CONOCOPHILLIPS COMPANY
PROJECT GUMBO NORTH

HYDROLOGIC MODIFICATION IMPACT ANALYSIS

OCTOBER 2023

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Providence Project No: 1429-007

PROVIDENCE

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1.0 OVERVIEW

1.1 Background and Site Location

Providence Engineering and Environmental Group LLC (Providence) has been contracted by the ConocoPhillips Company (COP) to conduct a Hydrologic Modification Impact Analysis (HMIA) for the development of a proposed appraisal well pad and access road within Cameron Parish, Louisiana (LA). The proposed facility will be located on an undeveloped parcel of property, south of LA Highway 82 approximately 3.75 miles East of Sabine Pass LNG facility. A site location map is included as Figure 1.

The access road will connect to the proposed appraisal well pad to LA Highway 82. This access road connection will include the installation of one 36" culvert designed to maintain the hydrological connection between either side of the access road along LA Highway 82.

1.2 Purpose

The purpose of this report is to analyze the impacts of the proposed design on runoff quantities, rates, and water quality parameters on the existing hydrologic conditions and adjacent properties or waterways. The intent of the proposed design is to minimize anticipated increases in post-development stormwater runoff rates, water elevations, and demonstrate that the drainage from post-development will not adversely impact any surrounding properties.

This report will identify measures to be taken to reduce adverse impacts resulting from the proposed alteration. This analysis has been conducted in accordance with established engineering practices and includes calculations for the pre- and post-development drainage conditions for the proposed facility as well as the requirements of the Office of Coastal Management (OCM) pursuant to La. RS. 49:214.27.B and C, and Coastal Use Guidelines found in LAC Title 43, Part 1, Chapter 7, Subpart B, § 701-709.

2.0 MODEL DEVELOPMENT

2.1 General Summary

To assess the flow path and flow rate along with capacity and corresponding water surface elevations (WSE) generated by a design storm, a Hec-Ras 2D model was developed to ensure the construction of the proposed appraisal well pad and access road have no negative hydrological impacts on the area. To develop the model, the most recent Light Detection and Ranging (LiDAR) elevation terrain, 2017, was downloaded from USGS's website in 1 meter resolution. Digital elevation maps can be found as Figure 2a and Figure 2b displaying elevations for the entire study area and elevations specific to the project site. All elevations presented in this report are NAVD88 unless otherwise noted. Cross-sections of the well pad, the access roadway, and the culvert are shown on Figure 3.

Through the National Resource Conservation Service (NRCS) map service soils map, included as Figure 4, the makeup of existing soil was determined to be of mostly muck and

silty clay loam with a Hydrologic Soil Group classification of D. In addition to the soils map, the 2019 land cover map was downloaded from NRCS and is included as Figure 5. From the soils and land cover maps, Hec-Ras generates the watershed's imperviousness, CN values, and Manning's n values used in hydraulic calculations. Where deemed appropriate, the Manning's n values were given more precise values to accurately represent specific features within the study area based on topographic survey information and general site observations as the land cover map is very generalized and often not as accurate for extremely rural areas.

Federal Emergency Management Agency (FEMA) has determined this area to be Flood Zone AE which are areas affected by the 100-year flood and have determined base flood elevations determined for them. FEMA has issued an effective Flood Insurance Rate Map (FIRM) as of 16 November 2012 which designates the area as Zone AE with a 100-year flood elevation of 14 feet, included in Attachment 1.

2.2 Watershed Area and HEC-RAS 2D Mesh

The watershed impacting the site location and what is effectively the study area represented by a Hec-Ras 2D computational mesh is located East of Sabine Pass and Chenier LNG terminal and West of the Johnsons Bayou High School. Its Northern boundary is LA Highway 82 (Gulf Beach Highway). The study area is represented in Figures 6 and 7. The computational mesh size was determined by considering the overall size of the study area and the mesh cells were aligned by breaklines to better capture the terrain's low and high areas, enabling the simulation to calculate flow direction, flow rate, and WSE correctly.

2.3 Design Storms

In order to accurately model a design storm for this project, OCM HMIA guidelines, the Coastal Protection and Restoration Authority (CPRA) issued Coastal Master Plan, as well as the LADOTD Hydraulic Manual information and guidelines were evaluated. The OCM HMIA guidelines state that design storms should represent a reasonable risk of flooding and address any potential changes to the 100-year flood zone and require a minimum 10-inch/24-hour model. The OCM HMIA guidelines do not specify a specific design storm frequency. The CPRA Coastal Master Plan guidelines for hydrodynamic models in coastal Louisiana does not state any requirements for design storms as the models are focused on specific historical past storm events such as hurricanes. The LADOTD hydraulics manual has several base requirements for a design storm depending on types of structures being modeled. Side drains under private drives and average conditions require a 5-year storm, median drains require a 10-year storm, storm drains and inlets require a 10-year storm, and roadside channels require a 5-year storm. In addition, it is stated in the design requirements within a wetland that minor structures shall have a minimum of a 5-year return interval design storm. Based on the OCM HMIA guidelines, CPRA's Master Plan, and the LADOTD Hydraulics Manual, a 10-year storm event was used as the basis for determining the peak WSE and flow rates and used for designing the drainage structure. For analysis of the peak flow and peak WSE generated from the study area, 10-year, 25-year, and 100-year 24-hour SCS type-III storm events were evaluated to satisfy the 10-inch/24-hour model requirements contained in the OCM HMIA guidelines.

According to the NOAA's National Hurricane Center Storm Surge Risk Map for a Category 1 tropical storm, the anticipated storm surge in this project area would be between 6 and 9 feet above ground surface. Storm surge prediction varies greatly with the speed of storm movement and actual storm path. Storm surge generated from a Category 1 tropical storm would inundate the project area through existing drainage features and then drain out within a 7–14-day period depending on the amount of rainfall, the level of storm surge received by the area, and any additional rainfall received after the storm has passed. The storm surge risk map is shown on Figure 8.

2.4 Initial Conditions

Before the existing and proposed conditions can be modeled, an initial condition (initial volume of water) for the study area must be determined. Under most circumstances, a rain event will occur with the study area already holding water. To model this initial condition, a 25-year 24-hour rain event was simulated for 9 hours using a dry existing condition model to "charge" the study area to an adequate WSE. This amount of water is added to future existing and proposed simulations to ensure that the model does not start a simulation dry.

2.5 Boundary Conditions

To allow water to exit the study area, a normal depth with a slope of 0.001 (simulating a conservative boundary condition) was added around the West and South boundaries of the computational mesh. Only West and South boundary conditions were added as water flow for the study area predominately flows East to West with a portion of the Eastern-most section flowing South and a small portion of the West section flowing South. LA Highway 82 to the North serves as a natural boundary; therefore, no boundary condition was needed.

3.0 PRE AND POST DEVELOPMENT DESIGN

3.1 Drainage Structures

3.1.1 Existing Structures

Three existing structures were identified by Providence via site reconnaissance within the study area and have been included in the model. The structures identified include: two bridges and one stop log structure. All three structures are located on an existing access road oriented North-South through the middle of the study area. These structures are shown in Figures 6 and 7.

3.1.2 Proposed Structures

To analyze potential flooding impacts the proposed project will have during a rainfall event and to analyze drainage structure design, pre- and post-WSE as well as flow rates upstream and downstream of the site were studied and compared. A culvert will be installed through the new access roadway connection to La Highway 82. The location of the proposed culvert was based on existing surface water flow direction and terrain. The culvert will be installed with an invert elevation of 1.3 feet NAVD88

to maintain the transfer of water through the project area and to keep the WSE and flow rates the same for the existing and proposed conditions. The purpose of the drainage structure is to maintain hydraulic connections without restricting stream flows. The 36-inch culvert was selected through an iterative process where a simulation was run monitoring WSE immediately prior to entering the culvert to ensure ponding does not occur. Also, a 36-inch culvert was chosen with an invert of 1.3 feet NAVD88, positioning the culvert top elevation at 4.3 feet NAVD88. The max 100-year WSE at the culvert location never exceeds 3.13 NAVD88 feet--therefore it will not run full for a 100-year 24-hour SCS type-III storm. The location of this drainage feature is noted in Figure 9. A typical section of the culvert is shown by Figure 3.

3.2 Terrain

3.2.1 Existing

The existing terrain was modified from the original downloaded terrain file from USGS to accurately represent the channel bathymetry and storage of the numerous ponds within the study area as LiDAR cannot penetrate water surface. This was done within Hec-Ras using the terrain edit tool. There was no provided bathymetry survey nor channel and borrow ditch topography survey data for the majority of the study area and nearly all ground surface topography for the model was based on the 2017 LiDAR data downloaded from USGS. Therefore, a conservative approach was taken when inputting the depth profile within the terrain for borrow ditches, channels and ponds by only lowering ponded areas by 0.5 feet and lowering borrow ditches and channels by no more than one foot.

3.2.2 Proposed

The proposed site terrain model includes all features of the existing site terrain model, with the addition of the proposed well pad, access road and drainage structure. No other modifications to the site terrain are proposed.

4.0 MODEL RESULTS

4.1 WSE At Critical Points of Interest

To ensure increased flooding does not occur as a result from the appraisal pad construction, WSE values were monitored at critical points of interest, shown on Figure 10, for the three storm events. Locations 1 and 2 are respectively located approximately 407 feet East and approximately 1,000 feet West of the appraisal well pad to monitor immediate and adjacent flooding that may be occurring near the project site. Locations 3 and 4 are respectively located approximately 1,875 feet Southeast and approximately 2,830 feet Southwest from the project site placing Location 3 near profile line 1 and Location 4 near profile line 2. Profile lines are also shown on Figure 10. Locations 3 and 4 are monitored within the model to ensure flooding does not occur at a major conveyance zone and natural detention area located near the project site. The access roadway to the West near the study area's Western

boundary acts as a damn/weir blocking water from flowing East to West near the north side of the study area pushing water south. Location 5 was put in place at the end of this road as stormwater to the North that does not over top the road in large rainfall events is pushed South to that location. Monitoring the WSE at this location provides a good indicator of the project's impacts on the watershed's flow and WSE; therefore, Location 5 will be referenced when talking about the projects overall impact on the project's watershed and will be referred to as the crucial point of interest. Figure 10 shows these WSE values for all three storms and Table 1 shows the WSE differences and percent differences for each storm event.

