Mississippi River Valley Division,
Regional Planning and Environment Division South

Port of Rosedale Feasibility Study

Appendix B - Engineering

April 2024

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Section 1
General

1.1 PURPOSE

This Engineering Appendix presents the design assumptions and assessment of alternatives for improvement of navigation capacity in the Port of Rosedale located in Rosedale, MS near river mile 584 on the Mississippi River. The purpose of this Engineering Appendix is to document the methodology used and results of the engineering performed in order to establish project alternative measures and recommendations that would meet the project needs of the Government and the local sponsor.

Section 2
Engineering

2.1 EXISTING DATA

Two primary data sources were utilized to construct an existing ground terrain surface for cutting cross sections and visualizing the existing site conditions: aerial LiDAR and the most recent hydrographic survey of the harbor. The aerial LiDAR dataset that was selected was collected by the USACE Vicksburg District in 2009. While somewhat dated, the data is high density and has been very reliable in recent experience if no major construction activities have taken place in the area of interest since the data was collected. No such construction has occurred in the vicinity of the Port of Rosedale Harbor. The hydrographic survey that was used was collected by the USACE Vicksburg District River Operations Branch prior to maintenance dredging of the Harbor in 2019. Given the dynamic nature of sedimentation in the Mississippi River, these two data sources were selected as they would provide a reasonable basis for determining rough order of magnitude quantities and visualization for the purposes of this study.

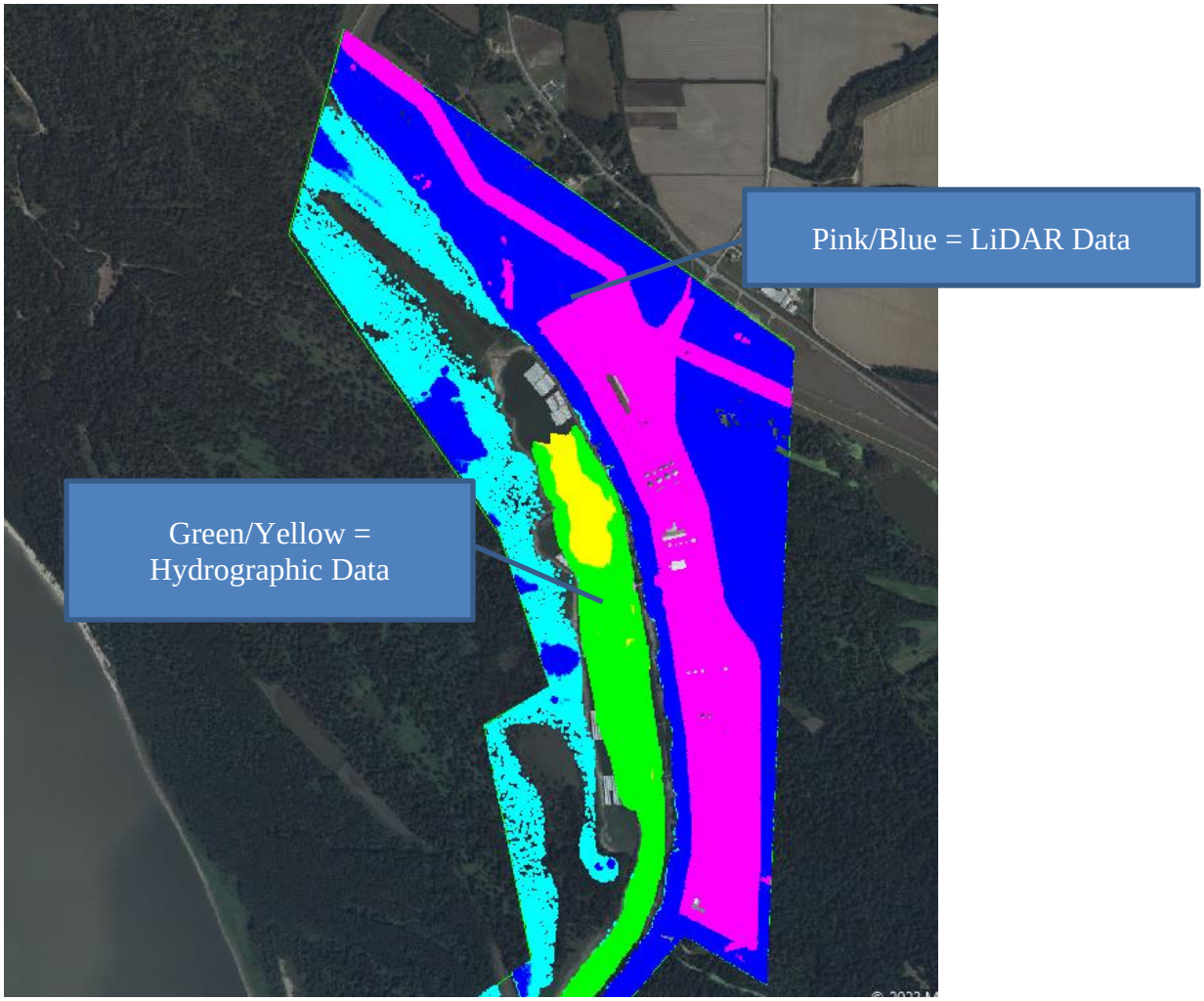


Figure 2.1 LiDAR Data

As can be seen in the figure above, due to differing water surface elevations at the times of the data collection, a gap in the data of varying distance exists at the top bank. To increase the resolution and accuracy of the combined existing surface, Google Earth's historical imagery feature was used to trace the contour of the water surface elevation from different dates of photography, and river stage data from RiverGages.com was used to correlate those contours to respective elevations. The contours were then merged into the existing ground data using Autodesk's Civil3D to improve triangulation of the final surface and better approximate the existing conditions.

