Mayhaw Bayou Drainage Study Report

Jefferson County, Texas

FINAL REPORT

Prepared for:

Jefferson County

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1 Executive Summary

In 2018, the Texas Department of Transportation installed additional culverts under Interstate Highway 10 at the crossings of the M400 and M400A laterals of Mayhaw Bayou. These culverts were added at the request of the Trinity Bay Conservation District, which is the conservation and reclamation district that provides drainage services in Chambers County. TxDOT installed the culverts but blocked them so they were inoperative until such time that a study determines the downstream effects of the culverts.

The scope of this project was to evaluate the water surface elevations (WSEL) for the existing conditions (i.e. prior to the culvert installation) and the proposed conditions once culverts are opened under IH-10 and to propose improvements to help mitigate an increase in WSEL in the Upper Mayhaw Bayou watershed. Hydrologic and hydraulic analyses were done using Atlas 14 rainfall data for 100-year storm events.

The results of the hydrologic and hydraulic modeling analysis shows that the opening of the culverts at the two locations results in minor WSEL increases downstream within Jefferson County. The analysis shows that no additional structures would be flooded due to the culverts being opened. Regardless, FEMA guidelines state that any proposed improvements within a floodway will require a “no-rise” certificate stipulating that the project will not result in any rises within the floodway. As such, the culverts under I-10 will not be able to be put into operation until such time that the Trinity Bay Conservation District has received approval by the Jefferson County and Chambers County Floodplain Administrators that the project will not result in any rises in the WSEL downstream within the floodway. This will require some form of mitigation projects to address the rise in WSEL shown in this study.

2 Introduction

Upper Mayhaw Bayou is a 11.7-miles channel that conveys approximately 13,300 acres of storm runoff that starts Northwest of Interstate Highway 10 (IH-10) and flows through TX-73 as shown in Figure 1.

In 2018, IH-10 was under construction north of the community of Winnie, Texas. The Trinity Bay Conservation District, located in Chambers County, requested that the Texas Department of Transportation (TxDOT) increase the sizes of the culverts at the IH-10 crossings of the M400 and M400A laterals of Mayhaw Bayou. The two crossings are located within the Trinity Bay Conservation District. TxDOT agreed to install the additional culverts under the main lanes of IH-10, but blocked them up to render them inoperative. Furthermore, they did not install the additional culverts under the feeder roads on either side of the main lanes at either of the lateral crossings. TxDOT stated that a hydrologic and hydraulic analysis would need to be performed prior to the additional culverts becoming operative to determine the effects of the additional culverts on the downstream areas of Jefferson County and Jefferson County Drainage District No. 3 (DD3). During construction, time was of the essence and the downstream impact analysis could not be performed in time due to the construction schedule of the ongoing project.

In 2021, Jefferson County allocated General Land Office (GLO) Community Development Block Grant (CDBG) Disaster Recovery (DR) grant funds for the purpose of the Mayhaw Bayou Study Update. The scope of the study was to update the previously studied Upper Mayhaw Bayou and its M400 and M400A laterals and the effects of the recently installed culverts under IH-10. However, early on in the study, it became apparent that the hydrologic and hydraulic (H&H) models used in the original study, completed nearly 20 years prior, were now obsolete and not suitable for updating. As such, a new H&H study was developed with new survey data and newly created H&H models. The scope of the study was to evaluate the existing conditions, the proposed opening of additional culverts running through IH-10, and the proposed improvements needed to mitigate increased inundation levels of the 100-year storm rainfall event.

HEC-HMS (v 4.7.1) was used to develop runoff flows for drainage areas for 100-year storm event using Atlas 14 rainfall data. A 2D Rain-on-mesh model was developed for creating inundation maps, comparing existing and proposed culvert openings WSEL level, and creating a model with detention ponds using HEC-

RAS (v 6.2). Analysis of proposed improvements included widening bridge openings, regrading and widening the channel downstream near TX-73, and developing detention ponds upstream of IH-10.

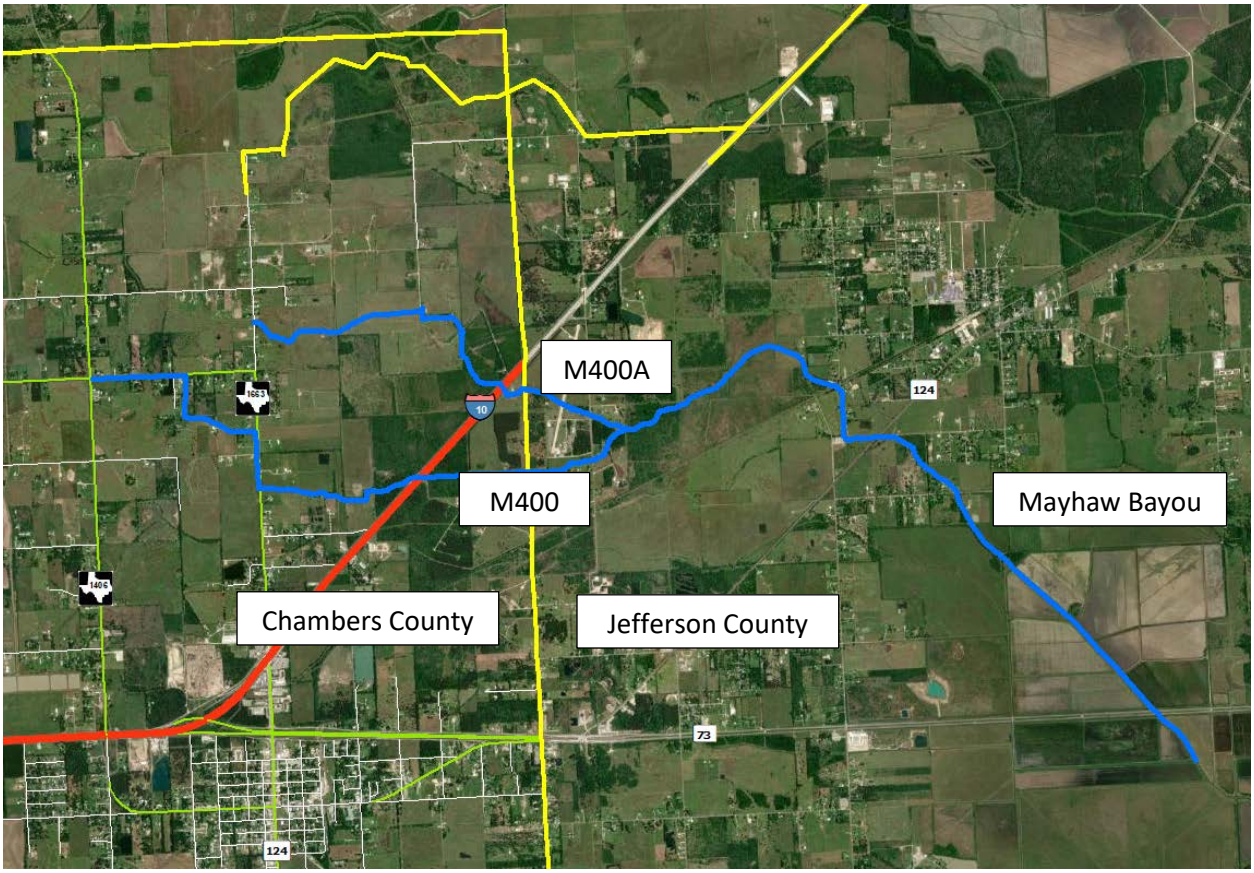

Figure 1: Vicinity Map

3 Methodology

This study was based on standards outline in the Drainage Criteria Manual for Jefferson County DD6 since there are no Drainage Criteria Manuals for Jefferson County DD3. HEC-HMS (v 4.7.1) was used for developing hydrology for the drainage areas run-off. HEC-RAS (v 6.2) was used for evaluating the channel hydraulics and inundation WSEL levels. LiDAR data was downloaded from the USGS TNM Downloader website and used to delineate sub-basins for the Upper Mayhaw Bayou watershed. All scenarios used Atlas 14 rainfall data to determine inundation to the area.

3.1 Hydrology

HEC-HMS (v 4.7.1) was used to develop peak flows and flow hydrographs as directed in the Drainage Criteria Manual for drainage areas of this size. The existing HEC-HMS models were developed for the 100-year Atlas 14 storm events. The components required to generate flow hydrographs in HEC-HMS are time of concentration, rainfall data, infiltration losses, and a transform method to convert the rainfall to a flow hydrograph.

There were 28 main sub basins delineated for the Upper Mayhaw Bayou watershed. The overall drainage map is shown in Figure 2 below.