Table 1: WSE Differences and Percent Change

Critical Point of Interest	10-year storm		25-year storm		100-year storm	
	WSE Difference (feet)	WSE Percent Difference	WSE Difference (feet)	WSE Percent Difference	WSE Difference (feet)	WSE Percent Difference
1	0.02	0.85	0.05	1.85	0.02	0.64
2	-0.01	0.429	0.04	1.50	-0.02	-0.65
3	0.01	0.420	0.04	1.47	0.00	0.00
4	0.00	0.00	0.05	1.91	-0.01	-0.332
5	0.00	0.00	0.03	1.22	0.00	0.00

The WSE difference between the proposed and existing conditions does not exceed 0.05 feet for any given storm event. This equates to a maximum of a 1.91% increase at any of the critical points of interest. For the 10-year design storm, the maximum WSE difference is 0.02 feet which equates to a 0.85% increase. At Location 5, the crucial point of interest, the 10 and 100-year storms have a difference of 0.00 and the 25-year has a difference of 0.03 feet, a 1.22% increase.

4.2 Flow Rates Across Profile Lines

To monitor flow rates, a profile line can be drawn within Hec-Ras program that can display the cumulative flow across the cell faces that the profile line intersects. Two profile lines were drawn, and their locations are shown in Figure 10. Profile line 1 is located to the East of the project location and profile line 2 is located West of the project location–this allows flow rates to be monitored before it reaches the appraisal well pad and after it passes the appraisal well pad. The length of the profile line was drawn to include enough cells where the flow would not be too site specific but not too large where the project's impact would be masked by a large volume. At each of the profile line's sections, the flow rate for each of the design storms existing condition's value is compared to the proposed condition's value. This is shown by the two graphs in Attachment 2. These graphs show that the pre and post flow for all three storms are very similar and are practically identical for the design 10-year storm.

Table 2 shows the flow differences and percent differences for all three storms at each of the profile lines.

Table 2: Profile Line Flow Differences and Percent Change

Storm Return Interval	Profile Line 1		Profile Line 2	
	Flow Difference (cfs)	Flow Percent Difference	Flow Difference (cfs)	Flow Percent Difference
10-year	-1.43	-1.21	-0.80	-0.58
25-year	-0.33	-0.14	9.58	3.84
100-year	-6.38	-1.72	-4.67	-1.02

The design 10-year storm shows a decrease in flow at both profile lines. The proposed conditions do not contribute to an increase in flow rate for 5 out of the 6 values shown in the above table. The flow rate is shown to be decreasing with the only increase occurring at profile line 2 for the 25-year storm.

5.0 IMPACT EVALUATION SUMMARY

The analysis in Section 4.0 shows the proposed culvert that conveys stormwater under the access road can provide adequate drainage for the 10-year, 25-year, and 100-year post-development storms. According to the modeling and analyses, the proposed development will not cause flooding upstream of the proposed facility. With the low relief topography in the area and because the project is surrounded by tidal and coastal marsh, the volume/rate of runoff pre- and post-construction will have minimal to no change, a maximum of 3.84% change, this is also supported by the graphs in Attachment 2.

The existing flow patterns will be minimally affected due to the construction of the access road and appraisal well pad as the discharges from the area will take place through the existing features as depicted in Figure 6. The project features minimally alter the existing flow patterns within the study area and post-construction flow patterns will be consistent with pre-construction flow patterns. In addition, the existing drainage channels will be minimally impacted, as their size will not be altered.

5.1 Impacted Receiving Land or Water Body

The construction of the access road and appraisal well pad will have a negligible change to the runoff from the project area. The project's study area will be minimally altered, and hence the change in the runoff generated from the road and appraisal pad will have no adverse effects to adjacent properties or the existing drainage network. The culvert installed near LA Highway 82 has been sized to maintain the volume of discharge from the area to prevent impounding of the wetlands in the study area.

After evaluating the WSE at the crucial point of interest, Location 5, and flow rates at the profile lines generated by Hec-Ras, it was determined that the change in runoff from the study area would be minimal. The WSE for the design 10-year storm, and the 100-year storm, remains unchanged at Location 5. The construction of the access road and appraisal well pad will not change the existing drainage patterns. To maintain the hydrology of the area and to prevent impounding in the wetlands, one culvert will be installed beneath the access road connecting LA Highway 82 and the appraisal well pad. Stormwater will continue to flow through the wetland marsh to the west of the project area and eventually out into the Gulf of Mexico.

5.2 Water Quality Analysis

The short-term and long-term point and non-point source impacts to water quality have been evaluated per EPA and LDNR guidelines based on the drainage analysis findings described above. The short-term impacts to water quality are associated with the construction activities and the long-term impacts to water quality are associated with the maintenance of the access road and appraisal well pad.

The potential water quality parameter to be affected by the proposed project is increased Total Suspended Solids (TSS) during construction (non-point and point sources). The fill that will be used to construct the access road and appraisal well pad will be imported granular fill and aggregates. Measures will be taken to ensure that fil materials imported for the construction activities are free from grease, oils, trash, fertilizers, nutrients, pathogens, pesticides, and metals.

TSS is the main potential water quality parameter that needs be considered for long-term maintenance of the constructed access road and appraisal well pad during initial consolidation, after construction, and repairs due to storms and hurricanes.

5.3 Construction Maintenance and Operation Plan

During construction of the appraisal well pad and access road, TSS and turbidity is anticipated to increase in adjacent waters. However, these increases will be temporary during periods of construction. All equipment operating in surface waters and adjacent wetlands will be required to have and maintain spill prevention and containment materials on board to respond to accidental spills. A project specific Stormwater Pollution Prevention Plan (SWPPP) will be developed and implemented as part of the construction activities. Appropriate best management practices (BMPs) will be utilized to minimize the volume/rate of runoff impacts in the area.

Routine roadway and pad maintenance will be required after the completion of the construction activities. This will include the addition of aggregate surface course and grading as needed. The placement of this additional aggregate will be limited to the roadway and pad surface.

6.0 MANAGEMENT MEASURES FOR NON-POINT SOURCE WATER POLLUTION

The drainage design for the proposed appraisal well pad and access road has accounted for the surrounding wetlands on the adjacent properties. Stormwater runoff rates from the undeveloped wetland areas will have no significant adverse impact to existing runoff rates. Rapid draining of this area is not anticipated to occur. The watershed basin has a history of localized ponding caused by the stoplog structure in lower lying areas to the East of the main road that runs through the study area which will continue to maintain soil moisture and support wetland vegetation. Therefore, the proposed appraisal well pad and access road will not significantly adversely impact adjacent lands.

6.1 Existing Federal and State Requirements

OCM, under the direction of the National Oceanic and Atmospheric Administration (NOAA) and in cooperation with the Louisiana Department of Environmental Quality (LDEQ) and the US Environmental Protection Agency (EPA), has agreed to implement New Development Management Measures to reduce non-point source water pollution. These measures are intended to protect and enhance the water quality of coastal waters through reduction of TSS in surface water runoff.

These measures are also intended to decrease the potential erosion and runoff caused by development, remove pollutants transported by stormwater runoff, retain hydrologic conditions, and preserve natural systems Section 6.2 explains how COP will comply with these requirements.

6.2 Best Management Practices (BMPs)

To control stormwater runoff and the discharge of pollutants, including sediment, into local water bodies during site preparation, construction, and maintenance operations, project specific Best Management Practices (BMPs) will be developed to meet the guidelines established in the LDNR Stormwater Runoff handbook. These BMPs will address the following:

General Housekeeping:

- The project site and associated staging areas will be kept free of leaks, spills, trash, and debris.
- Regular inspection, cleanup and proper disposal of any leaks, spills, trash, and debris.
- Proper storage of liquids, chemicals, fuels, and lubricants to avoid damage to containers and potential releases.
- Appropriate waste receptacle availability and use.

Site Preparation & Project Design:

- Confine construction impact to established project clearing limits to minimize vegetation disturbance.
- Limit the introduction of fine particles associated with imported fill material.
- Construction activity sequencing and coordination to reduce on-site erosion and off-site sedimentation.
- Established construction access/egress with attention to sediment control and surface stabilization prior to beginning construction activities.
- Road and pad side-slope design to minimize sloughing.

Construction:

- Bulk material placement and shaping to minimize sloughing.
- Use of slope breakers or sediment barriers such as silt fence, hay or straw bales, compacted earth, or sandbags to prevent or reduce runoff of sediment laden stormwater where appropriate.

- Use of Construction track-out controls to minimize the amount of sediment leaving or being tracked out from the construction site onto public roads.
- Weather considerations during construction execution.

Operations & Maintenance:

- Regular inspection and maintenance of existing erosion control measures.
- Use of clean aggregate for maintenance.