Figure 2.2 Contour Elevation 130

Figure 2.3 Contour Elevation 122

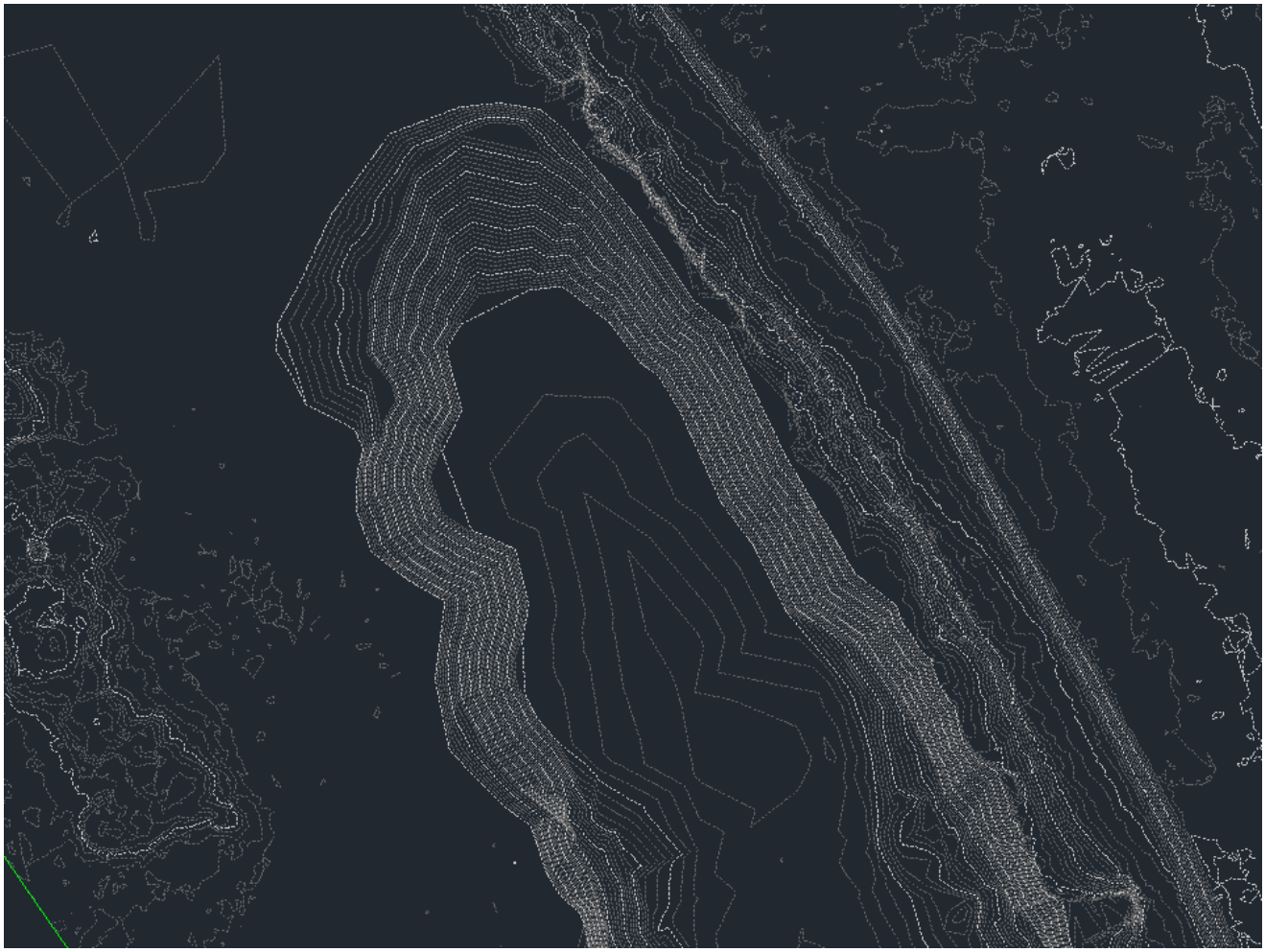


Figure 2.4 Modified Existing Contours

2.2 CLIMATE CHANGE ASSESSMENT

2.2.1 Background

Recent scientific evidence shows that in some places and for some impacts relevant to USACE operations, climate change is shifting the climatological baseline about which that natural climate variability occurs and may be changing the range of that variability as well. This is relevant to USACE because the assumptions of stationary climatic baselines and fixed range of natural variability, as captured in the historic hydrologic record, may no longer be appropriate for long-term projections of flood risk.

Climate Change impacts on hydrology of the Port of Rosedale in Bolivar County, MS were evaluated in accordance with USACE Engineering and Construction Bulletin 2018-14, *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs and Projects* (Reference 1), and USACE Engineering Technical Letter 1100-2-3 *Guidance for Detection of Nonstationarities in Annual Maximum Discharges* (Reference 2).

The USACE's current policy is to interpret and use climate change information for hydrologic analysis through a qualitative assessment of potential climate change threats and impacts relevant to the USACE project for which the hydrologic analysis is being performed. Qualitative analysis required includes consideration of both past (observed) changes as well as potential future (projected) changes to relevant hydrologic inputs.

2.2.2 Literature Review

A literature synopsis was generated to summarize published conclusions regarding both natural and anthropogenic climate trends in the Lower Mississippi River Basin.

USACE Climate Change Hydrology Literature Applicable to US Army Corps of Engineers Missions – Lower Mississippi Region 08 (Reference 3)

The USACE Climate Change and Hydrology Literature Synthesis for Lower Mississippi Region 08 summarized the climate change literature for the region regarding observed temperature, precipitation, and hydrology and projected temperature, precipitation, and hydrology.

- Summary of observed temperature: no significant trend in observed mean air temperature, though extreme minimum daily air temperature may be increasing.
- Summary of observed precipitation: a mild upward trend in precipitation has been identified by multiple authors but a clear consensus is lacking.
- Summary of observed hydrology: a mild upward trend in mean streamflow has been identified by multiple authors but a clear consensus is lacking.
- Summary of projected temperature: strong consensus exists that projected temperature shows a sharp increasing trend over the next century.
- Summary of projected precipitation: little consensus exists with respect to projected trends in future precipitation.
- Summary of projected hydrology: although consensus is lacking, a small number of reviewed studies indicate a mild decreasing trend in streamflow through the next century.

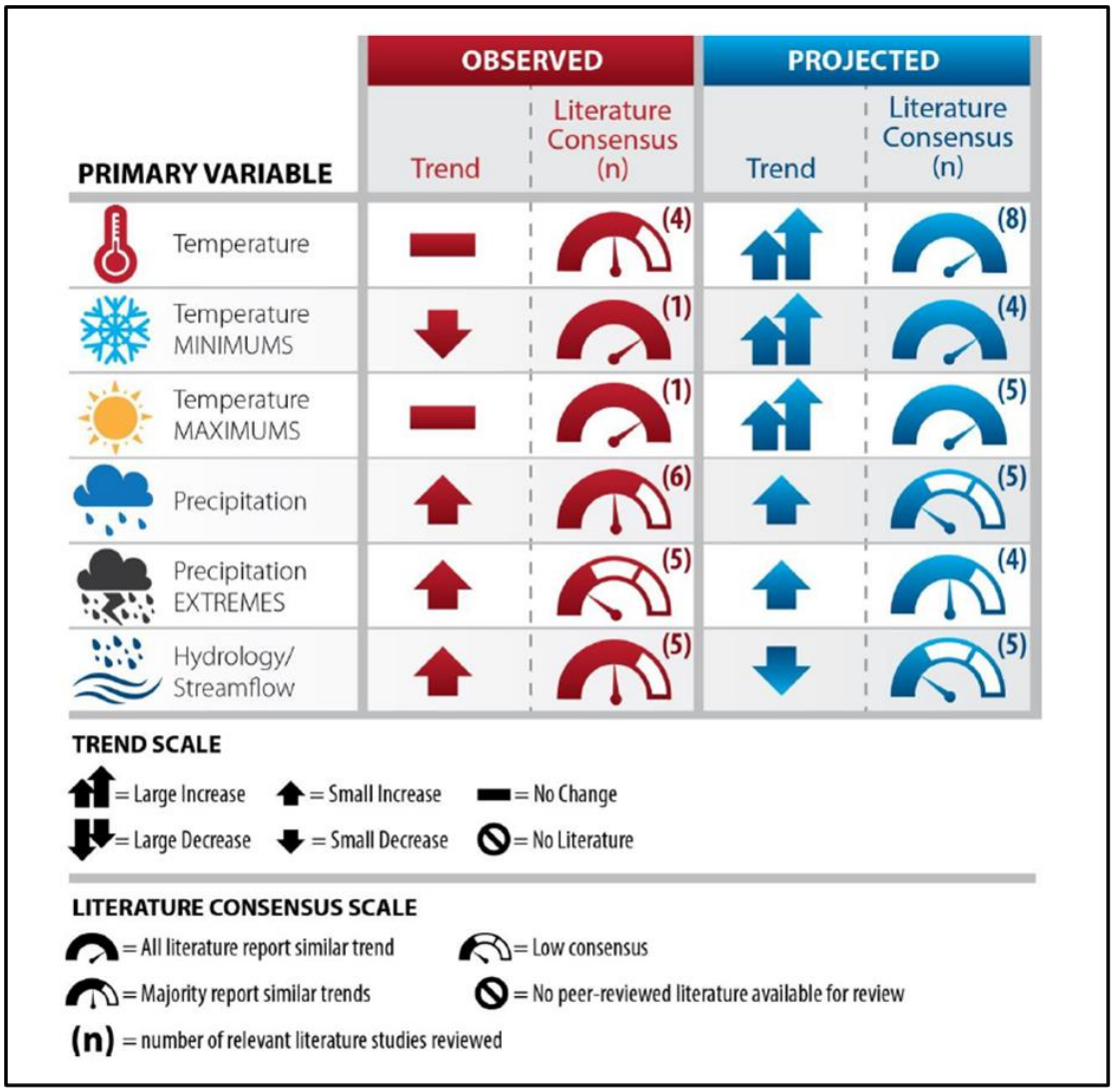


Figure 2.5 Summary of Climate Literature Consensus for Lower Mississippi Region 08 (Reference 3)

USGS Flood Trends Report: Fragmented patterns of flood change across the United States (Reference 4)

The USGS conducted a study to characterize the behavior of flood change across the United States. Regarding trends in peak magnitude, frequency, duration, and volume of frequent floods, half of the streamgages in this study showed no statistically significant change. Meaningful generalizations about these trends show no geographical cohesion.

Grid cells containing multiple streamgages were used for regional trend calculations. The grid cell that encompasses the Port of Rosedale was shown to have no statistically significant trend for flood frequency, peak magnitude, duration, or volume. None of the surrounding cells showed a consistent significant trend in any of the flood measurements.