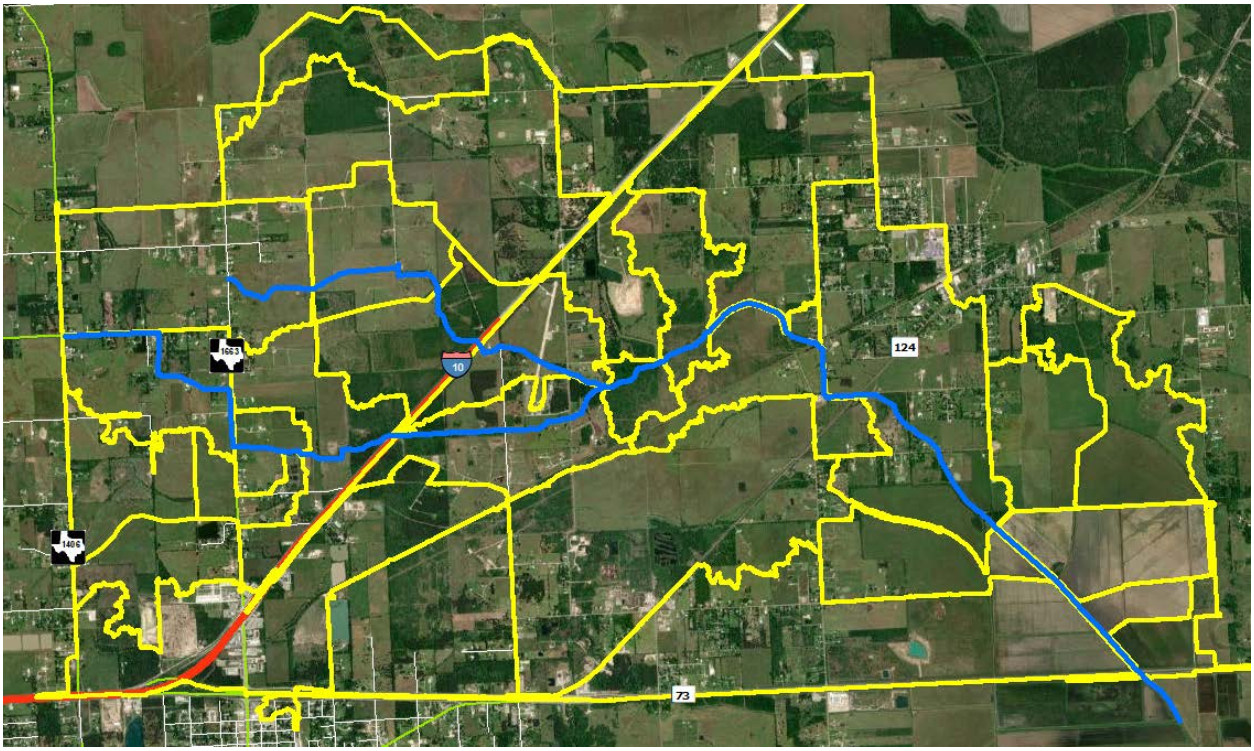

Figure 2: Subbasins for Upper Mayhaw Bayou

3.1.1 Rainfall

The rainfall data used reflects the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data for Hamshire, TX. A 67% intensity position is used as the peak center so that the maximum rainfall intensity occurs at approximately two-thirds of each storm event. The table below summarizes the rainfall depth in inches (note: the existing conditions, proposed conditions, and any proposed improvements were analyzed for the 100-year storm event).

Rainfall Storm Events Duration and Depth

Duration	Atlas 14 Rainfall (inches)				
	5 years	10 years	50 years	100 years	500 years
5 mins	0.748	0.881	1.18	1.31	1.62
15 mins	1.5	1.77	2.35	2.6	3.23
1 hour	2.86	3.39	4.52	5.03	6.45
2 hours	3.73	4.53	6.43	7.34	9.88
3 hours	4.29	5.29	7.83	9.09	12.6
6 hours	5.26	6.63	10.3	12.1	17.4
12 hours	6.23	7.94	12.6	15.1	22.3
1 day	7.25	9.3	15	18.1	27.4

3.1.2 Time of Concentration

Time of Concentration is defined by the time it takes runoff to travel the lengths of the longest flow path within a watershed. The longest flow path for each sub basin was divided into reach that represent various types of flow including overland sheet flow, shallow concentrated flow, pipe flow, and channel flow.

$$T_c = \frac{L}{V}$$

Where:

T_c = time of concentration, sec

L = longest distance to outfall, ft

V = average flow velocity, ft/sec

Time of Concentration (T_c) is calculated as the sum of all overland sheet flow, shallow concentrated flow, pipe flow, and channel flow. The Natural Resources Conservation Service's (NRCS) Technical Release 55 (TR-55) was used to estimate the flow velocities for the overland sheet flow, shallow concentrated flow, pipe flow, and channel flow.

3.1.3 Losses

Infiltration losses are accounted for using the Greene & Ampt method. This method estimates the infiltration losses based on the soil type of each sub basin and the ability of the soil to convey water. The initial abstraction losses, the infiltration, and the surface storage during the early parts of the storm, are based on the NRCS's Curve Number method. The NRCS curve number is a parameter based on the soil type, land use, and vegetative cover of a sub basin. A composite curve number was estimated based on

the soil type of the sub basin. Soils within the Upper Mayhaw Bayou watershed are mostly clayey and silty and are classified as class D. Infiltration rates are typically low and the runoff potential is high.

An impervious level of each sub basin is also required to determine the total losses. Percent imperious cover values for Jefferson County were used as instructed in the Drainage Criteria Manual and were applied to the different land used within each sub basin. The table below lists the percentage impervious values used for each land use category.

Land Use and Imperviousness

Land Use Categories	% Impervious
Undeveloped	0
Residential 1/2 ac	25
Residential 1/3 ac	30
Residential 1/8 ac	65
Light Industrial/Commercial	60
Water	100

3.1.4 Hydrograph Transformation

The Clark Unit Hydrograph method was used to compute unit hydrographs for each sub basin. Three components required for this method are time of concentration, a storage coefficient, and a time area curve. The storage coefficient is a parameter that indicates the available storage available within each watershed cased on depression, ponds, channels, and floodplains.

The storage coefficient equation is as follows:

$$R = 3T_c$$

Where:

R = storage coefficient

T_c = time of concentration

3.2 Hydraulics

A 2D unsteady rain-on-mesh model was created to simulate the inundation of the existing conditions, proposed culvert openings through IH-10, and a proposed detention pond. All models and scenarios for

the Upper Mayhaw Bayou watershed was performed with the 100-year storm event using HEC-RAS (v 6.2). The extents of the model were set to include all sub basins delineated through HEC-HMS (v 4.7.1).

3.2.1 Terrain

The main reach of Upper Mayhaw Bayou was named as Upper Mayhaw and included five lateral reaches. Two of the five reaches named M400 and M400A were the reaches with the proposed opened culverts. Cross sections for Upper Mayhaw, M400, and M400A were obtained through LiDAR data and field surveys. LiDAR data covered the remainder of the lateral reaches in the Upper Mayhaw Bayou watershed as well as all overbank areas. These two sources of data were what made the existing terrain and was used in all scenarios.

3.2.2 Hydraulic Parameters

From aerial photography, the main reaches for Upper Mayhaw Bayou appeared to be clean with minimal stone and weeds present in certain areas. The Manning's roughness coefficients of 0.035 for the channel was assigned. The overbank areas did have some vegetation with a conservative value of 0.05 used to the top of banks as there will be overflow passing over them during the major rainfall events. The 2D unsteady models utilized the NALCB (North America Land Cover Data Base) for land use covering the study area and surrounding regions.

Breaklines were added to the 2D model around areas of interest and wherever sharp changes in elevation occurred. These include the channels, ditches, roads, ponds, and more.

2D connections were placed where bridges and culverts are located. These connections allow for the bridges and culverts to be placed in the model and connected to the 2D region.

Rainfall developed from the HEC-HMS model (Precipitation Excess) was applied across the entire 2D model mesh. Water is allowed to leave the model via normal depth boundary condition lines that encompass the entire 2D mesh.

3.2.3 Bridges

Bridges and their culverts were added to the HEC-RAS models at IH-10, the airstrip at Griffith Exotic Ranch and Airport, Brush Island Road, Kiker Road, SH 124, Wise Road, TX-73, and all small unnamed crossings. Geometries were obtained through field survey with assistance from LiDAR data.

3.2.4 Routing Methodology

Detailed routing was performed using HEC-RAS and HEC-HMS to accurately model the storage-discharge relationship in each sub basin. The use of the storage-discharge function can help determine the amount of flow that runs through a given portion of a channel based on the volume of water that portion of the channel is holding.

The HEC-RAS model was assigned junction points at each inflow and outflow point of a sub basin. Storage volumes and flow rates at each junction node were imported into a spreadsheet. By taking the difference between a sub basins inflow and outflow, the volume difference and the flow rate difference can be found. This was then added into the HEC-HMS model and was resulting in hydrographs with new peak flows. Iterations with new peak flows were done until there was less than a 5% difference in peak flows between HEC-RAS and HEC-HMS. All scenarios with different geometries needed this iteration to find all changes to peak flows.

4 Existing Conditions

Existing conditions were reviewed with the 100-year Atlas 14 rainfall data. All of the features described in section 3.2.2 Hydraulic Parameters (breaklines, boundary condition, rainfall application, land cover, bridges and culverts) were put together to create the existing conditions model. A layout of the 2D existing model is shown below in Figure 3.