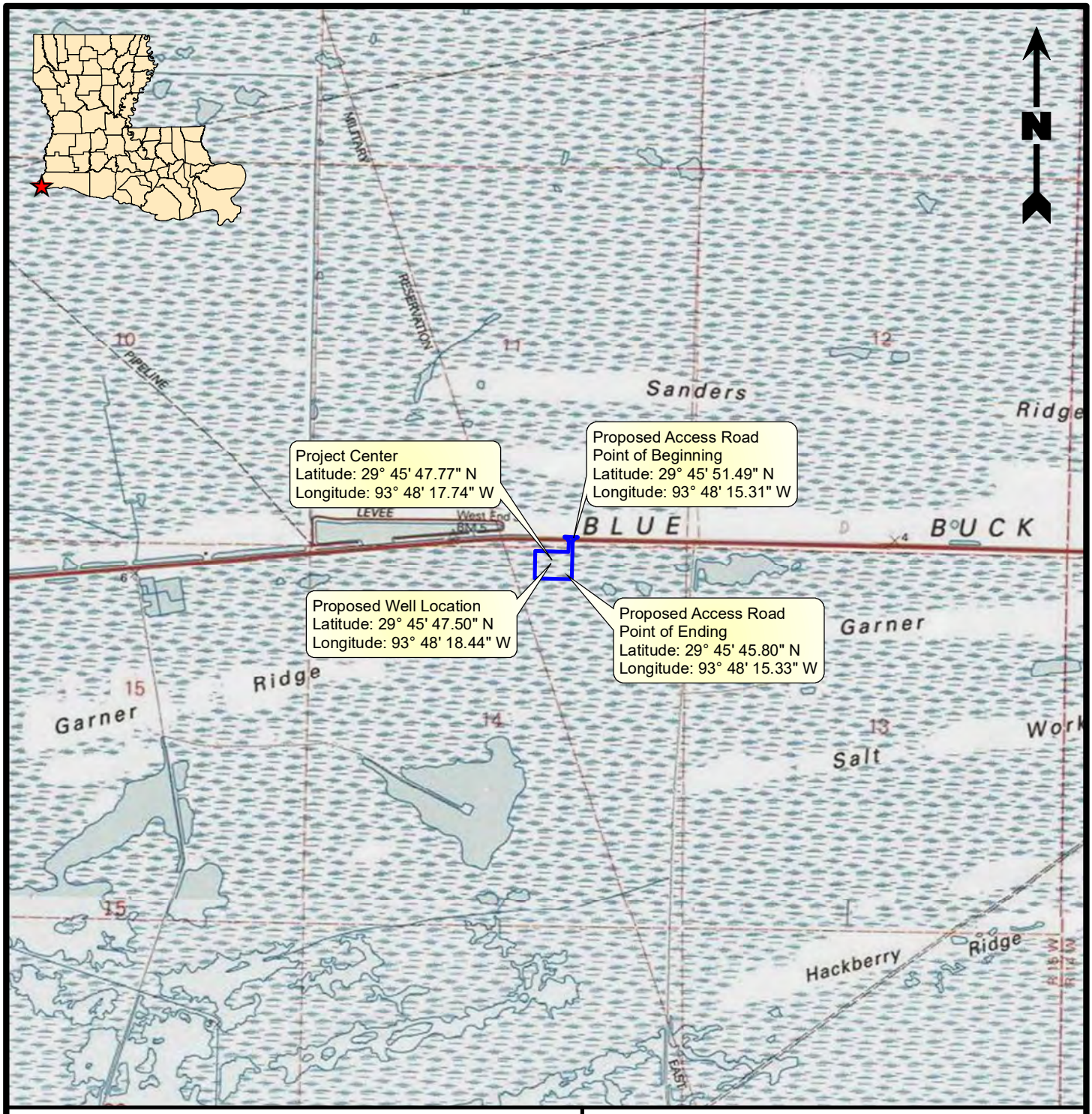
7.0 CONCLUSION

The 10-year design storm at the crucial point of interest, Location 5, showed no change in WSE. Considering all other points of interest, the 10-year design storm showed a maximum increase in WSE of 0.02 feet, which can be considered negligible, and showed a decrease in flow rates at both profile lines for all storms. For the 25-year storm, the crucial point of interest showed an increase of 0.03 feet which can be considered negligible. Considering all other points of interest, the 25-year storm event showed a maximum increase in water surface elevation of 0.05 feet, also negligible. The 25-year storm showed a decrease in flow of -0.14% at profile line 1 and an increase of 3.84% at profile line 2, this increase is considered negligible as the WSE at the crucial point of interest is only raised by 0.03 feet. The 100-year storm at the crucial point of interest showed no change in WSE. Considering all other points of interest, the 100-year storm showed a maximum increase in WSE of 0.02 feet. Like the 10 and 25-year storms, this increase is negligible for the 100-year storm and showed a decrease in flow rate at both profile lines. The 100-year storm does not follow the increasing WSE trend that is shown going from the 10 to the 25-year storms. This change in trend is because the area is already extensively inundated during the existing 100-year condition and the addition of the well pad has little effect to no effect on the maximum amount of water in the area. When considering the crucial point of interest, the pre- and post-development WSE only changes for the 25-year storm and peak flow rates only increase for the 25-year at profile line 2. This proves no significant adverse impact on the watershed drainage as the 10-year is the design storm and the 100-year storm represents the extreme storm event.

In summary, when considering the crucial point of interest for the design storm, the proposed project development with the designed culvert will not result in an increase in WSE and have negligible change in the flow rate caused by stormwater runoff flowing overland from the project area. There will be no anticipated increase in drainage from other properties or waterways, negligible change in flood elevations immediately upstream or downstream of the project area, and no anticipated long-term change in water quality after completion of construction.

FIGURE 1

SITE LOCATION MAP



2,000 1,000 0 2,000 Feet

Legend

Proposed Project Area (4.78 Acres)

Note

All coordinates shown are referenced to geographic coordinate system (NAD83).

Reference

Base map comprised of U.S.G.S. 7.5-minute topographic maps, "West of Johnsons Bayou, LA" and "Texas Point, TX".

Site Location Map

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

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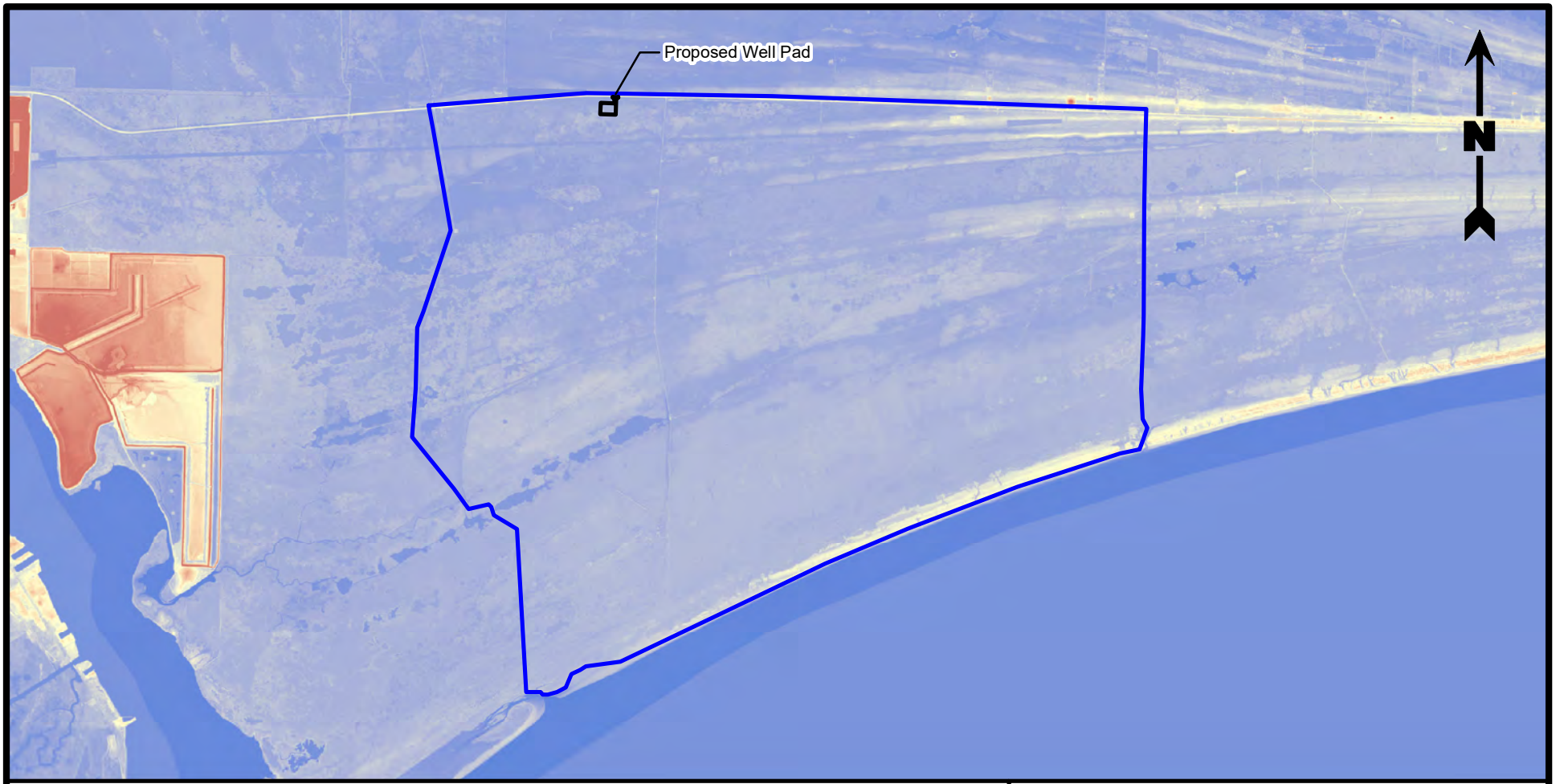
1429-007-A049

1
Figure

FIGURE 2a

DIGITAL ELEVATION MODEL OF ENTIRE STUDY AREA



Legend

Study Area

Elevation (Feet Above Sea Level)

36.73
0
-0.79

Reference

Base map comprised of ESRI World Terrain, exported 08/10/23.

5,000 2,500 0 5,000 Feet

Digital Elevation Model (Study Area)

HMIA Report

Johnson Bayou, Cameron Parish, Louisiana

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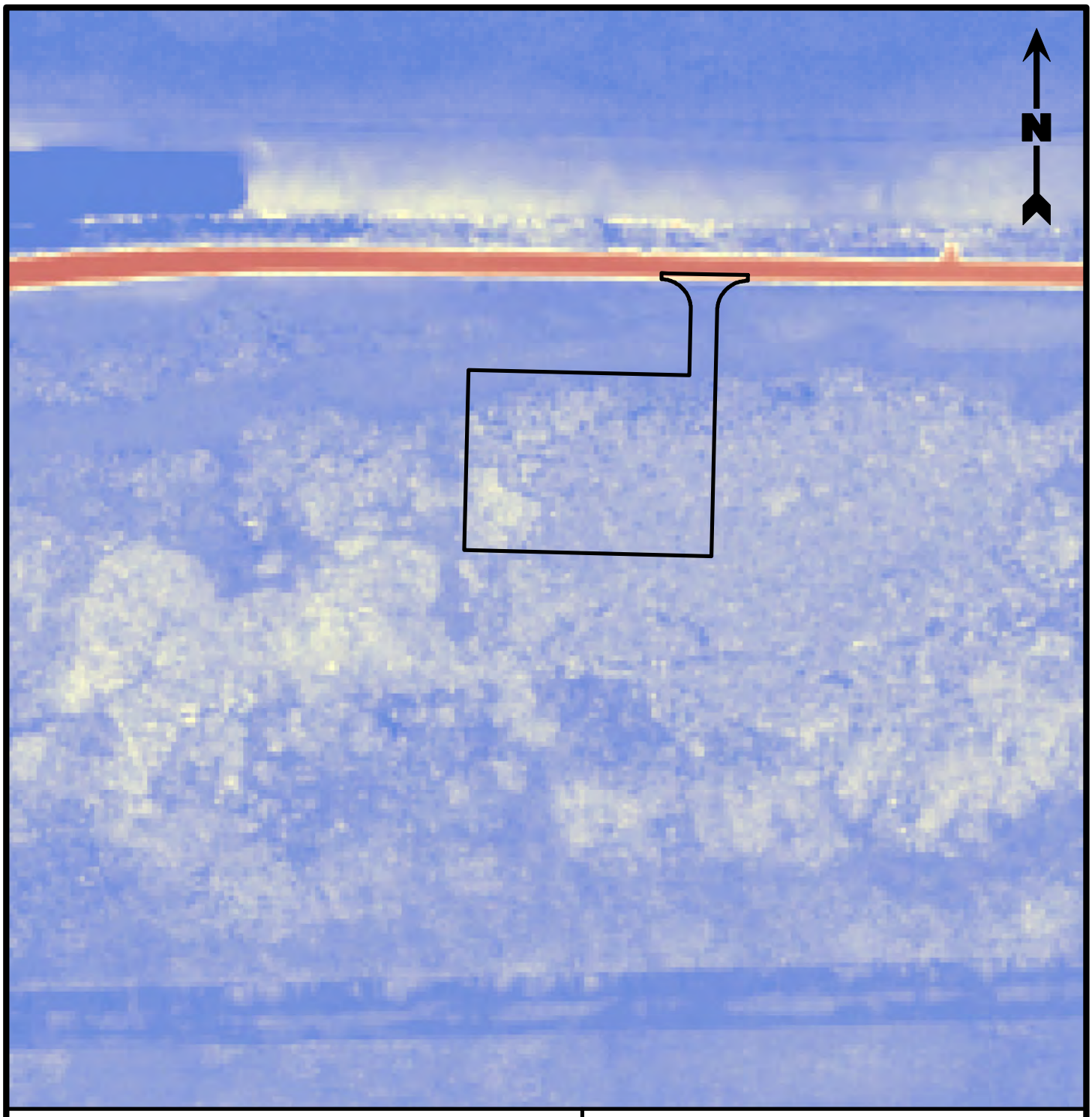
Drawing Number 1429-007-A067

