EXCEPTIONS

Part 1 of Fort Bend County's detailed hydraulic study required no exceptions.

IV. CONCLUSIONS

Results of the flood insurance study of Oyster Creek and Lower Oyster Creek are provided on Exhibits 2 to 7. The 1% Oyster Creek floodplain map stays within the channel downstream of US 90A and is generally smaller than the effective floodplain due to a better definition of the channel geometry and more detailed topography. It is much wider upstream of US 90A due to the 3 overflow locations. The Lower Oyster Creek 1% floodplain is generally confined within the channel.

Comparison with the effective Flood Insurance Study and other studies indicates that the differences are due to a more detailed overflow analysis and more defined head loss calculation at structures. This FEMA study benefits also from participation of Fort Bend County and the City of Sugar Land through the Cooperation Technical Partnership (CTP), which makes possible the acquisition of much better topographic data and detailed field survey data.

V. REFERENCES/MODELS

1. Fort Bend County Flood Insurance Study, Federal Emergency Management Agency, September 1992, Revised November 2001
2. Missouri City Master Drainage Plan Update: Mustang Bayou and Lower Oyster Creek, Dodson and Associates, February 2001
3. Upper Oyster Creek and Ditch "H" Drainage Study and Improvement Plan, Brown and Gay Engineers, Inc., Costello, Inc., October 2002
4. HEC-RAS model Version 3.1.3, US Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA., 2005