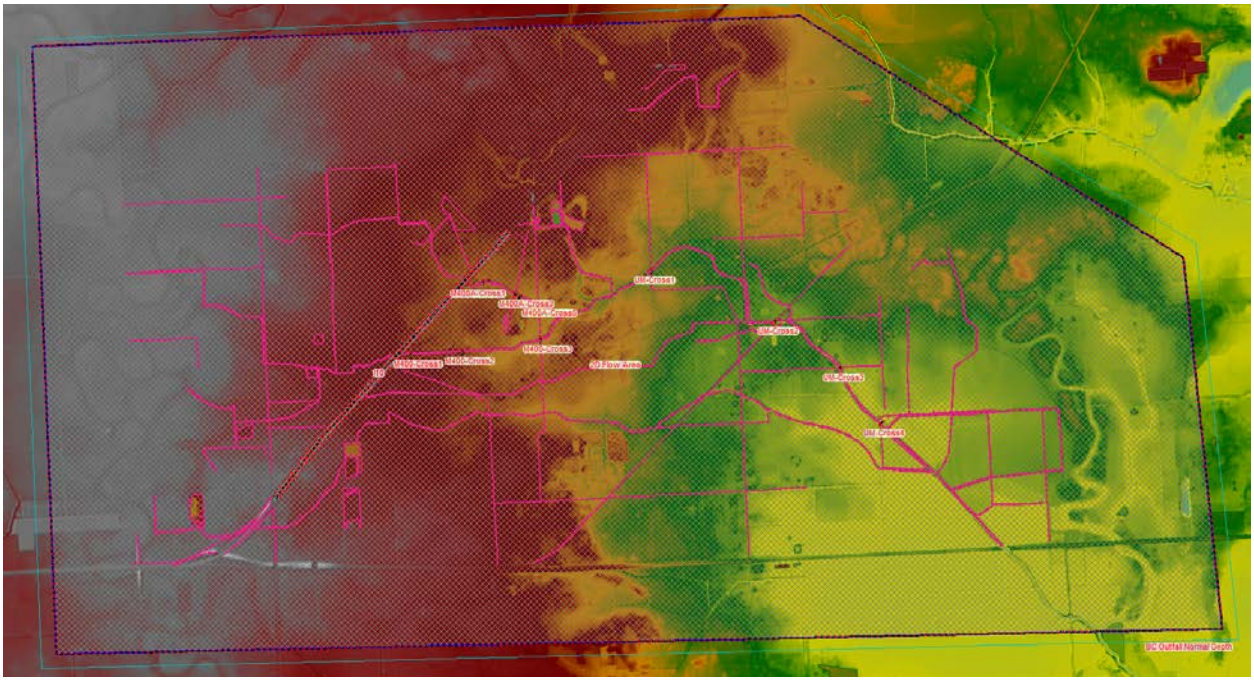

Figure 3: Existing model layout

4.1 Existing Culvert Geometry for IH-10

Existing culvert designs in Figure 4 and Figure 5 show what is currently operational through IH-10, which are described as follows:

- M400 – three (3) 7’ x 4’ reinforced concrete box (RCB) culverts
- M400A – one (1) 9’ x 6’ reinforced concrete box (RCD) culvert

Additional culverts were installed at these locations in 2018, but they were bricked up by TxDOT and are inoperative. As such, we did not include them in the existing conditions model, but they will be shown in the proposed culvert conditions.

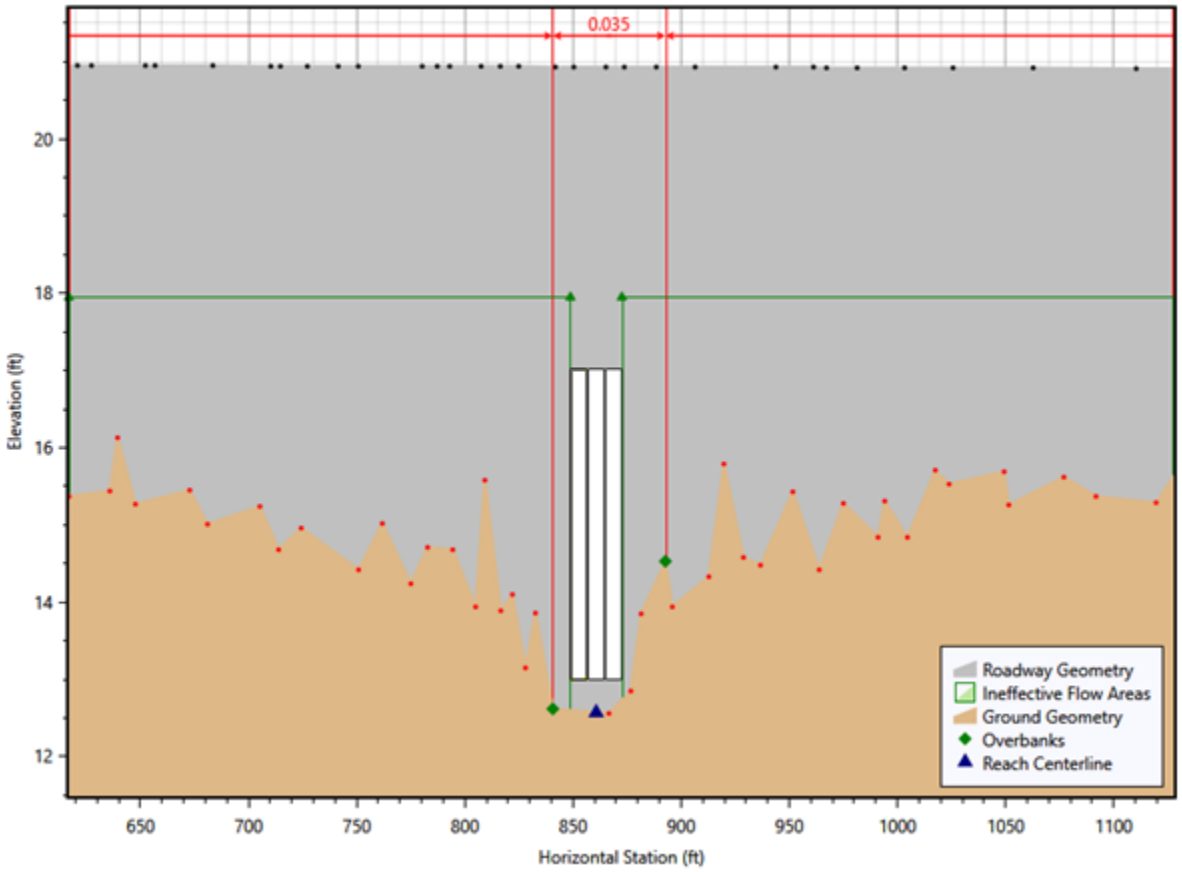

Figure 4: Existing M400 Culverts

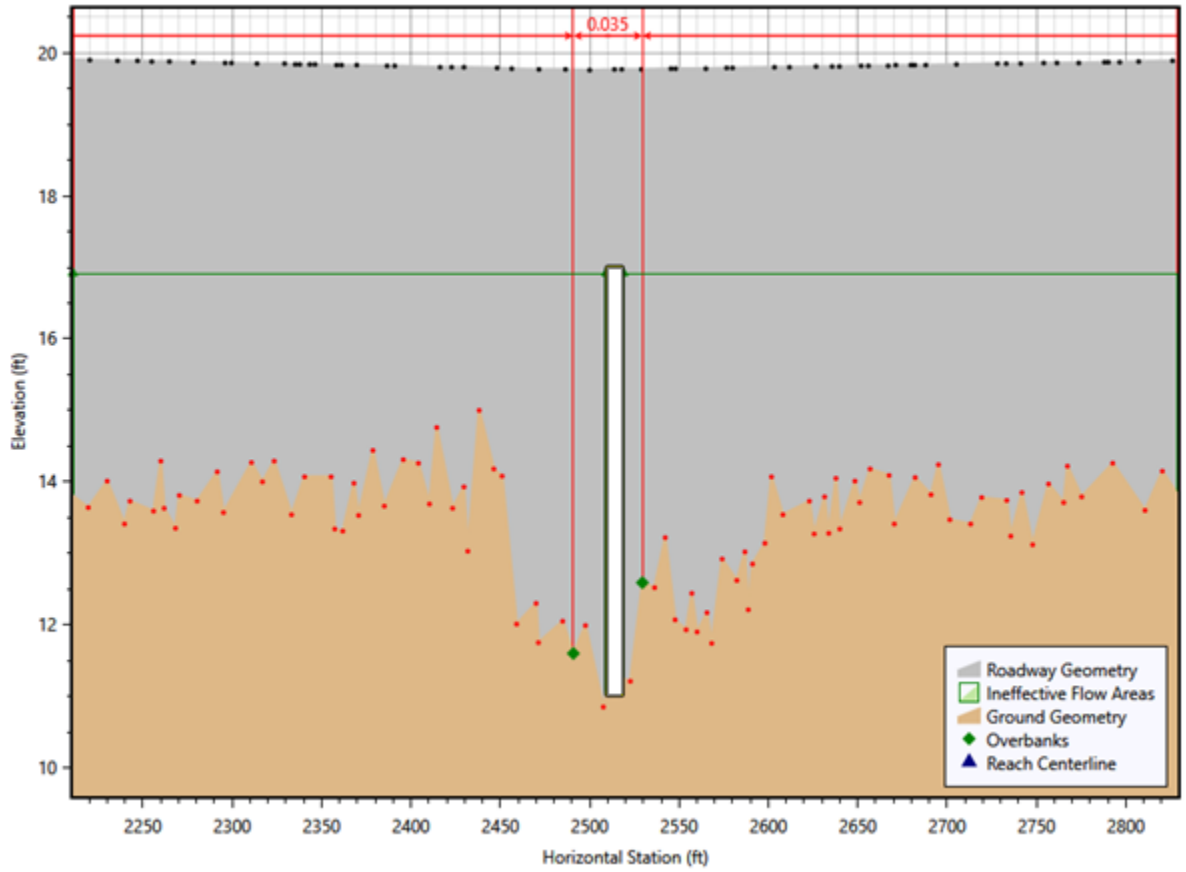

Figure 5: M400A Culverts

4.2 Inundation Map

The existing inundation map was analyzed to identify problem areas and to note differences between other scenarios. There are major flooding areas in most of the Upper Mayhaw Bayou watershed for the 100-year storm event as seen in Figure 6.