2a Figure

FIGURE 2b

DIGITAL ELEVATION MODEL OF SITE



300 150 0 300
Feet

Legend

Proposed Project Area
(4.78 Acres)

Elevation (Feet Above Sea Level)
High : 7.4
Low : 0.3

Reference

Base map comprised of ESRI World Terrain, exported 08/10/23.

Digital Elevation Model

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

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Approved By	TCK	09/25/23

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Drawing Number
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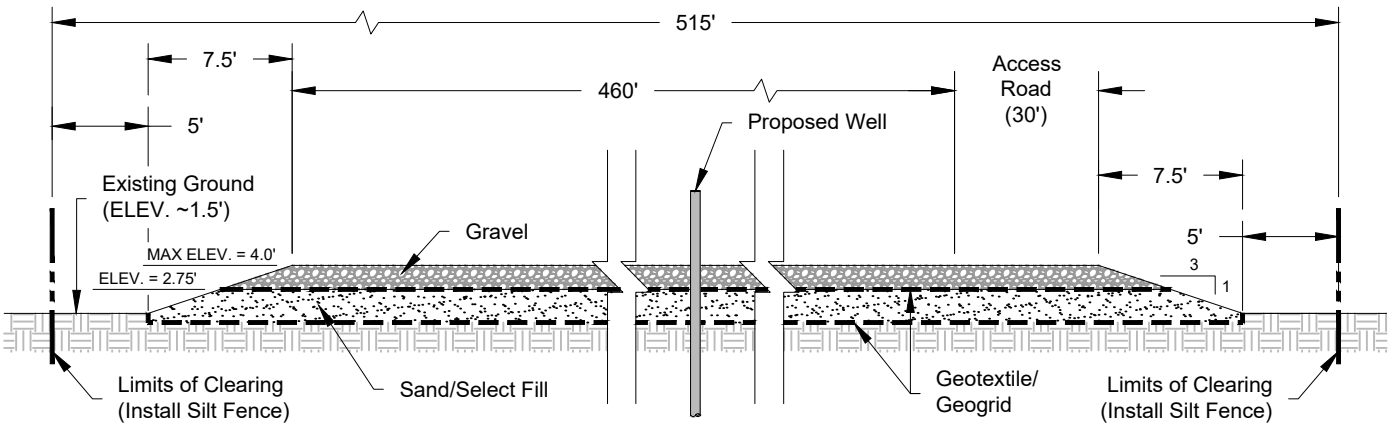
2b
Figure

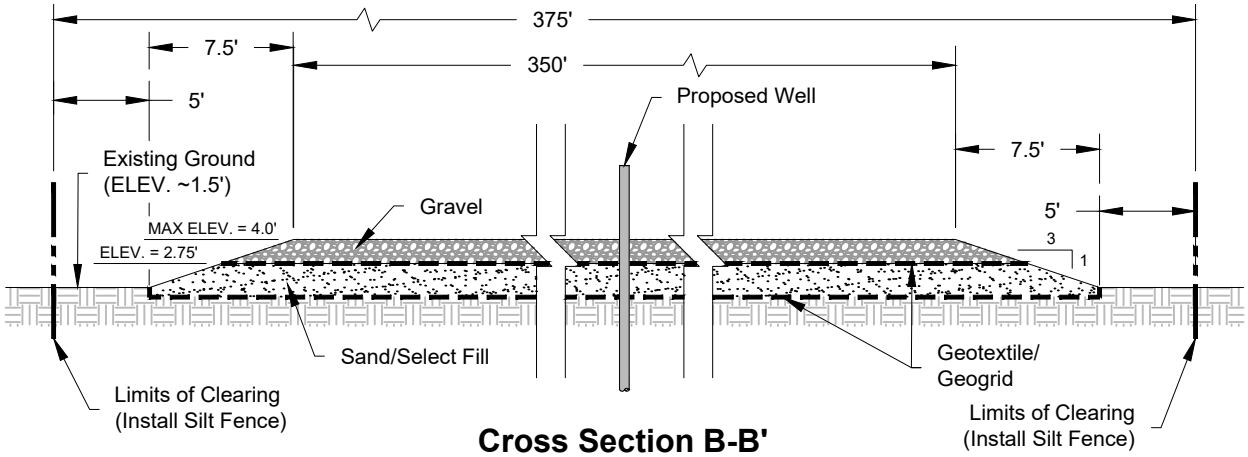
FIGURE 3

TYPICAL SECTIONS



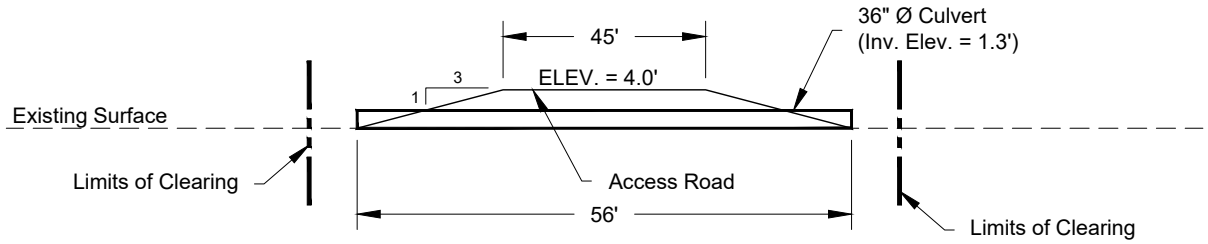
Cross Section A-A'

Not to Scale



Cross Section B-B'

Not to Scale



Culvert Typical Section

Not to Scale

Notes

1. Elevations (ELEV.) are referenced to North American Vertical Datum 1988 (NAVD88).
2. Water levels vary from no visible standing water to shallow inundation based on recent precipitation. No detailed water level history available.

Typical Sections

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

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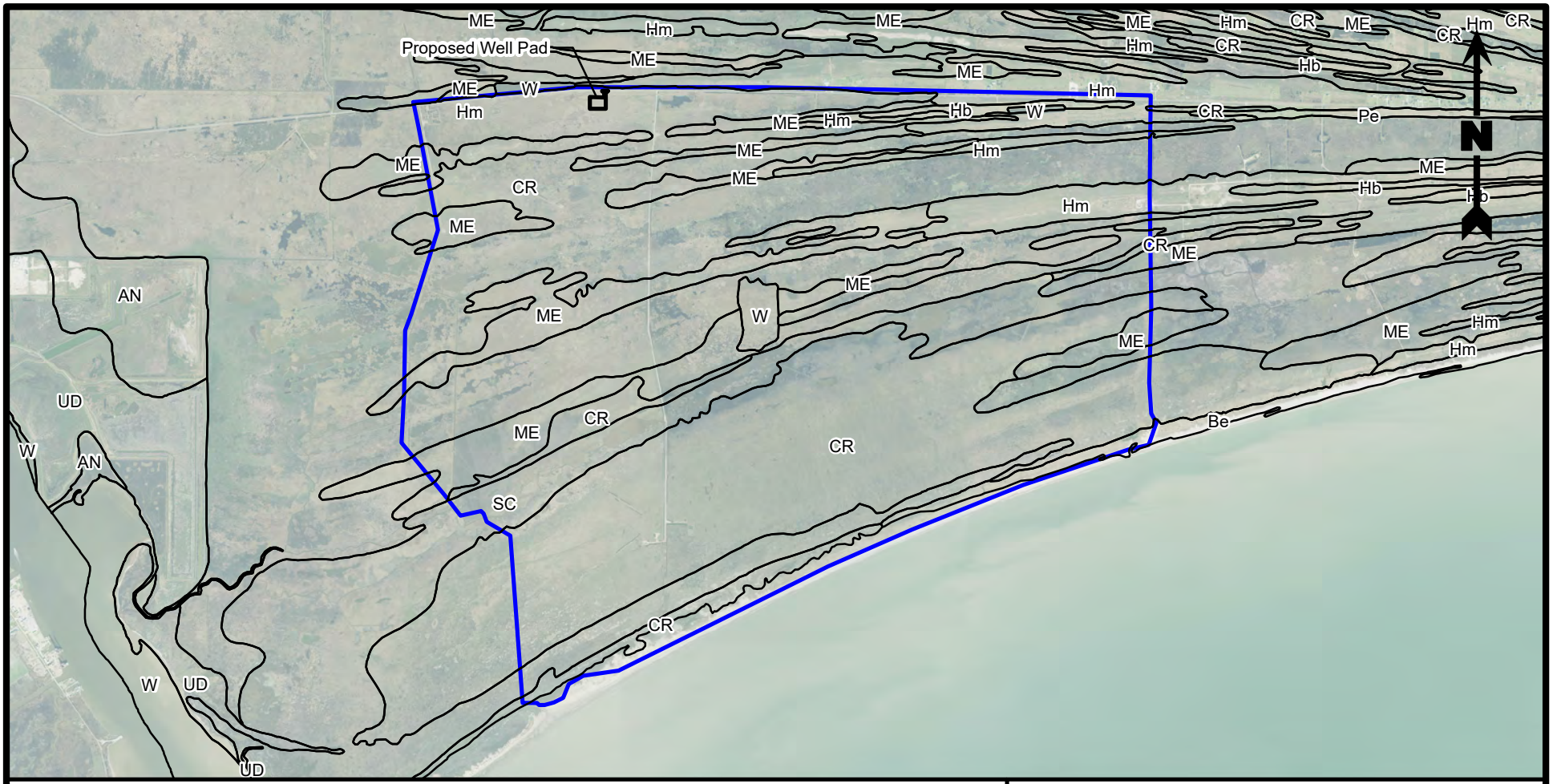
3 Figure

FIGURE 4

EXISTING SOILS MAP



Legend

Study Area

Soils

Be - Beaches, coastal
CR - Creole mucky clay
Hb - Hackberry loamy fine sand
Hm - Hackberry-Mermentau complex, gently undulating
ME - Mermentau clay
SC - Scatlake mucky clay, 0 to 0.2 percent slopes, tidal
W - Water

5,000 2,500 0 5,000 Feet

Reference

Base map comprised of 2021 aerial photography from USDA/FSA Aerial Photography Field Office, National Agriculture Imagery Program (NAIP). Soils data obtained from Natural Resources Conservation Service (NRCS) Web Soil Survey.