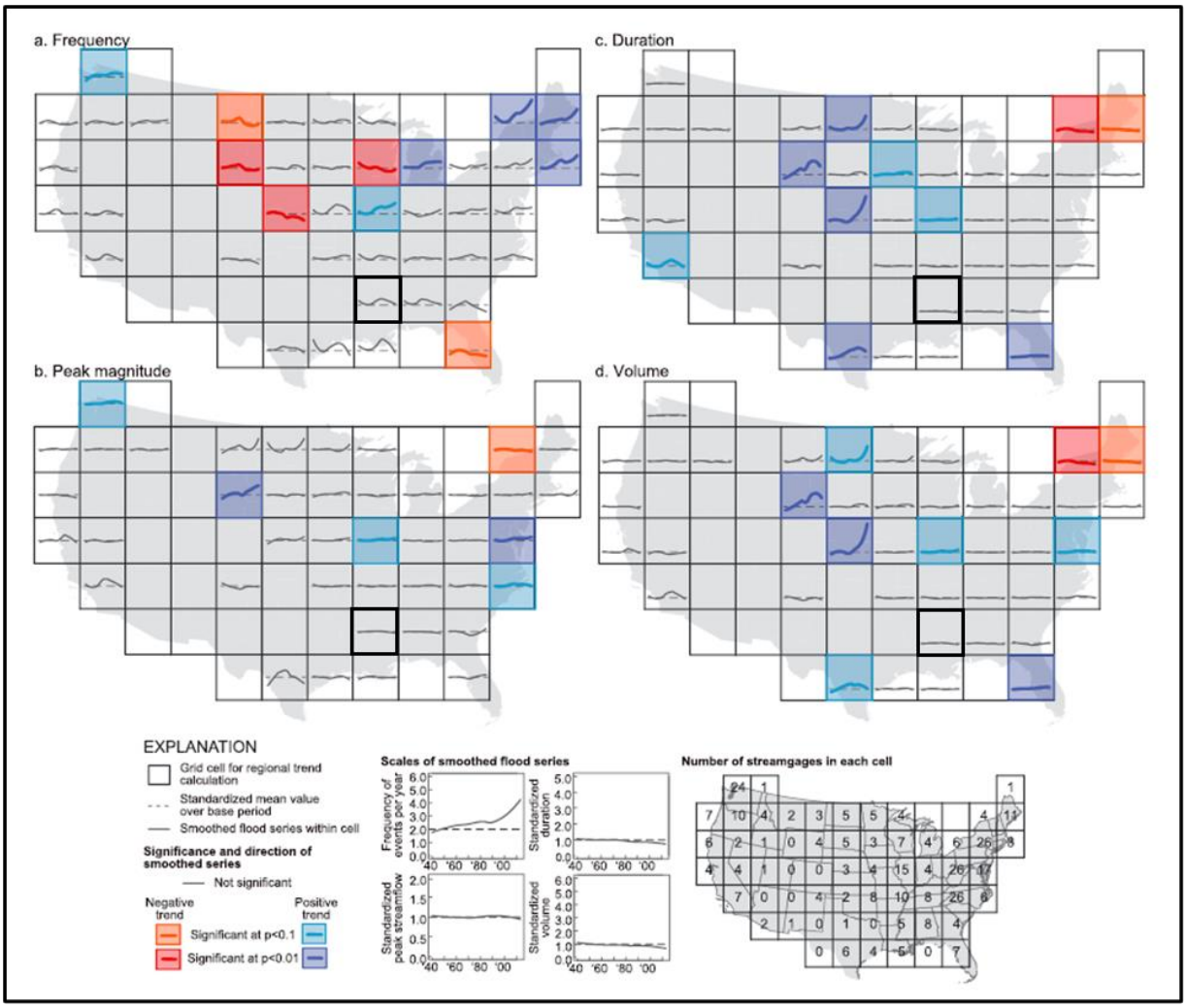


Figure 2.6 Regional Changes in Floods Across the United States (1940-1969 vs 1970-2013) (Reference 4)

Climate Change Impacts in the United States: The Fifth National Climate Assessment – Chapter 22: Southeast (Reference 5)

The Fifth National Climate Assessment, released in November 2023, assessed climate impacts across the different regions of the United States. The Port of Rosedale is located within the Southeast region for the National Climate Assessment.

The Fifth National Climate Assessment indicated that temperatures have been rising faster in the US compared to the global average. Higher latitudes are warming faster than the lower latitudes, as seen in Figure 2.7. The Southeast region of the US is closer to the global average of projected changes in global warming with six more days above 100°F each year.

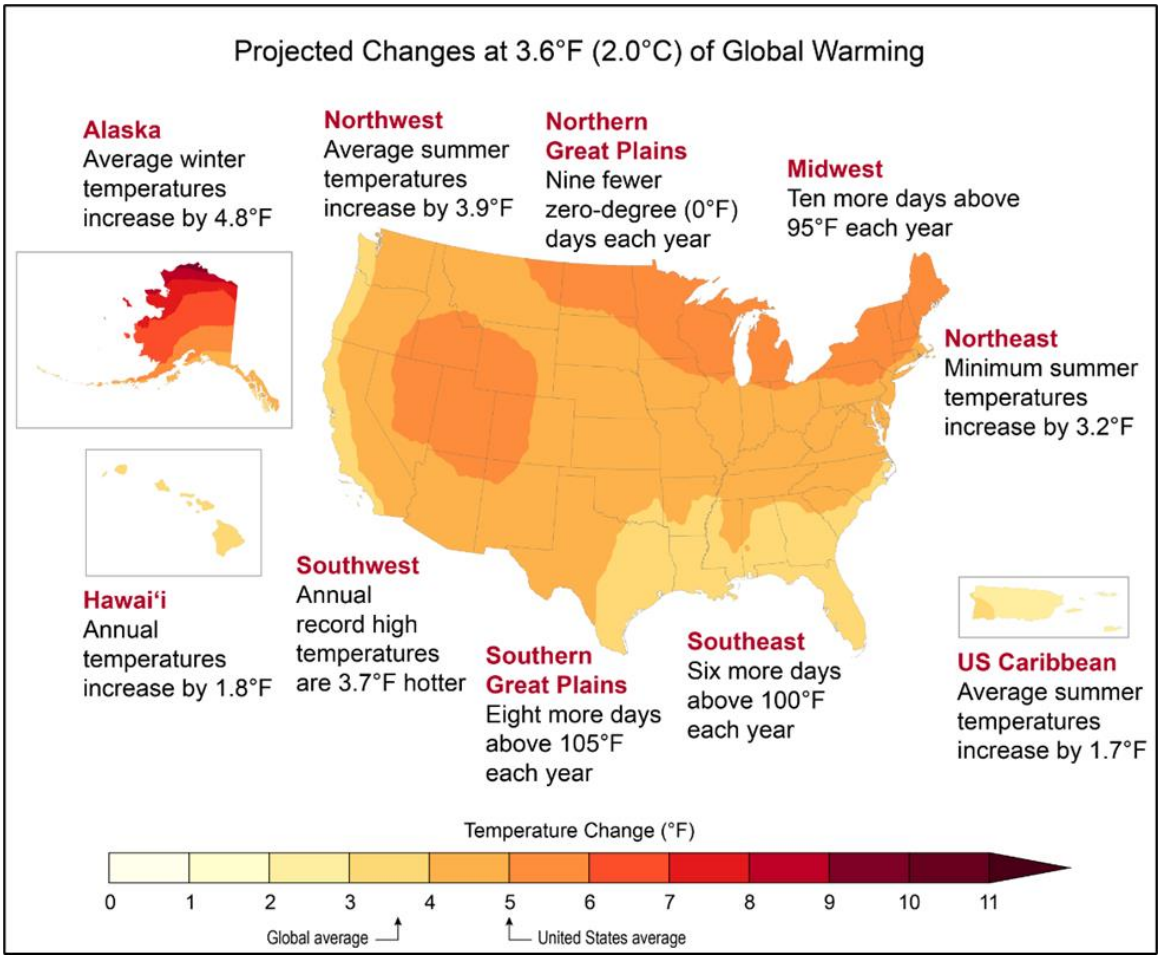


Figure 2.7 What 3.6°F (2°C) of global warming would feel like in the United States (Reference 5)

Mississippi State Climate Summaries 2022, NOAA National Centers for Environmental Information (Reference 6)

The NOAA 2022 Mississippi State Climate Summary is used to assess trends in local climate. The average annual temperature in Mississippi has risen by about 0.1°F since the beginning of the 20th century with the warmest consecutive 5-year interval being between 2016-2020. These higher temperatures could increase the intensity of naturally occurring droughts. Extreme precipitation events are projected to increase in frequency and intensity. There is also potential for a rise in sea level. This could result in higher storm surge and disappearing barrier islands.