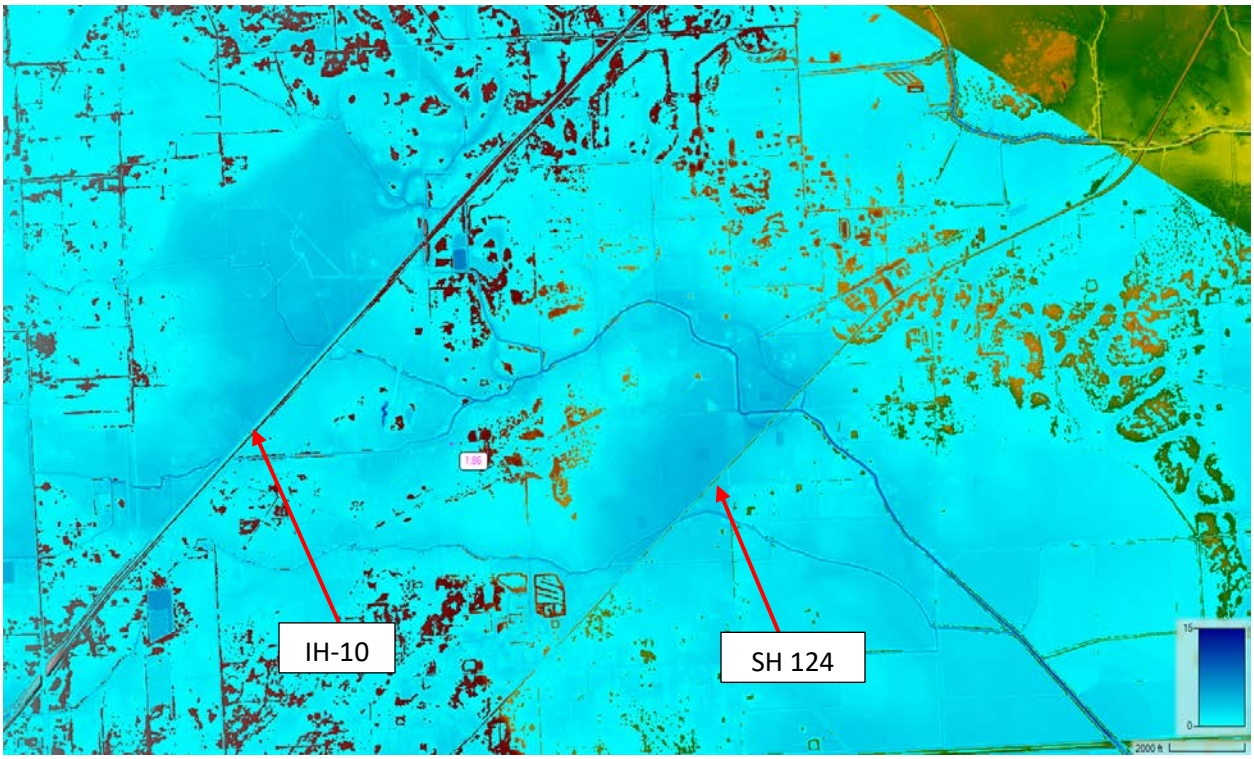

Figure 6: Existing Upper Mayhaw Bayou Watershed Inundation

There is a significant amount of ponding depth that is being bottlenecked by both IH-10 and SH124. Additionally, ponding depth increases are noted at the confluence and just upstream of the confluence of both M400 and M400A. This is caused by a combination of things: lack of conveyance volume in the main channels and bottlenecking at bridge crossings. In other words, the channels and crossings are undersized to adequately convey the volume and rates of water produced during a 100-year storm. The undersized channels and crossings result in most of the watershed between IH-10 and SH-73 being inundated during a 100-year storm event.

5 Proposed Culvert Openings

Proposed conditions were prepared by taking the existing conditions model, using the exact same hydrology, but changing the additional pipes underneath IH-10 to be open. This allows the pipes installed in 2018 to be modeled to convey additional water underneath IH-10 and its feeder roads.

5.1 Proposed Culvert Openings for IH-10

Proposed culvert designs in Figure 7 and Figure 8 shows what is currently installed under IH-10, which are described as follows:

- M400 – six (6) 7’ x 4’ reinforced concrete box (RCB) culverts
- M400A – two (2) 9’ x 6’ reinforced concrete box (RCD) culverts

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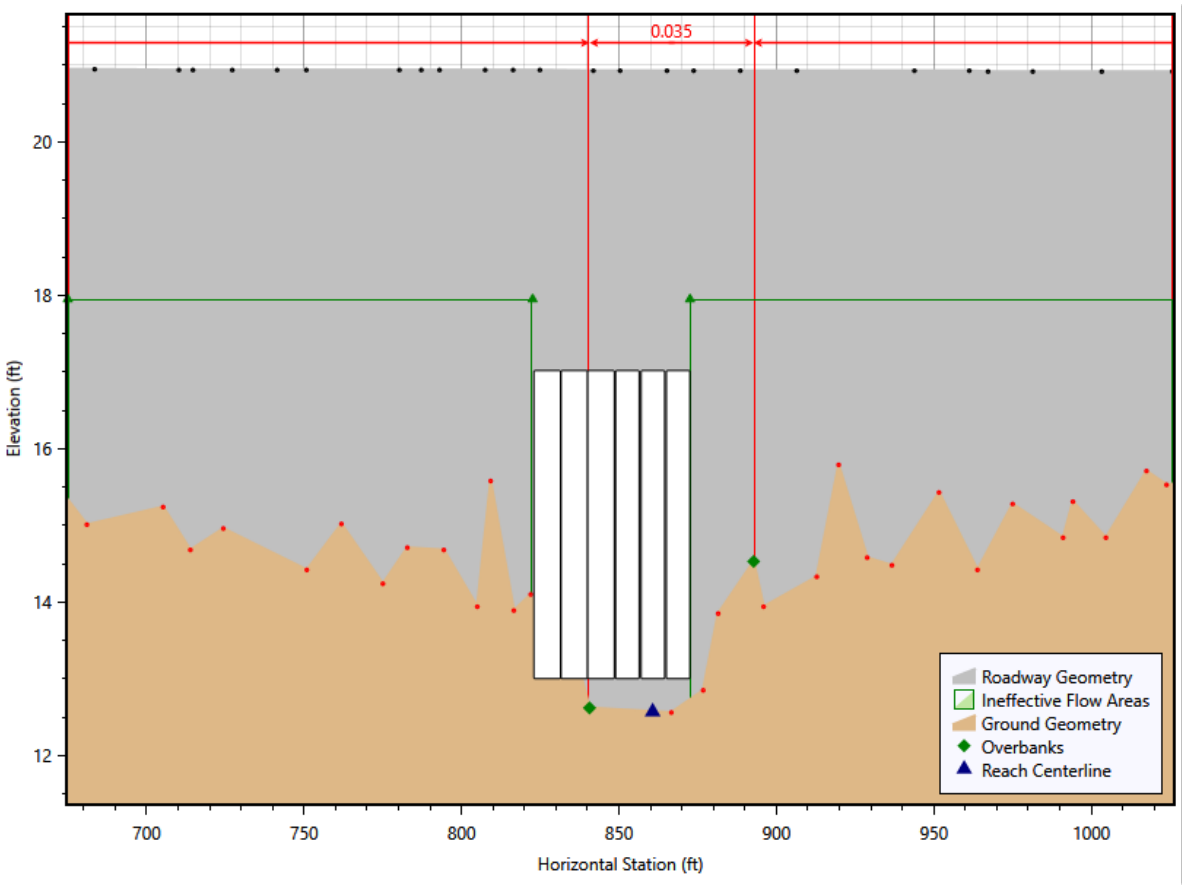