Existing Soils Map

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

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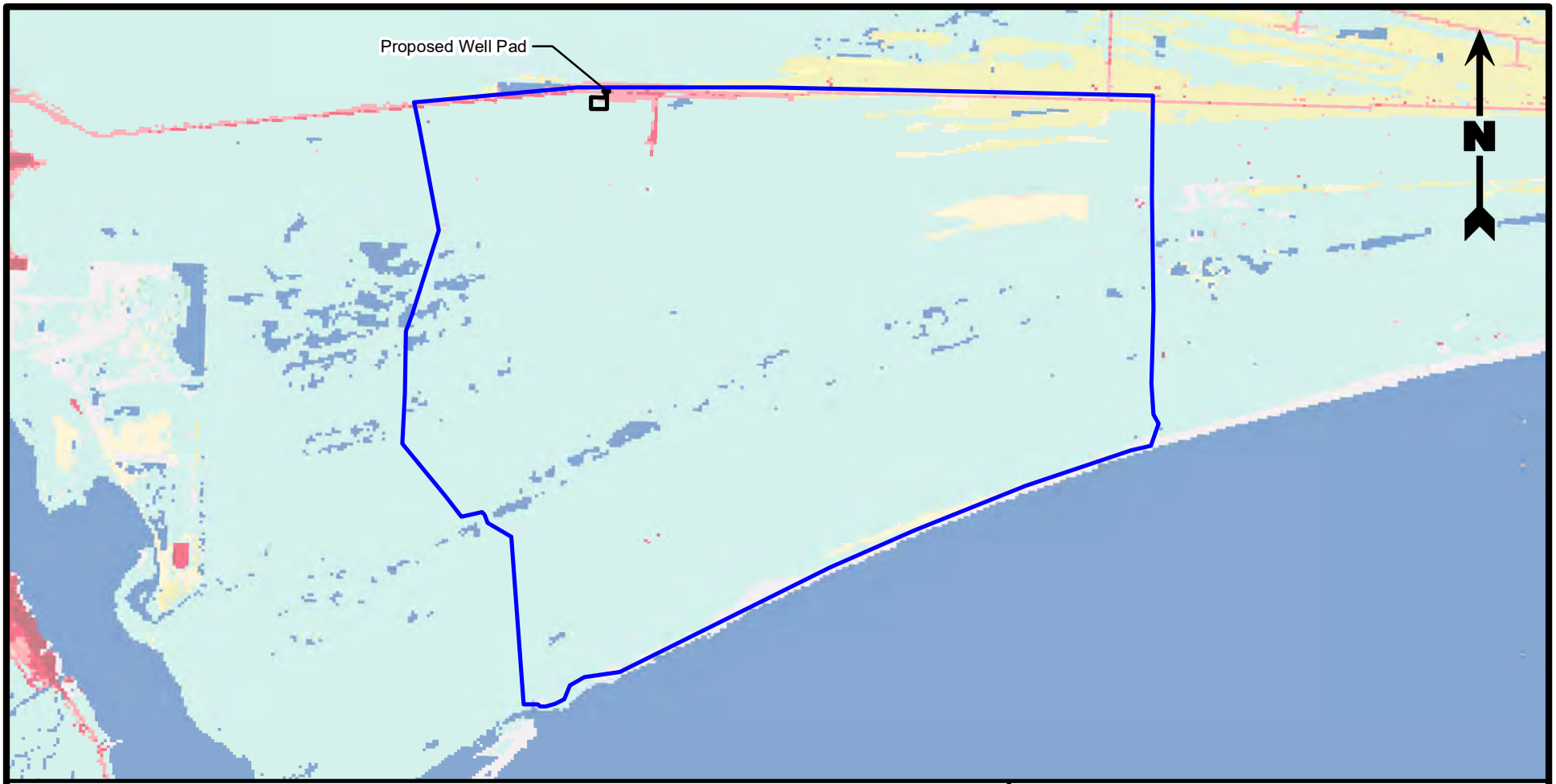
Drawing Number 1429-007-A051

4 Figure

FIGURE 5

LAND USE/LAND COVER MAP



Legend

- Study Area
- Barren Land
- Cultivated Crops
- Deciduous Forest
- Developed High Intensity
- Developed Low Intensity
- Developed Medium Intensity
- Developed Open Space
- Dwarf Scrub
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- Lichens
- Mixed Forest
- Moss
- Open Water
- Pasture/Hay
- Sedge/Herbaceous
- Shrub/Scrub
- Woody Wetlands

Reference

Land Use/Land Cover data comprised of ESRI USA NLCD Land Cover, exported 07/25/23.

5,000 2,500 0 5,000 Feet

Land Use/Land Cover Map

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

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Project Gumbo North

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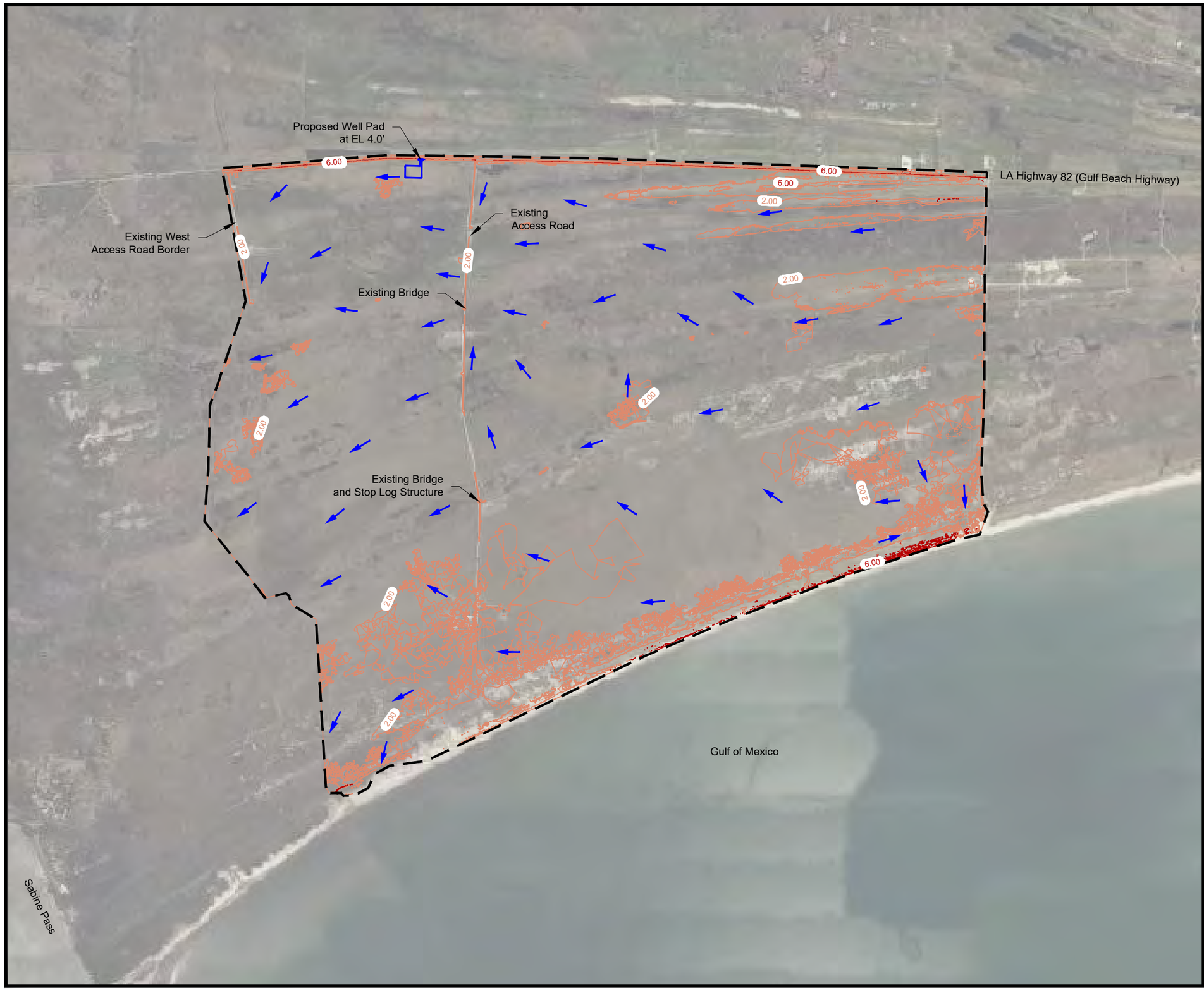
Drawing Number
1429-007-A066

5
Figure

FIGURE 6

PRE DEVELOPMENT WATER FLOW PATTERN



N

Legend

- Study Area
- Major Contour, FT (6' Intervals)
- Minor Contour, FT (2' Intervals)
- General Water Flow Direction

Reference

Base map comprised of Bing Maps Aerial Imagery (c) 2023 Microsoft Corporation and its data suppliers, exported 7/24/23. LiDAR contours derived from USGS 2017 DEM data titled LA Chenier Plain.