2.2.3 Vulnerability Assessment: Existing Conditions and Future Without Project Conditions

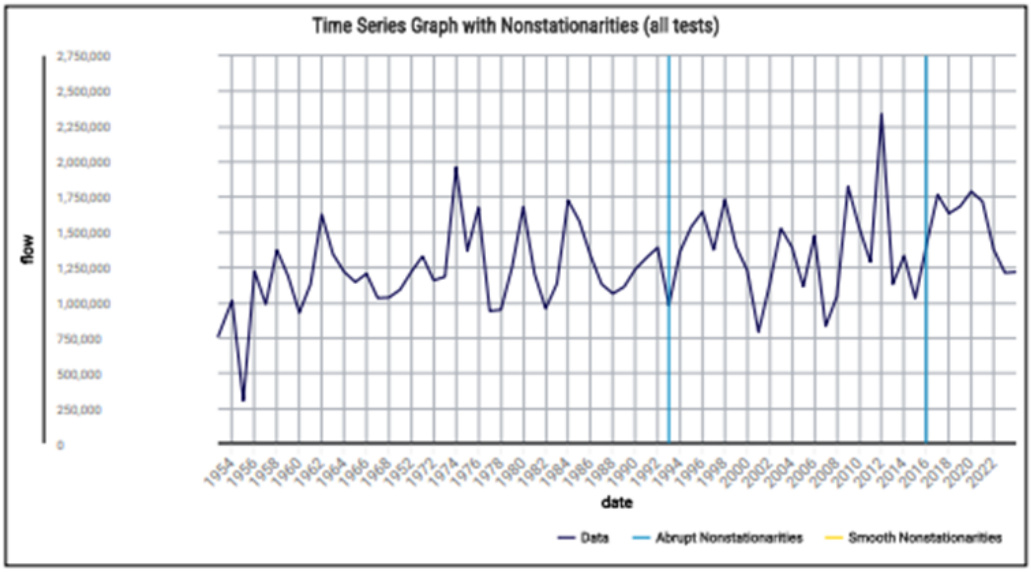
This portion of the climate change assessment focuses on carrying out first order statistical analysis using streamflow records observed at the USGS gage on the Mississippi River at Arkansas City, AR. This gage is roughly 27.5 river miles downstream of the project location.

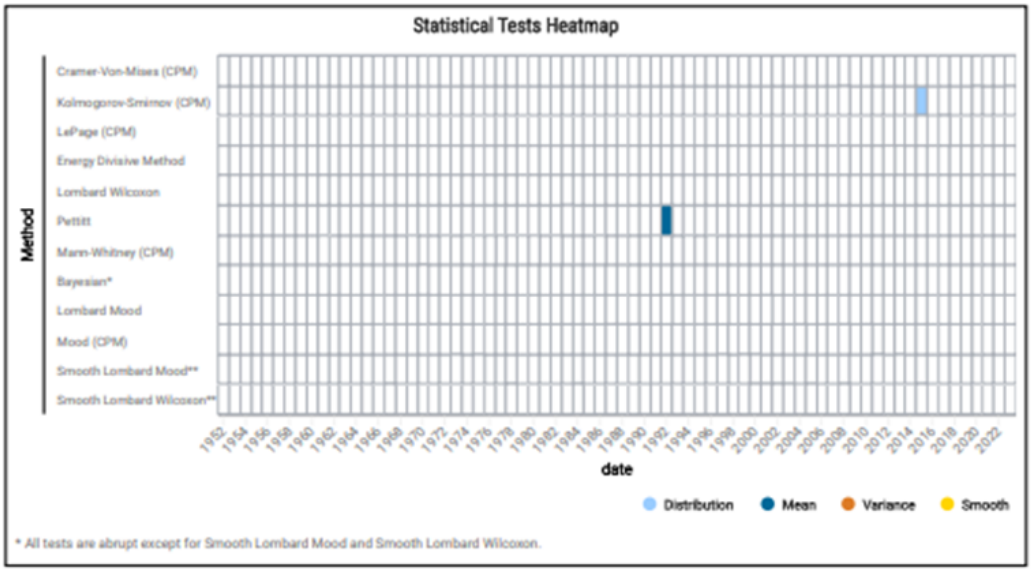
Detection of Nonstationarities in Observed Streamflow Records (Reference 7)

The USACE Nonstationarity Detection Tool determines whether flows recorded on the Mississippi River near the Port of Rosedale are representative of stationary hydroclimatic conditions. Stationary hydroclimatic conditions refer to flow datasets which have statistical characteristics that are unchanging. Changes in the statistical characteristics of stream flow can be caused by anthropogenic climate change, long-term natural fluctuations in climate, changes in water management, changes to land use, changes in land cover, and changes in the channel. The tool only notifies the user of a detected nonstationarity. It does not attribute a detected nonstationarity to one of the above changes.

The statistical methods applied by the Nonstationarity Detection Tool utilized the water year maximum streamflow dataset at the Mississippi River at Arkansas City, AR gage (USGS gage 07265450). Nonparametric statistical tests utilized the observed flow record of this long-term gage site. The Arkansas City, AR gage has a period of record from 1952 to the present year (the Nonstationarity Detection Tool only used data up to 2023). The Arkansas City, AR gage is located approximately 27.5 miles downstream from the project location at the Port of Rosedale.

Figure 2.8 shows the output of the tool for the Arkansas City, AR gage, with one test identifying a mean changepoint in 1992 and one test identifying a distribution changepoint in 2015. The nonstationarity in 1992 indicates an increase in mean flow that continues steadily through the remaining duration of the dataset. Even with the increase in mean at the changepoint in 1992, both nonstationarities are considered nonsignificant due to lack of robustness. Robustness is achieved when tests targeting changes in two or more different statistical properties indicate the same nonstationarity.


Time Series Graph with Nonstationarities (all tests)
flow
date
Data
Abrupt Nonstationarities
Smooth Nonstationarities


Statistical Tests Heatmap
Method
Cramer-Von-Mises (CPM)
Kolmogorov-Smirnov (CPM)
LePage (CPM)
Energy Divisive Method
Lombard Wilcoxon
Pettitt
Mann-Whitney (CPM)
Bayesian*
Lombard Mood
Mood (CPM)
Smooth Lombard Mood**
Smooth Lombard Wilcoxon**
date
Distribution
Mean
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* All tests are abrupt except for Smooth Lombard Mood and Smooth Lombard Wilcoxon.

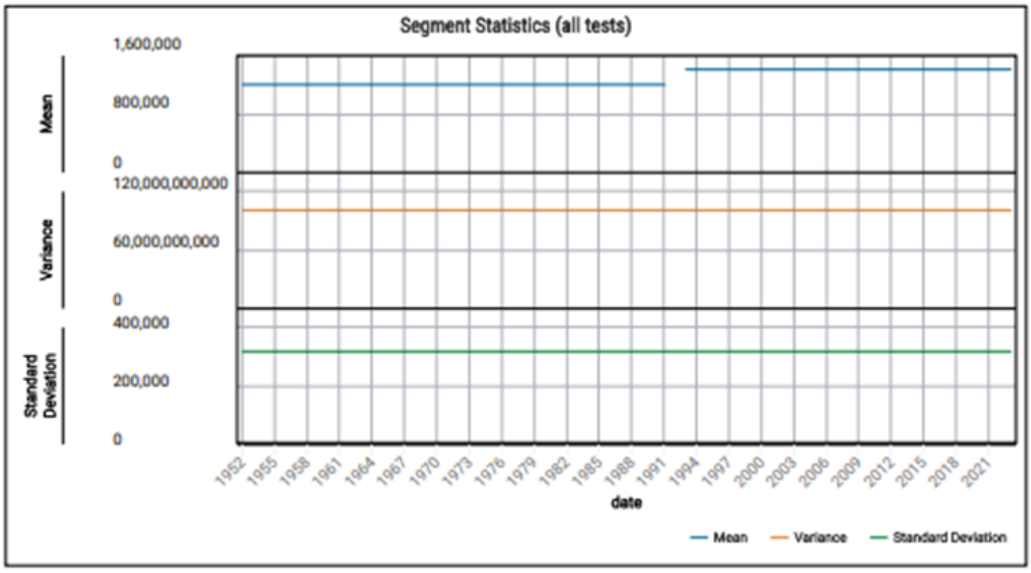

Segment Statistics (all tests)
Mean
Variance
Standard Deviation
date
Mean
Variance
Standard Deviation

Figure 2.8 Nonstationarity Analysis of Maximum Water Year Flow, USGS gage 07265450 Mississippi River at Arkansas City, AR (Reference 7)

Climate Hydrology Assessment using Observed Data (Reference 8)

The Climate Hydrology Assessment Tool (CHAT) creates annual streamflow visual outputs and performs simulated trend analysis for both historic and future periods. The CHAT includes robustness metrics to help assess whether the predicted future trend is significant relative to the historical variability. Projected hydroclimate time series in the CHAT for 2006 to 2099 are produced using two future scenarios: RCP 4.5 (where greenhouse gas emissions stabilize by the end of the century) and RCP 8.5 (where greenhouse gas emissions continue to increase throughout the century). Simulated output representing the historic period of 1951 to 2005 is generated using a reconstitution of historic GHG emissions.