Figure 7: Proposed M400 Culverts

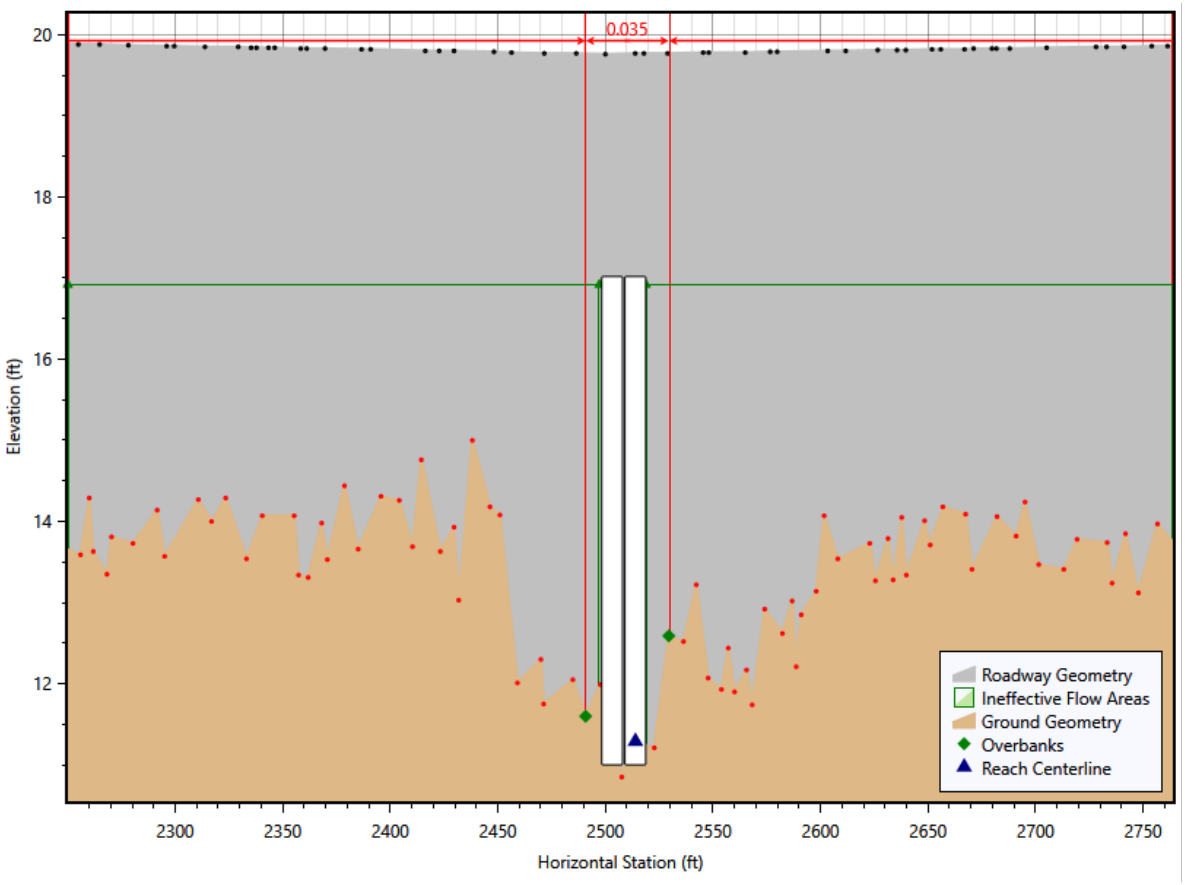

Figure 8: Proposed M400A Culverts

There are now six (6) 7 feet by 4 feet rectangular concrete culverts (up from three) running on M400 and two (2) 9 feet by 6 feet rectangular concrete culvert (up from one) running on M400A. Each set of culverts are sloped based on field survey depths and LiDAR elevation readings. The culvert set on M400 are sloped at 0.003 ft/ft while the culvert on M400A is sloped at 0.004 ft/ft.

5.2 Inundation Map

The proposed inundation map was produced and analyzed to identify problem areas and to note differences between other scenarios. There are major flooding areas in most of the Upper Mayhaw Bayou watershed for the 100-year storm event as seen in Figure 9.

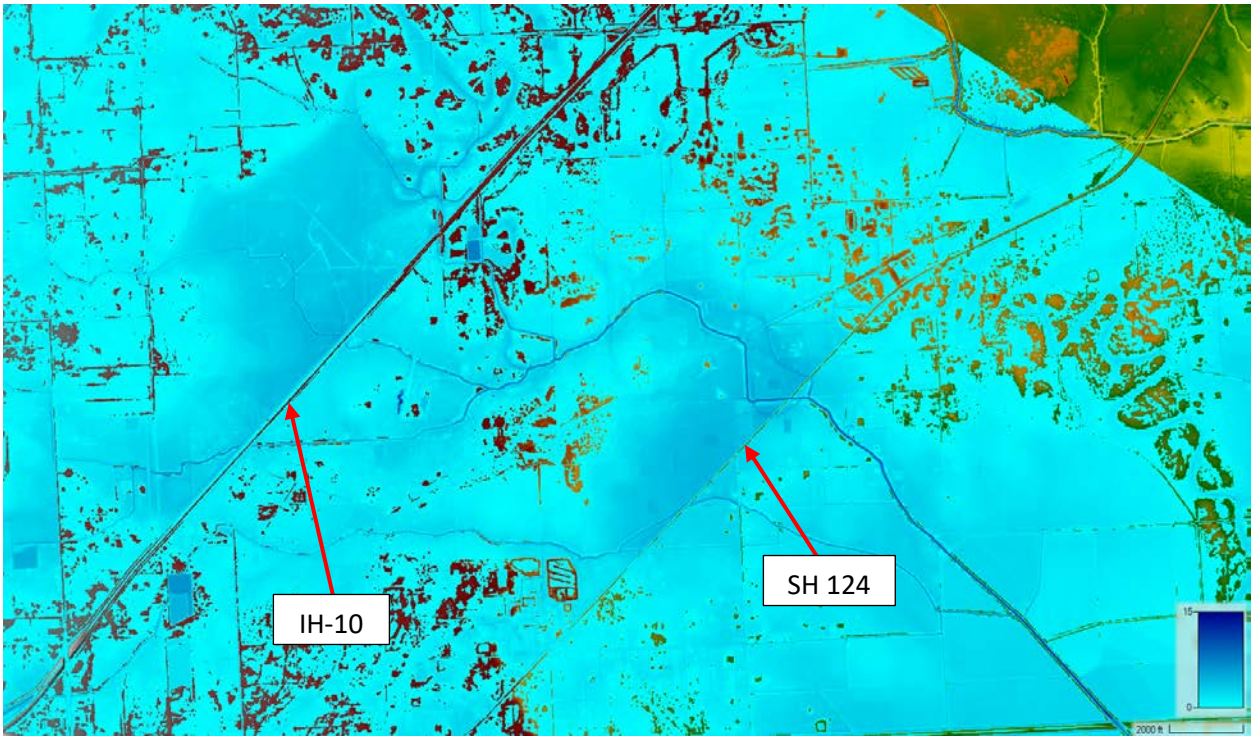

Figure 9: Proposed Upper Mayhaw Bayou Watershed Inundation

5.3 WSEL Comparison

Figure 10 shows the WSEL comparison. This is the difference of WSEL between the proposed conditions and existing conditions. The result of opening the additional pipes under IH-10 and allowing more water to flow through those pipes yields approximately 0.10’ decrease in WSEL upstream of IH-10, and multiple increases in elevation with the bright purple along M400 being 0.3’, the dark red ranging from 0.2’-0.1’, and the medium shade of red scaling down from 0.1’-0.05’. The increase of 100-year storm WSEL within Jefferson County and DD3 is anywhere from 0.1’ down to just a few hundredths of a foot further downstream. In viewing the result of the increased water surface levels on recent aerial photography, it appears that no additional insurable structures are being flooded due to the opening of the culverts. The increases of the WSEL within Jefferson County are minimal.

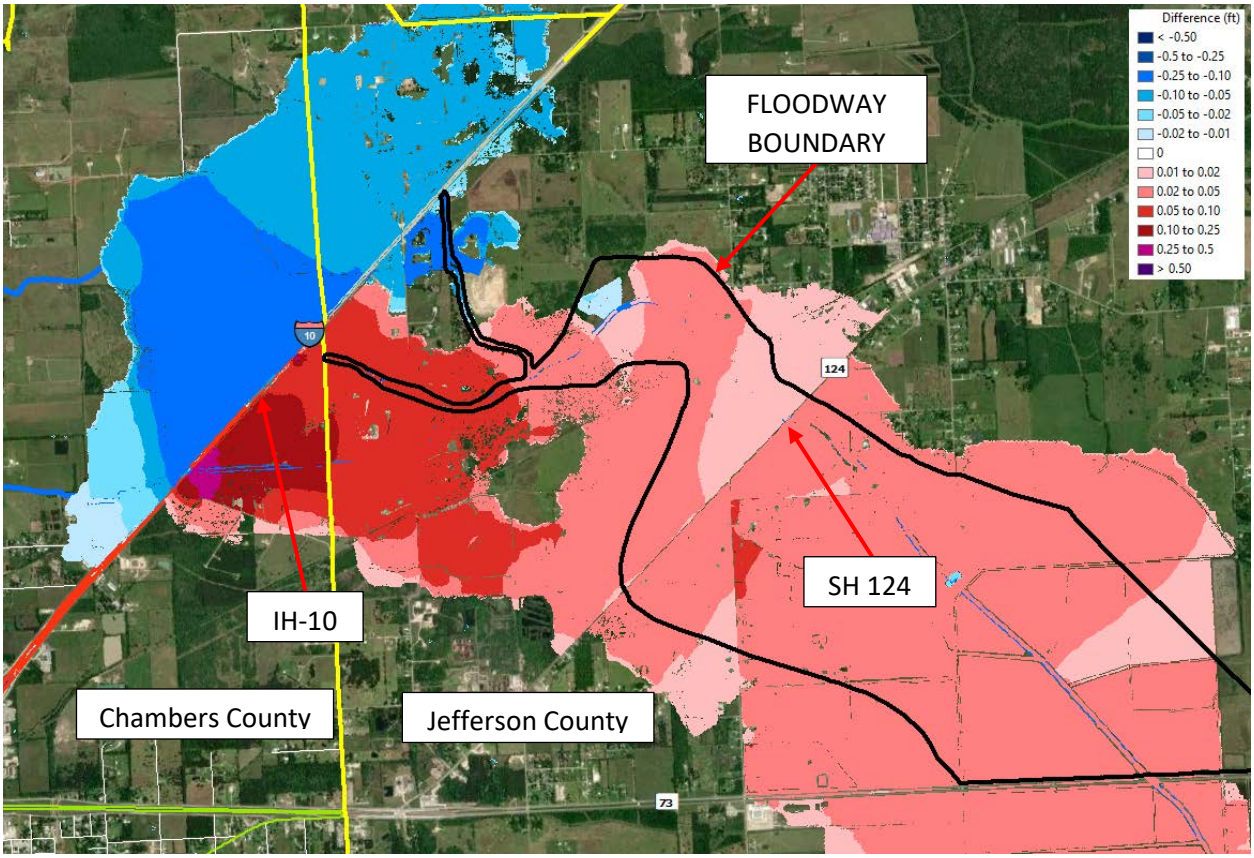

Figure 10: Water Surface Elevation Level Comparison between Existing and Proposed Conditions

6 Mitigation and Proposed Improvements

The 100-year storm event WSEL increases appear to not be significant and not to cause additional flooding within Jefferson County. However, the proposed WSELs do represent minor increases over the existing conditions WSEL. More importantly, there are rises within both Chambers and Jefferson Counties within the floodway of Mayhaw Bayou as seen in Figure 10. During this study, discussions were conducted with TxDOT engineers regarding what level of WSEL increases would be considered "significant" and thus require mitigation prior to allowing the installed culverts under IH-10 to become operative. Andrew Lee, P.E., of the TxDOT Beaumont District, stated that the downstream floodplain administrators for Chambers and Jefferson Counties would ultimately be the authority on what would constitute a "significant" rise within their jurisdictions that would need to be mitigated prior to allowing the installed culverts to become operational. Furthermore, Mr. Lee stated that TxDOT would not want to see any increases in the WSEL within the TxDOT r.o.w.