3,000 0 3,000

Scale: 1" = 3,000'

Pre-Development Water Flow Pattern

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

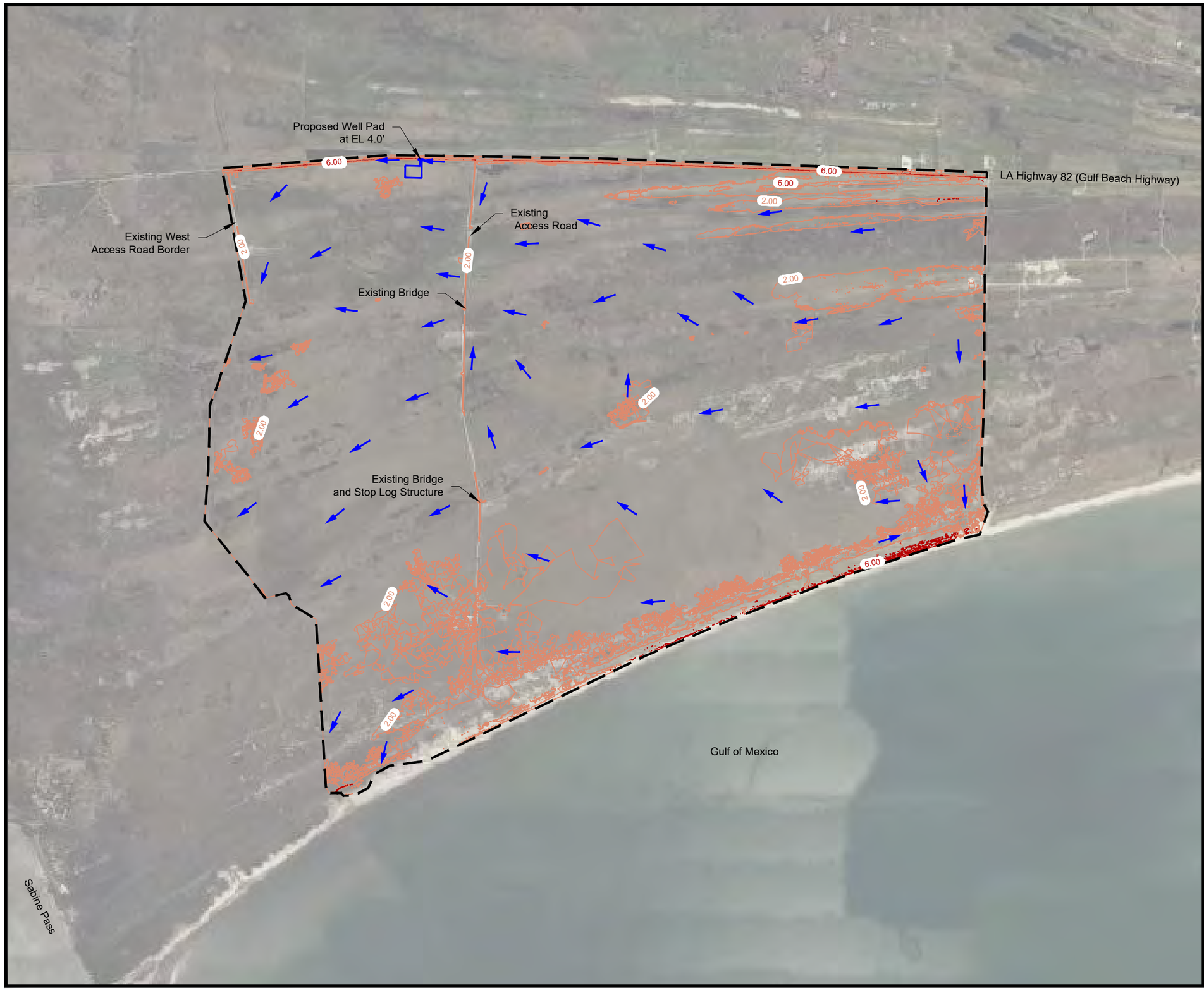
Project Number 1429-007

Drawing Number 1429-007-B052

6 Figure

FIGURE 7

POST DEVELOPMENT WATER FLOW PATTERN



N

Legend

- Study Area
- Major Contour, FT (6' Intervals)
- Minor Contour, FT (2' Intervals)
- General Water Flow Direction

Reference

Base map comprised of Bing Maps Aerial Imagery (c) 2023 Microsoft Corporation and its data suppliers, exported 7/24/23. LiDAR contours derived from USGS 2017 DEM data titled LA Chenier Plain.

3,000 0 3,000

Scale: 1" = 3,000'

Post-Development Water Flow Pattern

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

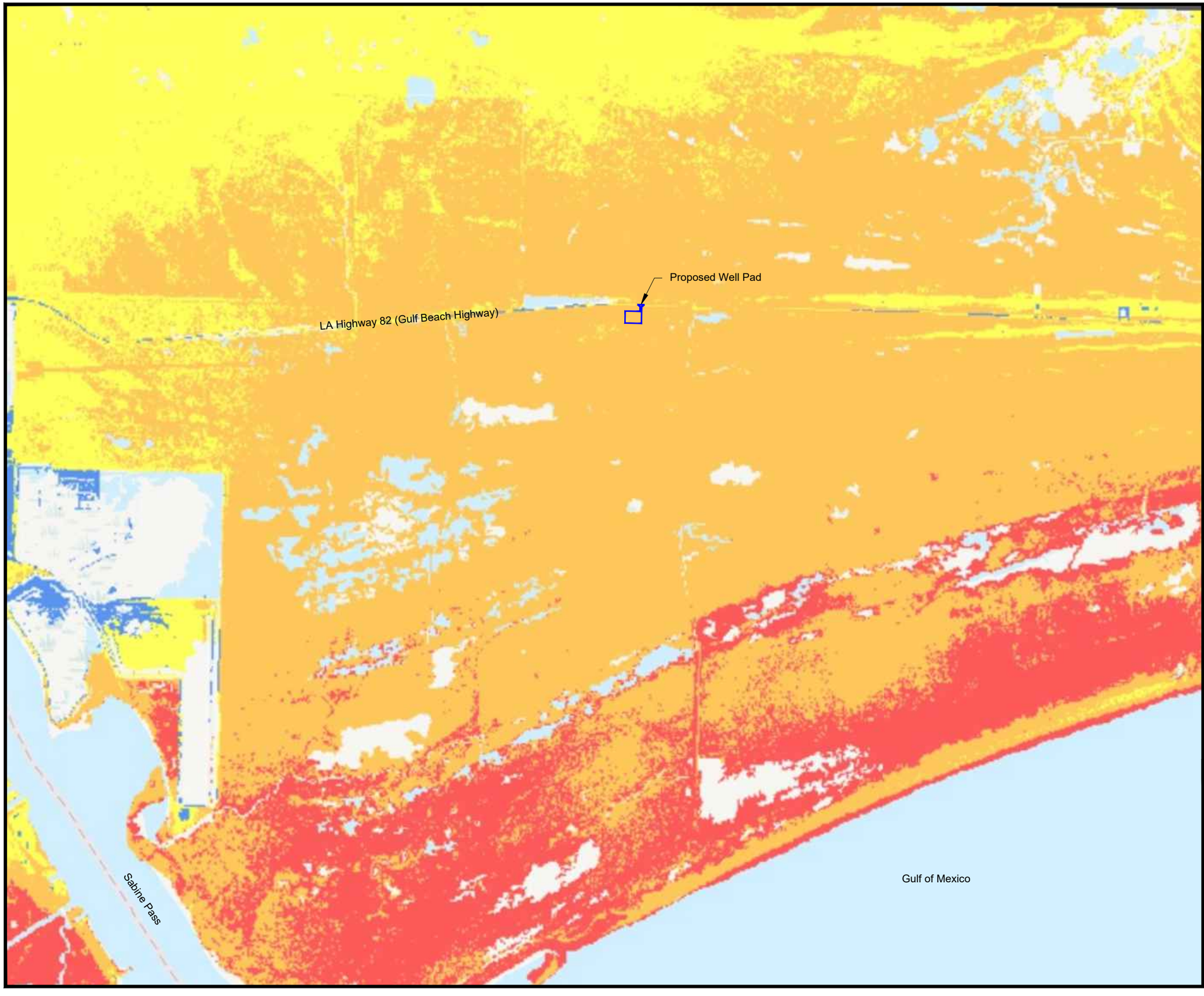
Project Number 1429-007

Drawing Number 1429-007-B054

7 Figure

FIGURE 8

STORM SURGE RISK MAP



N

Legend

- Less Than 3' Above Ground
- Greater Than 3' Above Ground
- Greater Than 6' Above Ground
- Greater Than 9' Above Ground

Reference

Storm surge risk map exported from NOAA 's online National Hurricane Center Storm Surge Risk Maps on 07/26/23 for a category 1 hurricane.

3,000 0 3,000

Scale: 1" = 3,000'

Storm Surge Risk Map

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

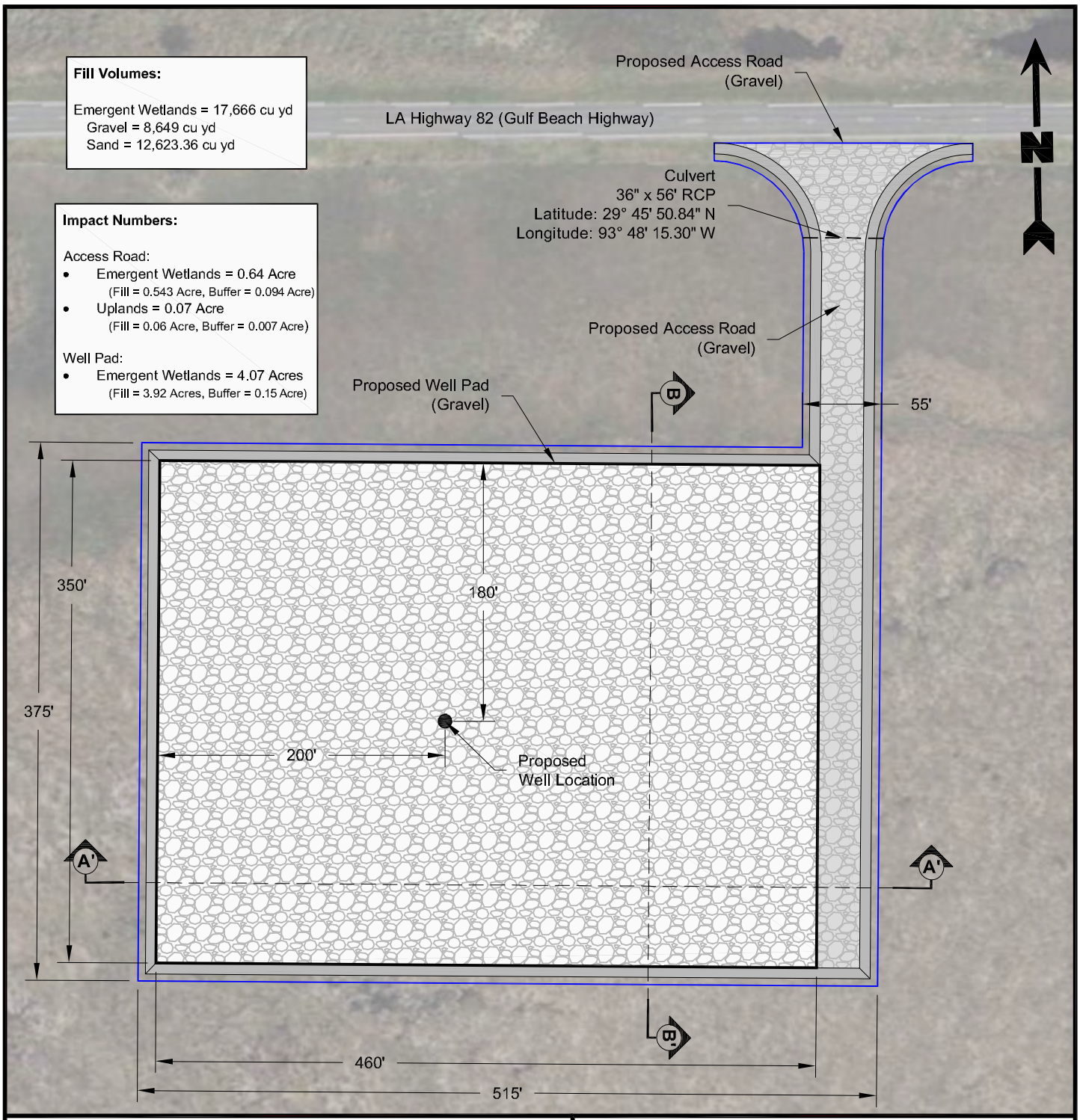
Project Number 1429-007

Drawing Number 1429-007-B065

8 Figure

FIGURE 9

SITE PLAN



100 0 100

Scale: 1" = 100'

Legend

Proposed Project Area / Limits of Clearing (4.78 Acres)

Proposed Well Pad

Proposed Access Road

Side Slope

Note

All coordinates shown are referenced to geographic coordinate system (NAD83).