For the Lower Mississippi-Helena (HUC 08020100) watershed, trends in projected, annual maximum monthly streamflow are evaluated using the t-Test, Mann-Kendall, and Spearman Rank-Order tests. All three statistical tests are applied using a 0.05 level of significance (p-values<0.05 are considered statistically significant). The directionality and magnitude of change in statistically significant trends are evaluated using the slope of the fitted linear regression.

Projections in annual maximum mean monthly streamflow for HUC 08020100 (Lower Mississippi-Helena) are shown in Figure 2.9 for the historic period (1950-2006) and future period (2006-2099). The overall trend in the mean projected annual maximum monthly streamflow increases over time. This increase is statistically significant as the p-value is less than 0.05, as seen in Figure 2.10. This suggests there will be an increased chance of flood risk in the future for the Lower Mississippi-Helena watershed.

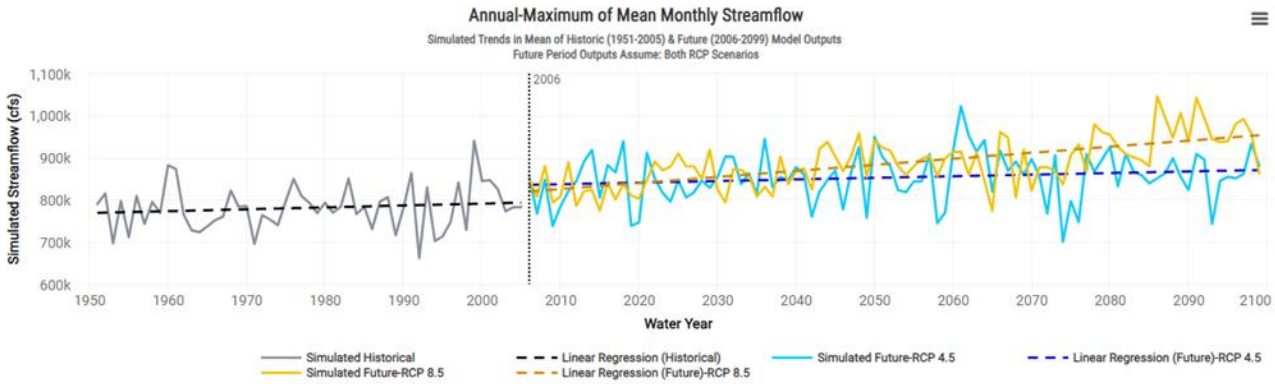
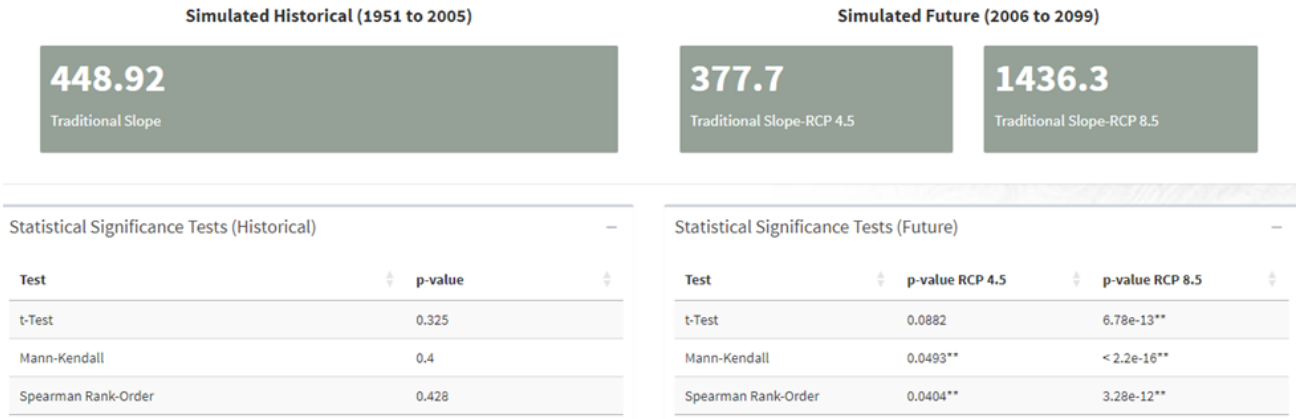


Figure 2.9 Trend Analysis of Average Model Output: Annual Maximum of Mean Monthly Streamflow (Lower Mississippi/ Helena HUC) (Reference 8)



Test	p-value
t-Test	0.325
Mann-Kendall	0.4
Spearman Rank-Order	0.428

Test	p-value RCP 4.5	p-value RCP 8.5
t-Test	0.0882	6.78e-13**
Mann-Kendall	0.0493**	< 2.2e-16**
Spearman Rank-Order	0.0404**	3.28e-12**

Figure 2.10 Statistical Significance Test: Annual Maximum of Mean Monthly Streamflow (Reference 8)

USACE Watershed Climate Vulnerability Assessment Tool (Reference 9)

The USACE Watershed Climate Vulnerability Assessment Tool (VA) facilitates a screening level, comparative assessment of the vulnerability of a given business line and a HUC-4 watershed to the impacts of climate change, relative to the other HUC-4 watersheds within the continental United States. It uses the Coupled Model Intercomparison Project (CMIP5) GCM-BCSD (Bias Corrected, Spatially Disaggregated) -VIC dataset to define projected hydrometeorological inputs, combined with other data types to define a series of indicator variables and a vulnerability score.

Vulnerabilities are represented by a weighted-order, weighted-average (WOWA) score generated for two epochs, one ranging from 2035 through 2065 and is centered on 2050 and the second ranging from 2070 through 2100 and is centered on 2085. The VA tool also determines exposure for two subsets of simulations, wet (top 50% of cumulative runoff projections) and dry (bottom 50% cumulative runoff projections). For this application, the tool was applied using its default, National Standards Settings. In the context of the VA tool, there is some uncertainty in all the inputs to the vulnerability assessments. Some of this uncertainty is reflected by the differences in results for each of the subset-epoch combinations.

As shown in Figure 2.11. the Lower Mississippi-St. Francis (HUC 0802) watershed is considered not relatively vulnerable to climate change impacts for the flood risk reduction business line for the four epoch-subset combinations. A watershed is considered relatively vulnerable to climate change impacts if it has a vulnerability score that falls within the top 20% of WOWA scores for a given business line in the CONUS (includes all 4-digit HUCs for flood risk management). Table 2.1 shows the dominant indicator contributing to the Lower Mississippi-St. Francis watershed's vulnerability score.