Michelle Falgout, the Jefferson County Floodplain Administrator, has stated that no projects will be approved within Jefferson County that will result in any rise in WSE within the floodway. FEMA regulations state:

> *Any project in a floodway must be reviewed to determine if the project will increase flood heights. An engineering analysis must be conducted before a permit can be issued. The community's permit file must have a record of the results of this analysis, which can be in the form of a No-rise Certification. This No-rise Certification must be supported by technical data and signed by a registered professional engineer.*

As such, any project that will open up the culverts under I-10 must receive a No-rise Certification from the local floodplain administrators. There are many options for proposed improvements that TBCD could undertake to mitigate the impacts in order to receive a No-rise Certification. Jefferson County and/or DD3 could also make improvements to Mayhaw within their boundaries for mitigation. However, it is the understanding of LJA that DD3 did not want the culverts to be improved in 2018 and would probably not want to use their funds to implement any improvements within their district in order to mitigate the increases. As such, the scope of this study does not include any detailed analysis of proposed mitigation improvements that could be performed by Jefferson County or DD3. However, for the purpose of including some proposed mitigation improvements that could be implemented by TBCD, some detention pond scenarios were investigated for upstream of IH-10 only.

These improvements consist of several detention ponds with the goal of storing and slowing down water. Several iterations and configurations of ponds were evaluated. The best configuration to remove all impacts caused by opening the IH-10 culverts is seen below in Figure 11. Each of these proposed ponds were analyzed as to drain via gravity outlet structures (i.e. no pumping), resulting in some shallow pond areas. These proposed pond areas were analyzed solely for their benefits in providing reductions to the downstream water surface levels in Jefferson County in order to mitigate the rises due to the additional culverts under IH-10. No research was done as to the suitability or availability of the property areas, nor

analysis of any utilities/pipelines that would be prevent them to be utilized as detention ponds by TBCD.

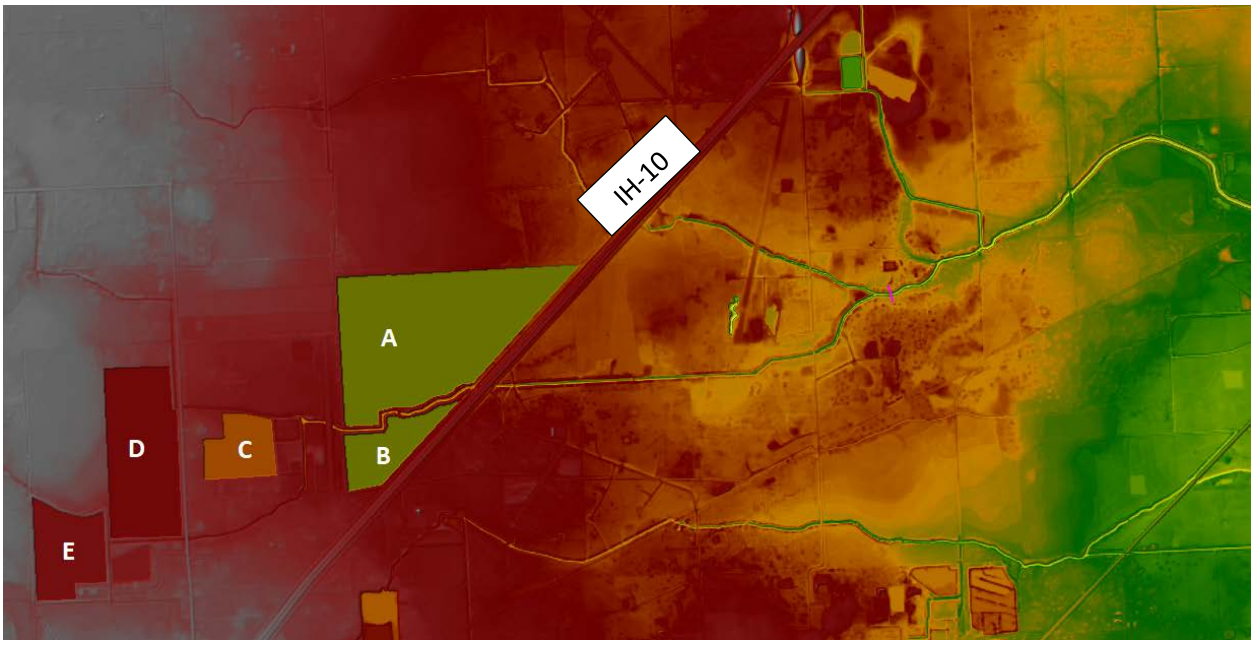

Figure 11: Proposed Upstream Pond Locations

The pond sizes are as follows:

Pond A: 160 acre footprint, 7’ deep

Pond B: 29 acre footprint, 7’ deep

Pond C:16 acre footprint, 6’ deep

Pond D: 82 acre footprint, 4’ deep

Pond E: 40 acre footprint, 4’ deep

The results from these proposed improvements are shown in Figure 12, and they yield 0.5’-1.5’ decreases in WSEL upstream of IH-10, several places downstream of IH-10 with 0.3’ decrease in WSEL, and widespread decrease of 0.1-0.2’ in WSEL as you get closer to SH-124. Additional analysis and design would need to be performed by TBCD to determine the appropriate type and level of improvements projects in order to achieve zero rise or even a decrease in WSEL within the TxDOT r.o.w. corridor and downstream.

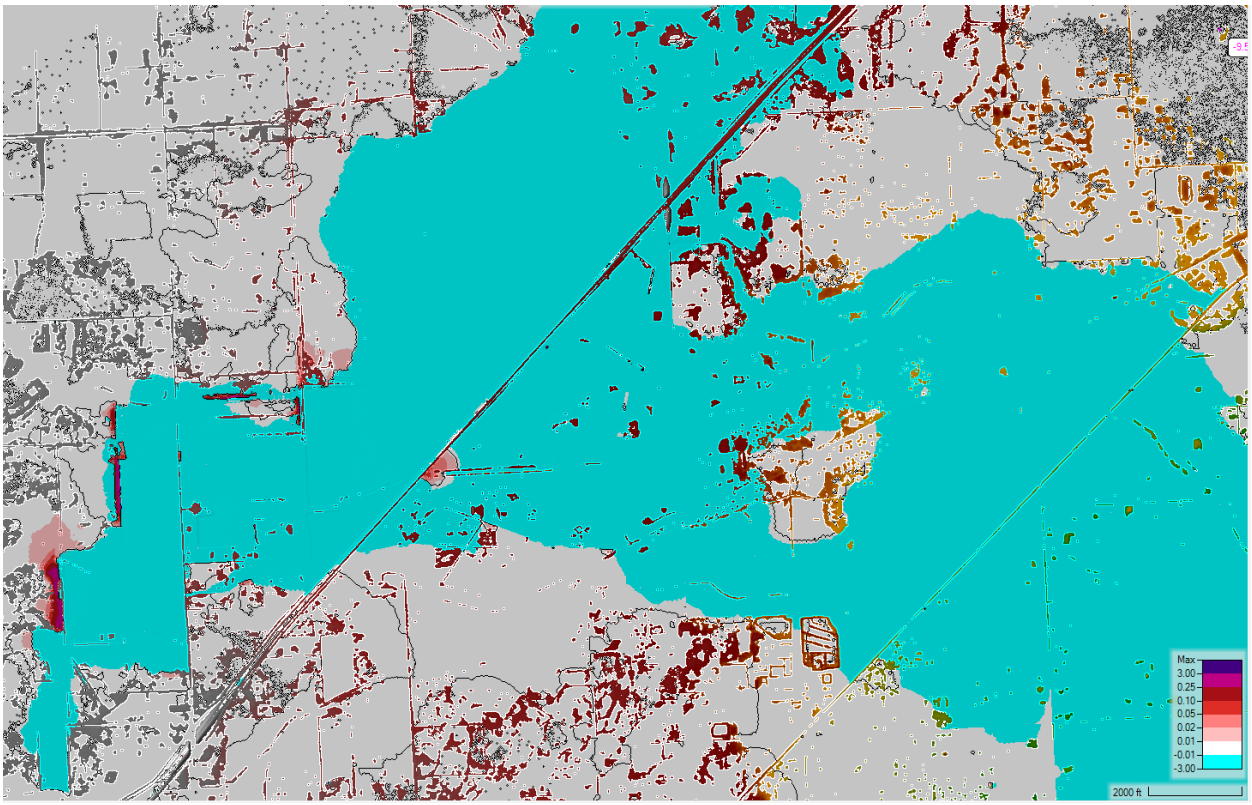

Figure 12: Proposed Upstream Improvements vs Existing Conditions WSEL Comparison

6.1 Additional Proposed Improvements

The modeling results as described and shown in Section 4.2 illustrate the level of existing conditions flooding that occurs on Mayhaw Bayou during a 100-year storm event. Whether or not the additional culverts installed in 2018 are allowed to become operative, improvements can be implemented within Jefferson County on Mayhaw Bayou to lower the existing levels of flooding.