Reference

Base map comprised of Bing Maps aerial imagery from (c) 2023 Microsoft Corporation and its data suppliers, exported 09/25/23.

Site Plan

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

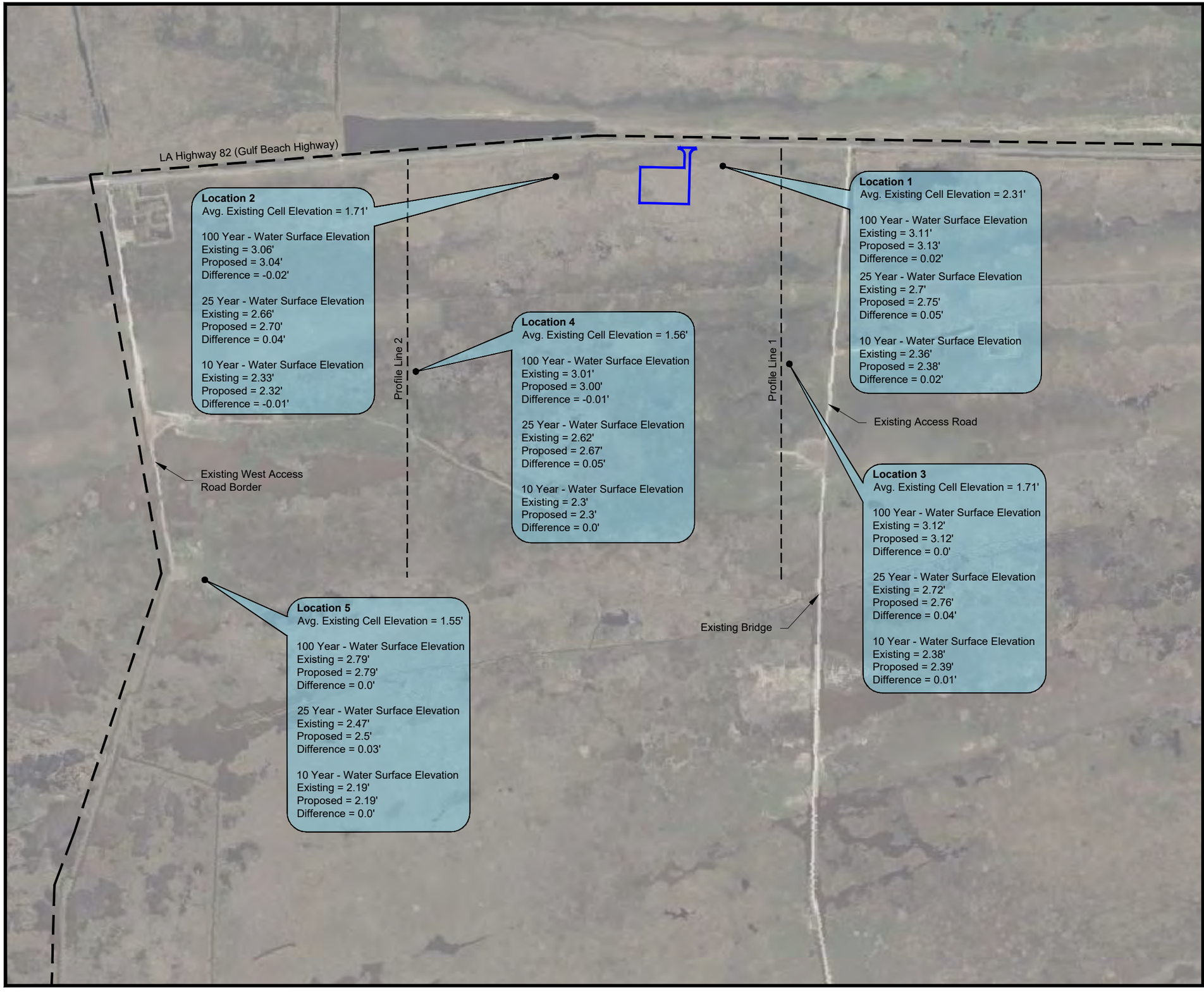
Project Number
1429-007

Drawing Number
1429-007-A056

9
Figure

FIGURE 10

CRITICAL POINTS OF INTEREST MAP



N

Legend

- Study Area
- Proposed Well Pad

Note

Elevations are referenced to North American Vertical Datum 1988 (NAVD88).

Reference

Base map comprised of Bing Maps Aerial Imagery (c) 2023 Microsoft Corporation and its data suppliers, exported 7/24/23.

1,000 0 1,000

Scale: 1" = 1,000'

Critical Points of Intrest

HMIA Report
Johnson Bayou, Cameron Parish, Louisiana

ConocoPhillips Company
Project Gumbo North

PROVIDENCE

Drawn By	LMM	09/25/23
Checked By	LMH	09/25/23
Approved By	IMS	09/25/23

Project Number 1429-007

Drawing Number 1429-007-B064

10 Figure

ATTACHMENT 1

FEMA FIRM MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Louisiana State Plane south zone (FIPSZONE 1702). The **horizontal datum** was NAD83, GRS1980 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 jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.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

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from multiple sources between 2006 and 2011, including the Louisiana Geological Survey, the Louisiana Oil Spill Coordinator's Office (LOSCO), the US Census Bureau, the National Geodetic Survey, the US Fish and Wildlife Service, and the US Geological Survey.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

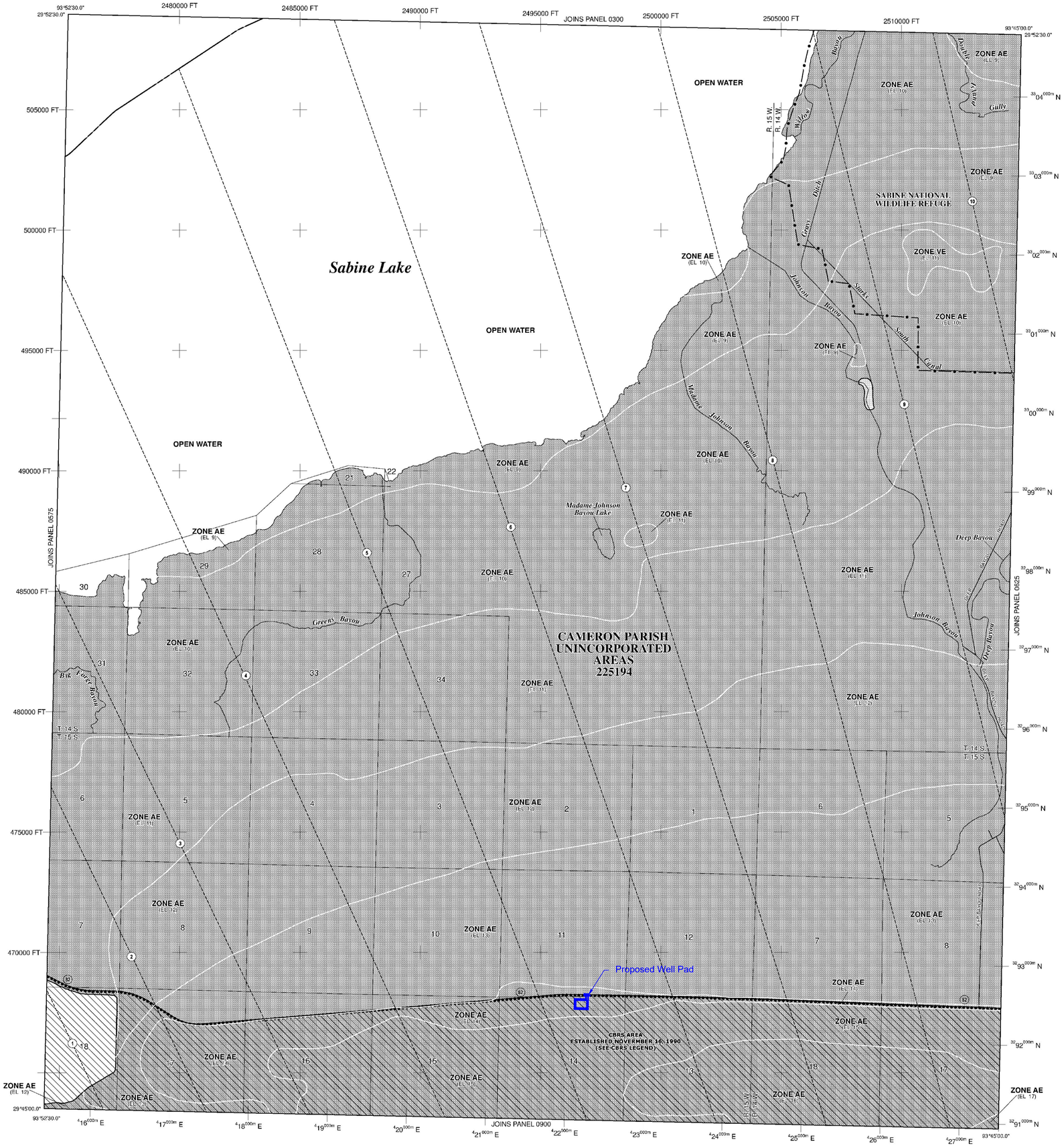
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the **FEMA Map Service Center** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the **FEMA Map Service Center** website or by calling the FEMA Map Information eXchange.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) LEGEND

11-16-1990 CBRS Area
FLOOD INSURANCE NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER NOVEMBER 16, 1990, IN DESIGNATED CBRS AREAS.