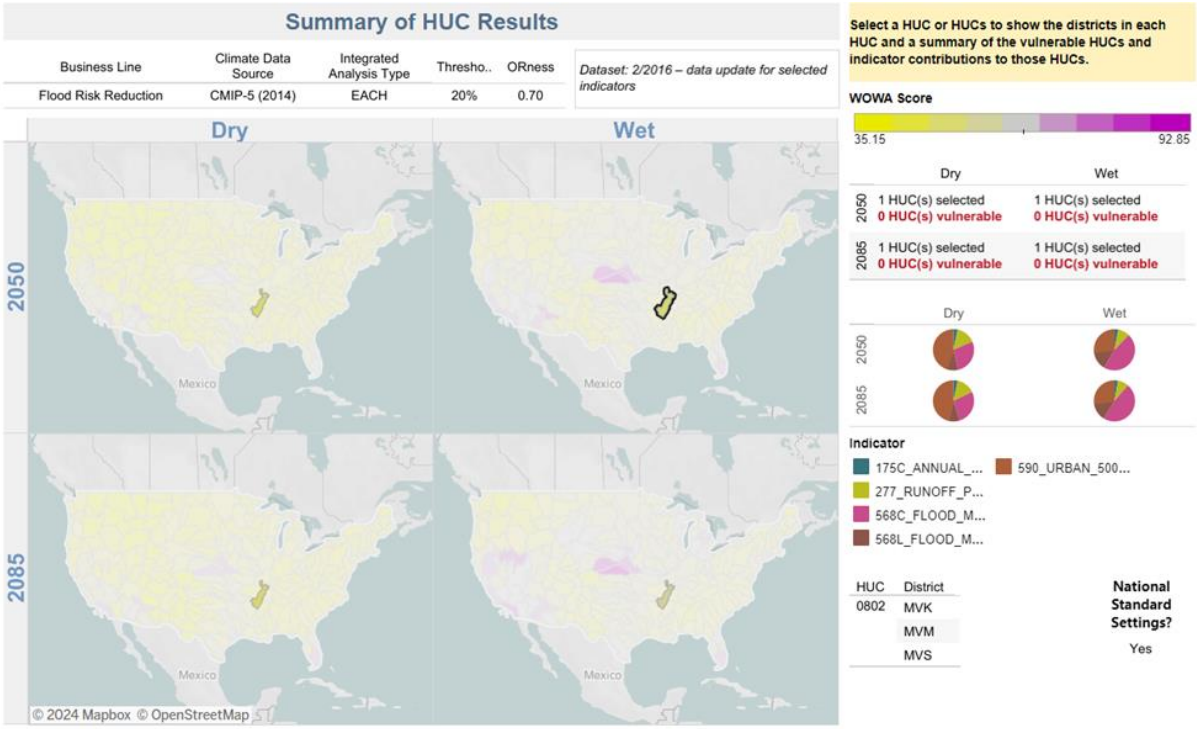


Figure 2.11 Summary of HUC Results from the USACE Watershed Climate Vulnerability Tool (Reference 9)

Table 2.1 VA Tool Output – Flood Risk Reduction Business Line (Reference 9)

Subset	Epoch	WOWA Score	Dominant Indicator
WET	2050	51.82	568C_FLOOD_MAGNIFICATION
	2085	55.54	568C_FLOOD_MAGNIFICATION
DRY	2050	49.04	590_URBAN_500YRFLOODPLAIN_AREA
	2085	51.15	590_URBAN_500YRFLOODPLAIN_AREA

2.2.4 Conclusions

Due to its location and proximity to the confluence of the Arkansas River with the Lower Mississippi River, the Port of Rosedale is a significant port of access to several major cities including Memphis, Houston, Birmingham, and Atlanta. The Rosedale-Bolivar County Port Commission identified navigation challenges and safety risks within the Port of Rosedale harbor. The channel is extremely narrow and dangerous to navigate, especially during the low water period of the year. This risk to navigation and the annual problem of sedimentation create extended barge traffic delays and navigation safety issues for barges moving through the port. To resolve these issues, the Port of Rosedale Expansion is proposing to widen and lengthen the entire channel, as well as to relocate and widen the turning basin.

In the literature reviewed, there was a consensus for an increase in temperature; however, the sources lacked a consensus with regard to precipitation and streamflow within the project area. There is evidence of two nonstationarities in the peak flow record in 1992 and 2015, however these were determined to be not statistically significant. CHAT based analysis of projected, annual maximum monthly streamflow time series for the watershed encompassing the project area indicates annual peak streamflow may increase in the future. The USACE VA Tool indicates that Flood Risk Reduction in the Lower Mississippi-St. Francis (HUC0802) is

not considered vulnerable to the impacts of climate change relative to other watersheds in the CONUS for most of the epoch/subset combinations.

Overall, the available literature and USACE Climate Assessment tools do not reach a clear consensus on observed and projected streamflow throughout the Lower Mississippi River Basin due to long-term persistent climate trends or anthropogenic climate change. However, there is some agreement that streamflow variability may increase. Table 2.2 summarizes the residual risk due to climate change for the Port of Rosedale project along with qualitative likelihood rating.

Table 2.2 Residual Risk Due to Climate Change at Port of Rosedale

Project Feature	Trigger	Hazard	Harm	Qualitative Likelihood Rating
New width/length of channel	Increased streamflow	Potential for increased sediment carrying capacity	Higher rate of sediment deposition within port requires more frequent dredging	Unlikely

Higher velocities in the Mississippi River could lead to a slight increase in the sediment carrying capacity, therefore increasing the deposition into the slack waters of the Port of Rosedale. To maintain proper navigation, the port could potentially require more frequent dredging. Due to the lack of consensus from the available literature and USACE Climate Assessment tools, this risk was determined to be unlikely.

2.3 HYDRAULICS

As this is a slack water harbor with no significant inflow from creeks or streams, this work will have little to no impact on the hydraulics of the main Mississippi River Channel. Sedimentation of the harbor is fairly well characterized based on current operations, and no alternatives considered altering the bottom grade of the constructed channel. As a result, neither the flow nor the sedimentation rate would substantially be altered by any of the alternatives considered herein. Therefore, no substantive hydraulic analysis was performed.

A hydraulic analysis was performed to determine the months of the year the stage at the Arkansas City gage could reach 10 ft or below, triggering the removal of barges from the harbor to be stored on the Mississippi River. The analysis shows stages falling below 10 ft occurring almost every year any time during the months from June

to February. The most recent low water occurred in 2023 between the months of June to January, as shown on the Hydrograph in Figure 2.12.

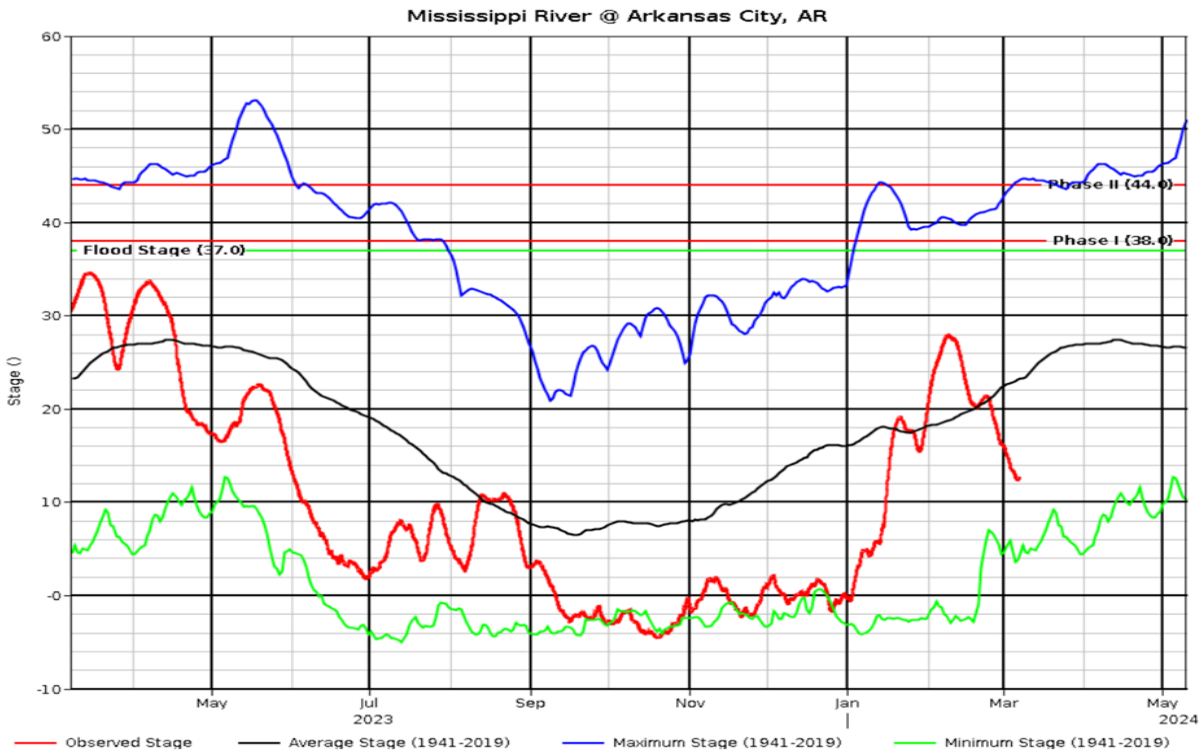


Figure 2.12 Mississippi River @ Arkansas City 2023 - 2024

Since 1941, the Arkansas River gage has reached 10 ft or less almost every year, as shown in Figure 2.13. Figure 2.14 shows a hydrograph at the Arkansas City gage reaching 10 ft or less in five of the last six years.