To help reduce the increase in WSEL due to the opening of the pipes under IH-10, several iterations and combinations of improvements were evaluated. The best result obtained included a combination of bridge improvements, channel widening, channel regrading, and detention ponds. Within the hydraulic models, both M400 and M400A, as well as the main Mayhaw Bayou channel from their confluence to SH-124 were regraded and widened. A typical cross section of before/after the widening is seen below in figure 13. The new channel contains 4:1 side slopes, a 30’ bottom width, and maintains a similar but

cleaned up centerline slope. Approximately 22,150 linear feet of channel are included within the proposed channelization improvements. All of the crossings along the path are proposed to have their culverts replaced with larger culverts to allow more flow to pass through.

The bridge crossings will be replaced/enlarged and culverts upsized with the following pipe configurations:

M400 – Jones WH Ministries property crossing (located in Chambers County): 2- 10'x5' boxes

M400 – Taylor Living Trust property crossing (located in Chambers County): 2- 10'x5' boxes

M400 – Brush Island Road crossing: 2- 10'x5' boxes

M400A - Griffith property crossing: 4- 5'x3' boxes

M400A - Griffith property crossing: 4- 5'x3' boxes

M400A - Griffith runway crossing: 2-10'x5' boxes

M400A - Griffith property crossing: 2- 10'x5' boxes

M400A - Brush Island Road crossing: 2- 10'x5' boxes

Mayhaw - Kiker property crossing: 2- 10'x5' boxes

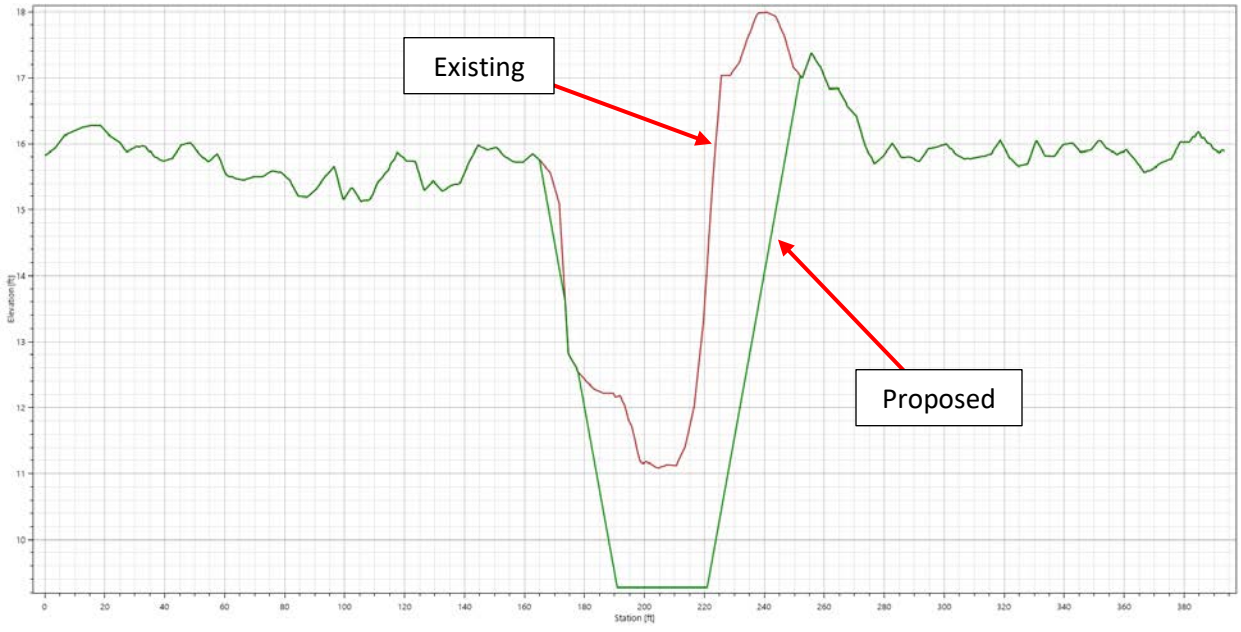

Figure 13: Typical cross section improvement

Additionally, two detention ponds were analyzed downstream of IH-10 to help intercept the increased flows. These detention ponds are both 9’ deep and have a 1’ high berm bordering the east side of the southern pond and the south and east sides of the northern pond. Figure 14 below shows the pond locations. The southern pond has a 19-acre footprint, and the northern pond has a 12-acre footprint. As with the proposed ponds analyzed upstream of IH-10, these locations were analyzed only for potential H&H benefits to reduce the WSEL and not for their suitability or availability. Potential or suitable areas for detention ponds of similar proposed size downstream of IH-10 within Jefferson County could be further researched by DD3 if funding becomes available.

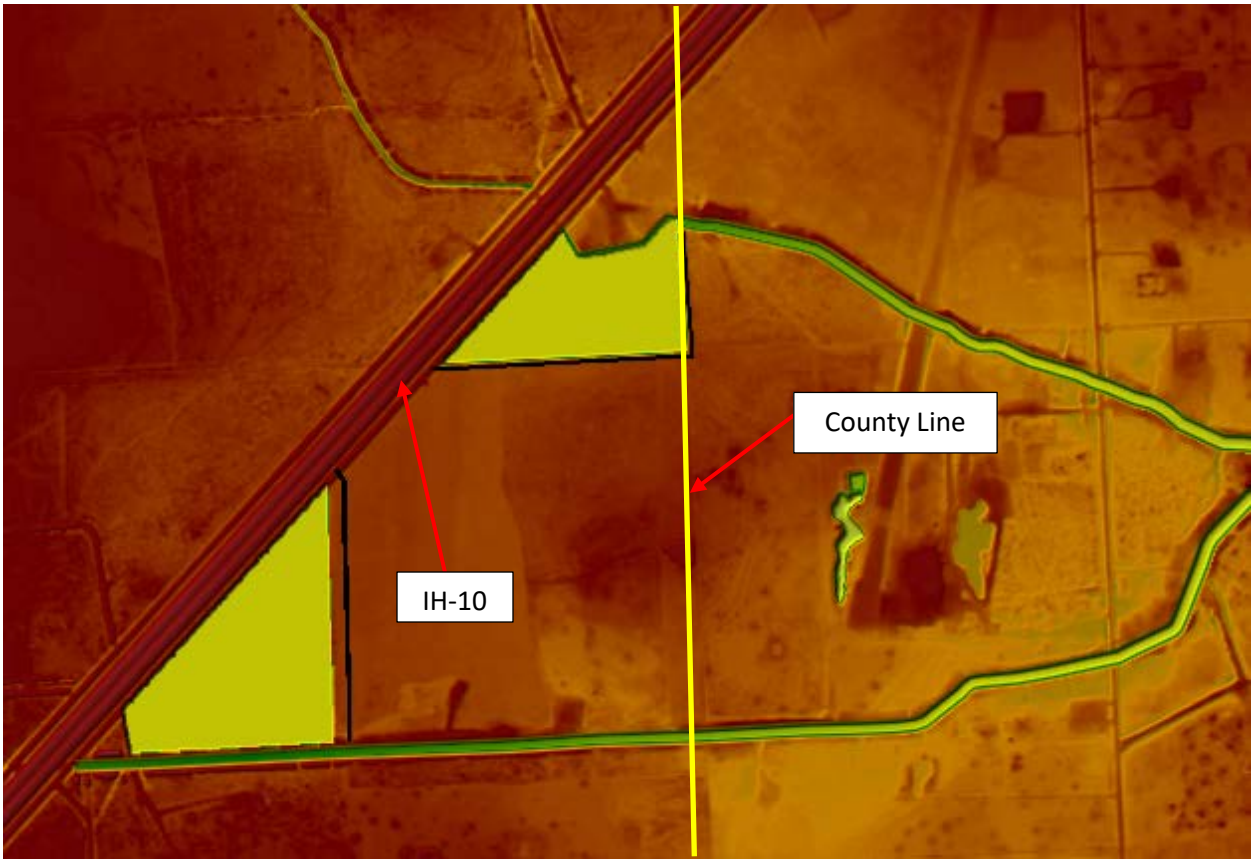

Figure 14: Proposed Pond improvements

The results of these improvements provide relief by mitigating the increases in WSEL caused by opening the pipes under IH-10. Figure 15 shows the WSEL comparison of these proposed improvements versus existing conditions.

With the proposed improvements discussed in Section 6.1, the level of benefit we see is roughly 0.15'-0.1' decrease in WSEL upstream of IH-10, and widespread decreases in WSEL from 0.02' to 0.10' downstream of IH-10. The increases in WSEL downstream are significantly reduced but not removed. The large dark portion of increases occur within a proposed detention pond. The small dark red adjacent to IH-10 and M400 are 0.12' increase within the channel, and it decreases down to no impact 500' south of the channel.