Boundaries of the John H. Chafee Coastal Barrier Resources System (CBRS) shown on this FIRM were transferred from the official CBRS source map(s) for this area and are depicted on this FIRM for informational purposes only. The official CBRS maps are enacted by Congress via the Coastal Barrier Resources Act, as amended, and maintained by the U.S. Fish and Wildlife (FWS). The official CBRS maps used to determine whether or not an area is located within the CBRS are available for download at http://www.fws.gov. For an official determination of whether or not an area is located within the CBRS, or for any questions regarding the CBRS, please contact the FWS field office for this area at (703) 358-2161.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referred to the North American Vertical Datum of 1988 (NAVD 88)

- A-A — Cross section line
- 23-23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 15
- 6000000 FT — 5000-foot grid ticks: Louisiana State Plane coordinate system, south zone (FIPSZONE 1702), Lambert Conformal Conic
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
November 16, 2012
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0600H

FIRM
FLOOD INSURANCE RATE MAP
CAMERON PARISH, LOUISIANA

PANEL 600 OF 1275
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CAMERON PARISH	225194	0600	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
22023C0600H

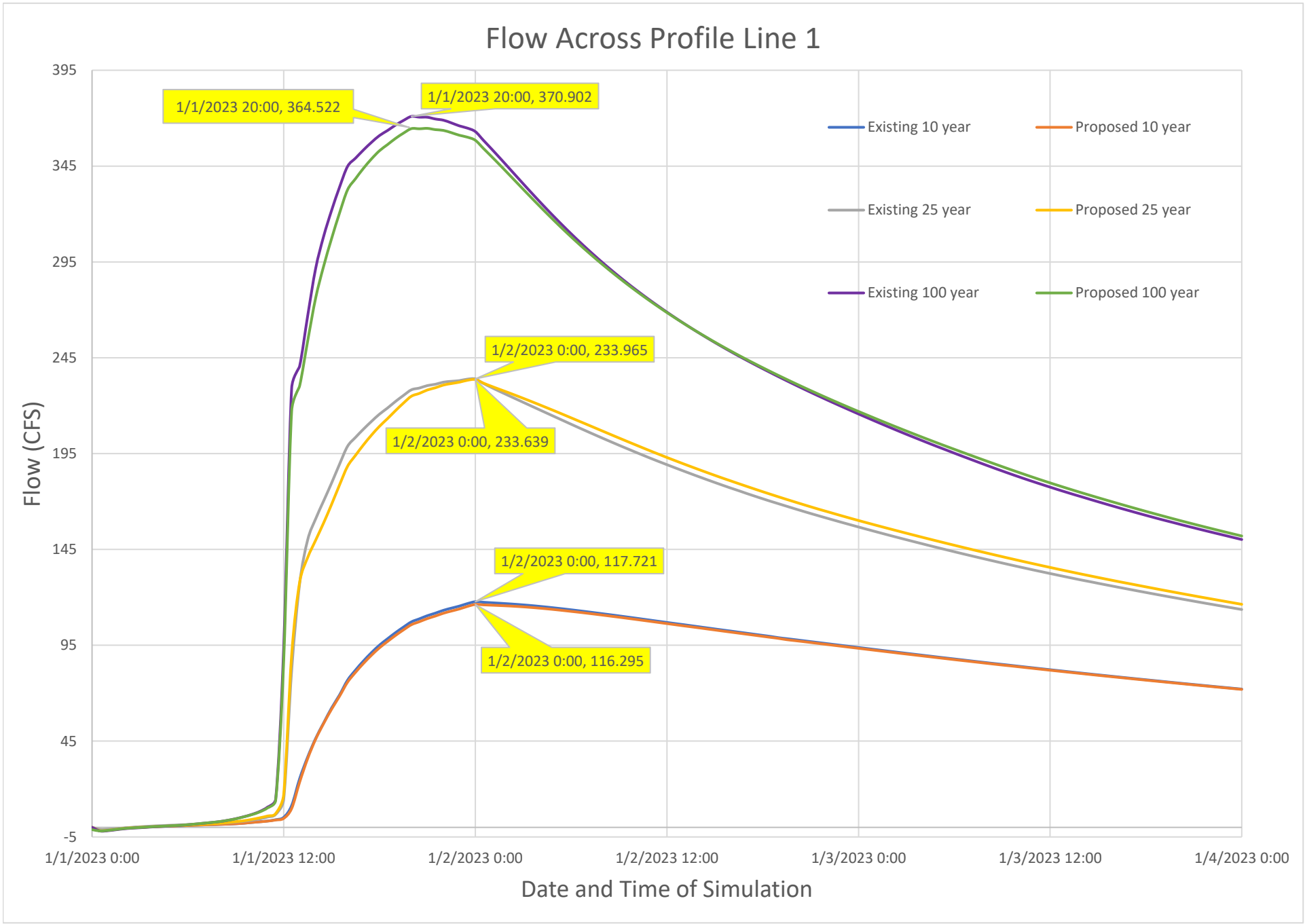
EFFECTIVE DATE
NOVEMBER 16, 2012

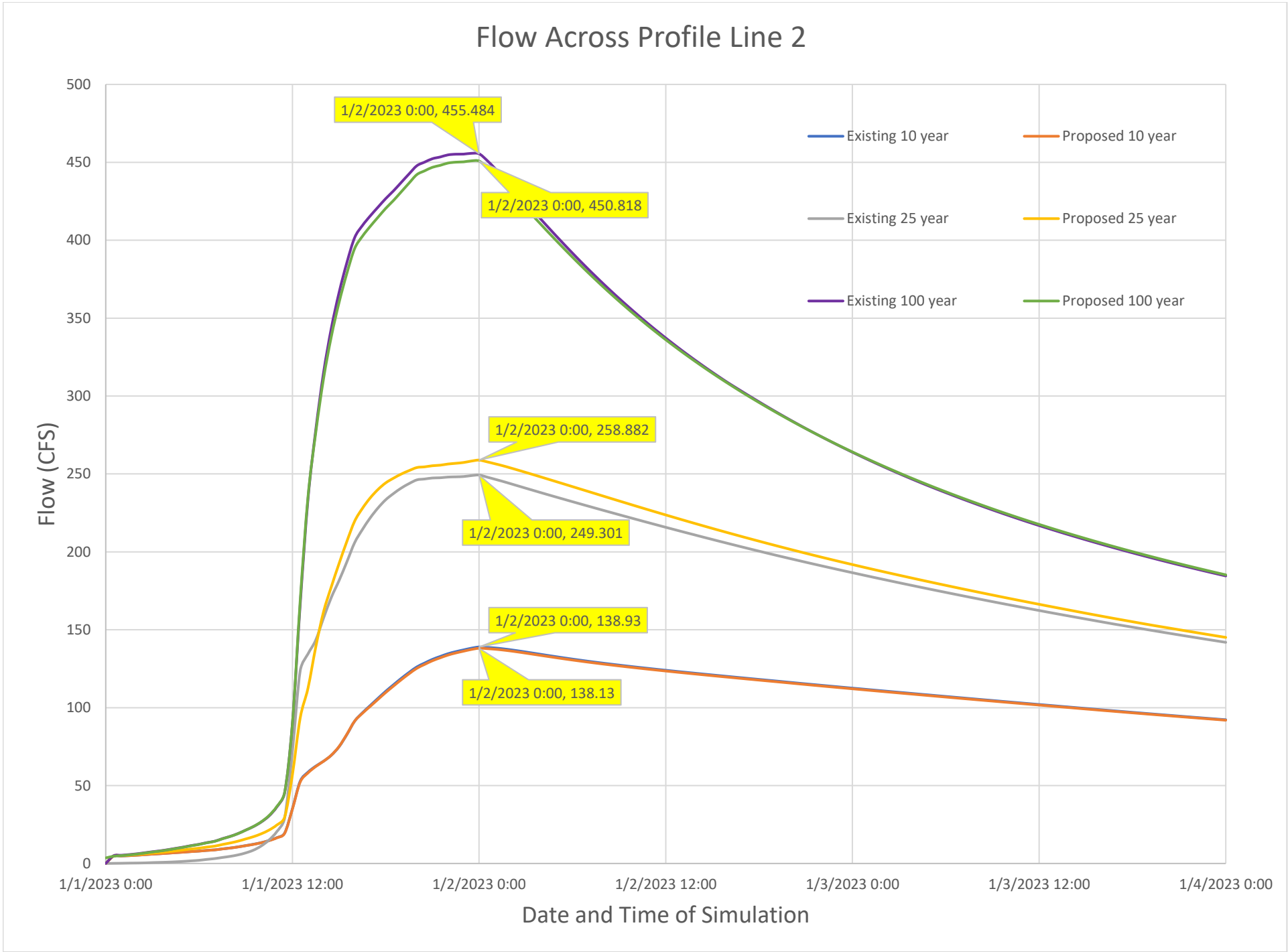
Federal Emergency Management Agency

1429-007-C079

ATTACHMENT 2

HEC-RAS PROFILE LINE FLOW OUTPUT GRAPHS


Flow Across Profile Line 1
395
345
295
245
195
145
95
45
-5
Flow (CFS)
1/1/2023 0:00
1/1/2023 12:00
1/2/2023 0:00
1/2/2023 12:00
1/3/2023 0:00
1/3/2023 12:00
1/4/2023 0:00
Date and Time of Simulation
1/1/2023 20:00, 364.522
1/1/2023 20:00, 370.902
1/2/2023 0:00, 233.965
1/2/2023 0:00, 233.639
1/2/2023 0:00, 117.721
1/2/2023 0:00, 116.295
Existing 10 year
Proposed 10 year
Existing 25 year
Proposed 25 year
Existing 100 year
Proposed 100 year


Flow Across Profile Line 2
Flow (CFS)
500
450
400
350
300
250
200
150
100
50
0
1/1/2023 0:00
1/1/2023 12:00
1/2/2023 0:00
1/2/2023 12:00
1/3/2023 0:00
1/3/2023 12:00
1/4/2023 0:00
Date and Time of Simulation
1/2/2023 0:00, 455.484
1/2/2023 0:00, 450.818
1/2/2023 0:00, 258.882
1/2/2023 0:00, 249.301
1/2/2023 0:00, 138.93
1/2/2023 0:00, 138.13
Existing 10 year
Proposed 10 year
Existing 25 year
Proposed 25 year
Existing 100 year
Proposed 100 year