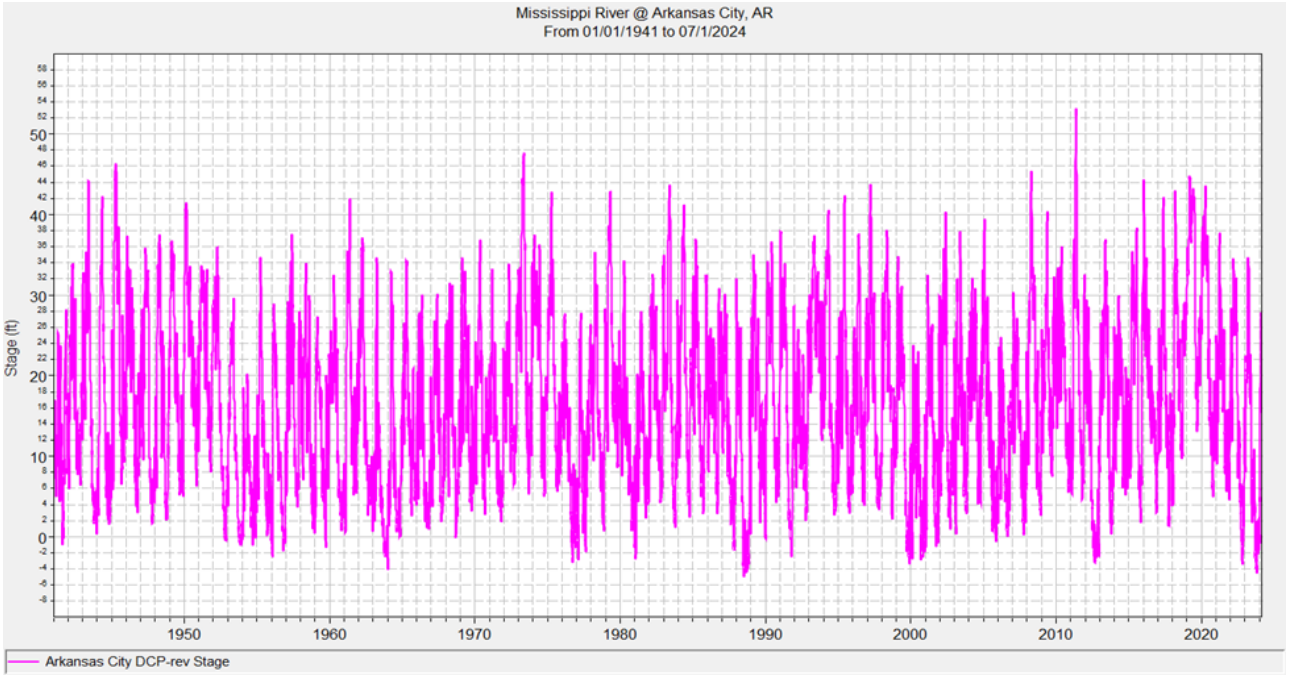


Figure 2.13 Mississippi River @ Arkansas City 1941 – 2024

Figure 2.14 Mississippi River @ Arkansas City 2018 - 2024

2.4 GEOTECHNICAL

As no existing geotechnical data was available for analysis, each alternative that requires grading of new slopes outside the existing channel limits were estimated assuming a uniform 1V:3H cut slope. Based on experience with bank grading on the main Mississippi River Channel in this area, this slope has a high likelihood of being stable and maintainable. When this effort reaches the PED phase, subsurface geotechnical data will likely be collected for confirmation of this assumption, but any variation would have very little impact on the quantities or footprints discussed herein. As a result, no geotechnical analysis was made beyond this general recommendation.

2.4.1 SITE CHARACTERIZATION

2.4.1.1 Regional Geology

The project area is located regionally in the Gulf Coastal Plain in the SE United States and locally in the Alluvial Plain physiographic province of Mississippi. It lies within the Mississippi Embayment and geomorphically, it is comprised of Holocene Meander Belts and Pleistocene Valley Trains. The Port of Rosedale is in Bolivar, County Mississippi located near the town of Rosedale, MS. The project site is underlain by point bar meander scrolls and abandoned channels of the ancestral Mississippi River and neighboring streams and tributaries. These Quaternary alluvial sediments generally exhibit clays and silts which can produce vertisols (soils with >30% clay with shrinking/swelling potentials) underlain by sand and gravels at depth. Typically, these environments showcase what is known as a “fining upward sequence” in sequence stratigraphy. A fining upward sequence indicates that grain sizes decrease at shallower depths and increase at greater depths. To deposit heavier grains hydraulic energy must be higher so this sequence highlights distinct facies change due to depositional environment down section. The Mississippi Embayment was filled by large river and delta system during the Cenozoic depositing sediments up to 45,000 ft thick beneath the Gulf Coastal Plain. The Quaternary alluvium, sands, gravels, and loess deposited in the last 2.5 million years (myr) are considered shallow deposits and are the primary materials considered for construction and analysis. The Geologic Map of Mississippi (Figure 2.15) indicates presence of alluvium at the project site (yellow star) but does not delineate it further. A local map of the Port of Rosedale project can be referenced in Figure 2.16 for additional resolution near Rosedale.

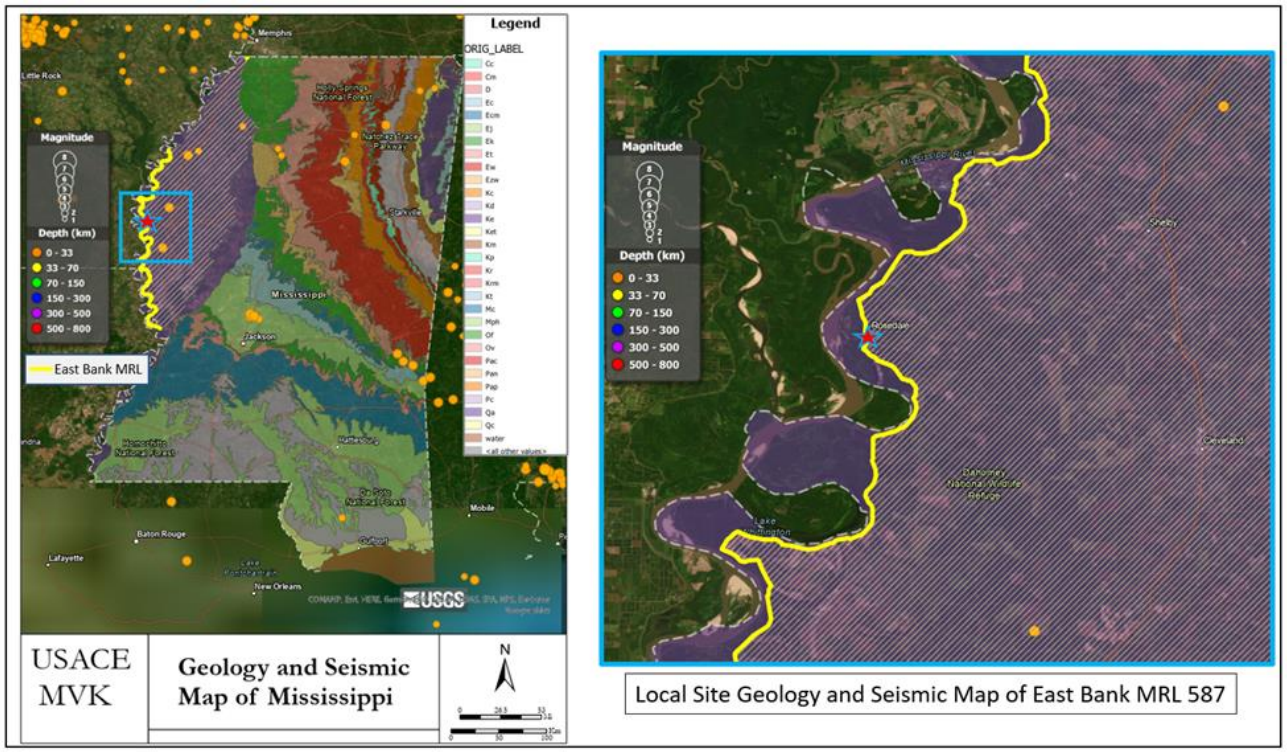


Figure 2.15. State Geology and Seismic Maps indicate the foundation of the Port of Rosedale is based on Quaternary alluvium and distal to any historic seismic event.