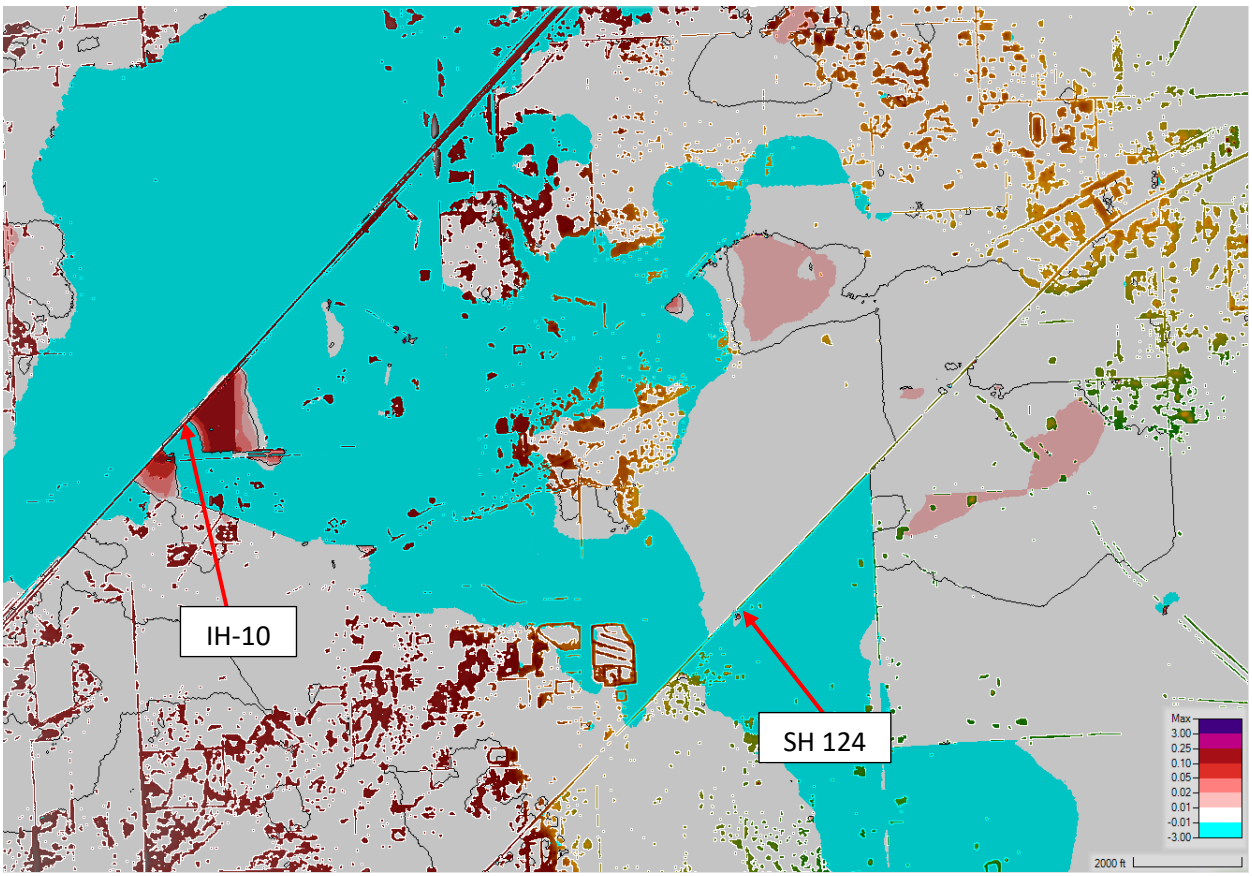

Figure 15: Proposed Improvements vs existing conditions WSEL comparison

6.2 Additional Considerations

Mayhaw Bayou may be improved with further considerations as follows:

- Improvements can be performed in phases depending on need and available funding.
- Determine economic cost benefit analysis as needed.
- Geotechnical investigations need to be performed for areas of excavation and fill to verify side slope soil stability.

- Obtain boundary surveys where additional right-of-way (ROW) or property acquisition may be required.
- Perform topographic survey, engineering, and design for planned projects.
- Apply with FEMA for improvements in effective floodplain or floodway areas.
- The design of any improvements shall meet any and all state and federal environmental permitting regulations including those required for disturbance of wetlands or other waters of the U.S.

7 Costs

The preliminary opinions of probable construction costs for improvements to M400, M400A, and Mayhaw Bayou is summarized below.

M400 Improvements	$26,468,750
M400a Improvements	$9,418,750
Mayhaw Bayou Improvements	$13,500,000

The cost estimates are based on the following:

- TxDOT 3- or 12-month pricing as available rounded up
- Recent bid tabulations for similar projects in Southeast Texas
- 25% for contingencies
- R.O.W. acquisition cost estimates are based on 2022 property values

The proposed improvements as outlined in Section 6.1 and estimated in the Appendix A Cost Estimates are “high level” estimates for the purpose of this drainage study. Further analysis is recommended to obtain multiple scenarios of improvements to best achieve the level of WSE reduction desired by Jefferson County and DD3.

APPENDIX A – COST ESTIMATES

PRELIMINARY ENGINEERS ESTIMATE OF CONSTRUCTION COST
JEFFERSON COUNTY
MAYHAW BAYOU DRAINAGE STUDY

PROPOSED IMPROVEMENTS: M400 Channelization and Crossings Improvements

ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION	1	L.S.	$750,000	$750,000
CLEARING & GRUBBING	20	ACRE	$5,000	$100,000
CHANNEL EXCAVATION	1,900,000	C.Y.	$9	$17,100,000
REM/REPLACE JONES WH MIN. CROSSING	1	EACH	$200,000	$200,000
REM/REPLACE TAYLOR LIV. TRUST CROSS.	1	EACH	$200,000	$200,000
REM/REPLACE BRUSH ISLAND ROAD CROSS.	1	EACH	$250,000	$250,000
HYDROMULCH	20	ACRE	$7,500	$150,000
SWPPP CONTROLS	1	L.S.	$25,000	$25,000
SUBTOTAL				$18,775,000
CONTINGENCIES (25%)				$4,693,750
TOTAL ESTIMATED CONSTRUCTION COSTS				$23,468,750
PROFESSIONAL ENGINEERING SERVICES				$2,000,000
PROFESSIONAL GRANT ADMINISTRATION SERVICES				$1,000,000
ACQUISITION				$75,000
TOTAL ESTIMATED COST				$26,468,750

Not Included in Estimates
Utility Adjustments/Relocations
Pipeline Adjustment/Relocations

PRELIMINARY ENGINEERS ESTIMATE OF CONSTRUCTION COST
JEFFERSON COUNTY
MAYHAW BAYOU DRAINAGE STUDY

PROPOSED IMPROVEMENTS: M400A Channelization and Crossings Improvements

ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION	1	L.S.	$200,000	$200,000
CLEARING & GRUBBING	12	ACRE	$5,000	$60,000
CHANNEL EXCAVATION	500,000	C.Y.	$9	$4,500,000
REM/REPLACE GRIFFITH SMALL CROSSING	2	EACH	$75,000	$150,000
REM/REPLACE GRIFFITH RUNWAY CROSS.	1	EACH	$500,000	$500,000
REM/REPLACE GRIFFITH LARGE CROSS.	1	EACH	$200,000	$200,000
REM/REPLACE BRUSH ISLAND RD. CROSS.	1	EACH	$250,000	$250,000
HYDROMULCH	12	ACRE	$7,500	$90,000
SWPPP CONTROLS	1	L.S.	$25,000	$25,000
SUBTOTAL				$5,975,000
CONTINGENCIES (25%)				$1,493,750
TOTAL ESTIMATED CONSTRUCTION COSTS				$7,468,750
PROFESSIONAL ENGINEERING SERVICES				$1,200,000
PROFESSIONAL GRANT ADMINISTRATION SERVICES				$750,000
ACQUISITION				$50,000
TOTAL ESTIMATED COST				$9,418,750

Not Included in Estimates
Utility Adjustments/Relocations
Pipeline Adjustment/Relocations

PRELIMINARY ENGINEERS ESTIMATE OF CONSTRUCTION COST
JEFFERSON COUNTY
MAYHAW BAYOU DRAINAGE STUDY

PROPOSED IMPROVEMENTS: Mayhaw Bayou Channelization and Crossings Improvements

ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION	1	L.S.	$400,000	$400,000
CLEARING & GRUBBING	32	ACRE	$5,000	$160,000
CHANNEL EXCAVATION	900,000	C.Y.	$9	$8,100,000
REM/REPLACE KIKER PROP. CROSSING	1	EACH	$250,000	$250,000
HYDROMULCH	32	ACRE	$7,500	$240,000
SWPPP CONTROLS	1	L.S.	$50,000	$50,000
SUBTOTAL				$9,200,000
CONTINGENCIES (25%)				$2,300,000
TOTAL ESTIMATED CONSTRUCTION COSTS				$11,500,000
PROFESSIONAL ENGINEERING SERVICES				$1,250,000
PROFESSIONAL GRANT ADMINISTRATION SERVICES				$750,000
ACQUISITION				$150,000
TOTAL ESTIMATED COST				$13,500,000

Not Included in Estimates
Utility Adjustments/Relocations
Pipeline Adjustment/Relocations