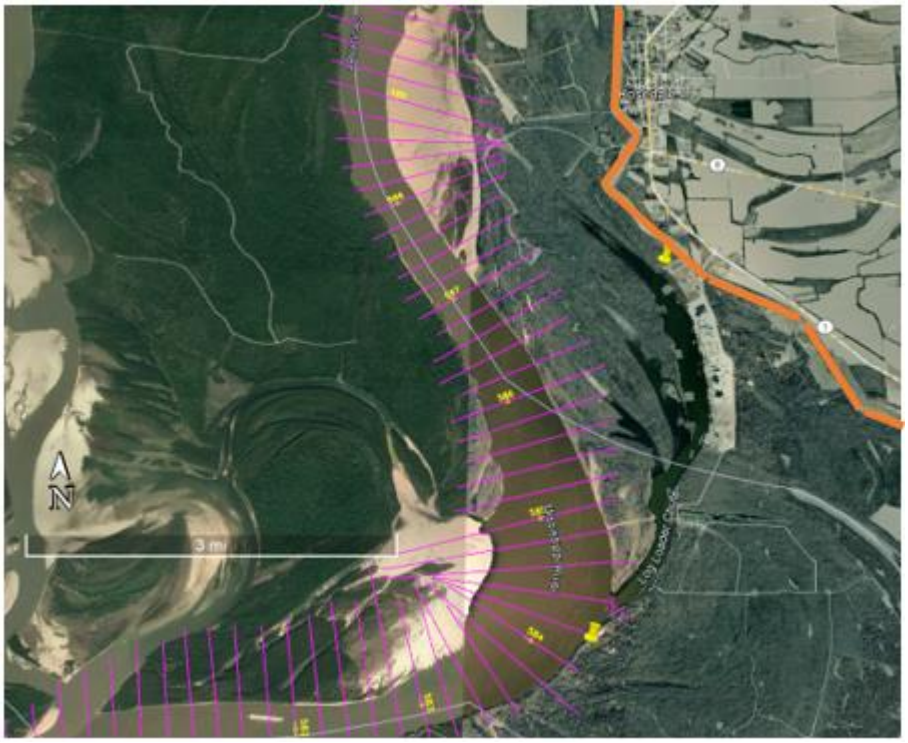


Figure 2.16. Yellow pins indicate the extent of the project area in Rosedale, MS.

2.4.1.2 Local and Site Geology

The Port of Rosedale project site rests locally on point bar and abandoned channels (Figure 2.17 and Figure 2.18) on the left descending bank of the Mississippi River near Rosedale, MS. Lithologically, abandoned channels typically host fine grained material (ML, CH, CL) and point bars host coarser grained materials (SP, SM, SW). Foundation conditions analyzed through previous drilling programs corroborates the presence of these soils. These different soil types pinch out and are laterally discontinuous in some areas whereas in others they swell and are continuous as seen in the cross sections in Figures 2.19 and 2.20. This architecture and geospatial distribution is typical of meandering fluvial environments. Additional subsurface site conditions are cataloged in more recent Tertiary and foundation borings drilled along the Mississippi River Levee (MRL) 587, indicated by the orange line in Figure 2.16. These borings are listed below in Table 2.3 and visualized in Figure 2.21.

Borehole ID	Latitude	Longitude
587-1-22T	33.8477	-91.0302
587-1-22U	33.8429	-91.0333
587-2-22U	33.8383	-91.0316
587-2-22T	33.8342	-91.0274
587-3-22U	33.8312	-91.0223
587-4-22U	33.8280	-91.0170
587-3-22T	33.8258	91.01107
587-5-22U	33.8228	-91.0057
587-6-22U	33.8183	-91.0022
587-4-22T	33.8160	-91.0005

Table 2.3. Recent foundation and Tertiary borings and associated coordinates drilled at MRL 587.

These recent borings reveal that dominant particle size distribution is weighted heavily on fine grained materials. These materials include ML, CH, CL, and SM. Coarser materials are found at depth and no gravels were encountered. The coarser and most permeable material yielding highest hydraulic conductivity is poorly graded sand (SP). Boring profiles of these holes corroborates the current geologic understanding of the project site in that it yields a fining upward sequence and is distributed laterally in pinches and swells. This is the expected architecture in fluvial geomorphology of a meandering river.

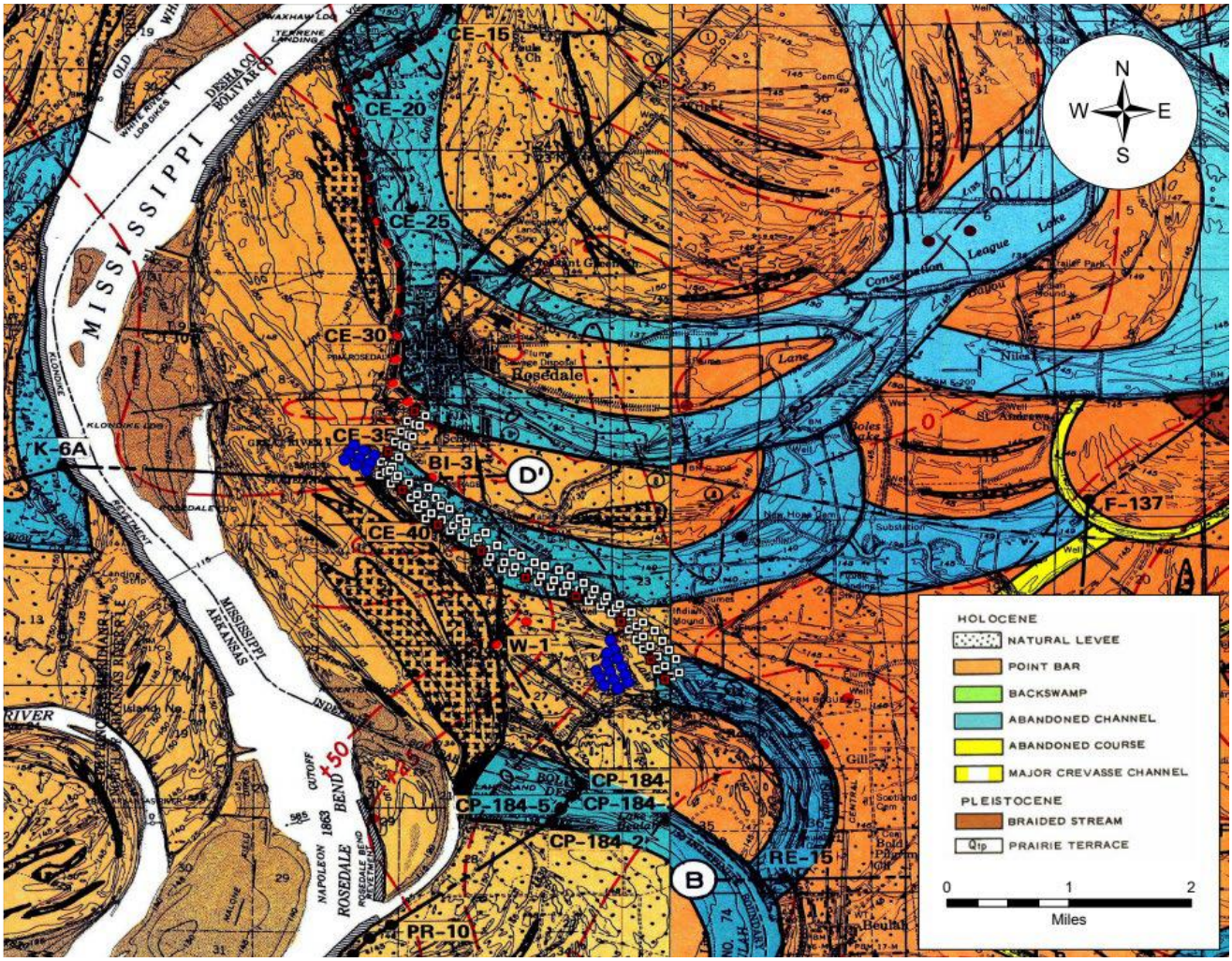


Figure 2.17. Depositional sequences and spatial stratigraphy of Rosedale, MS.

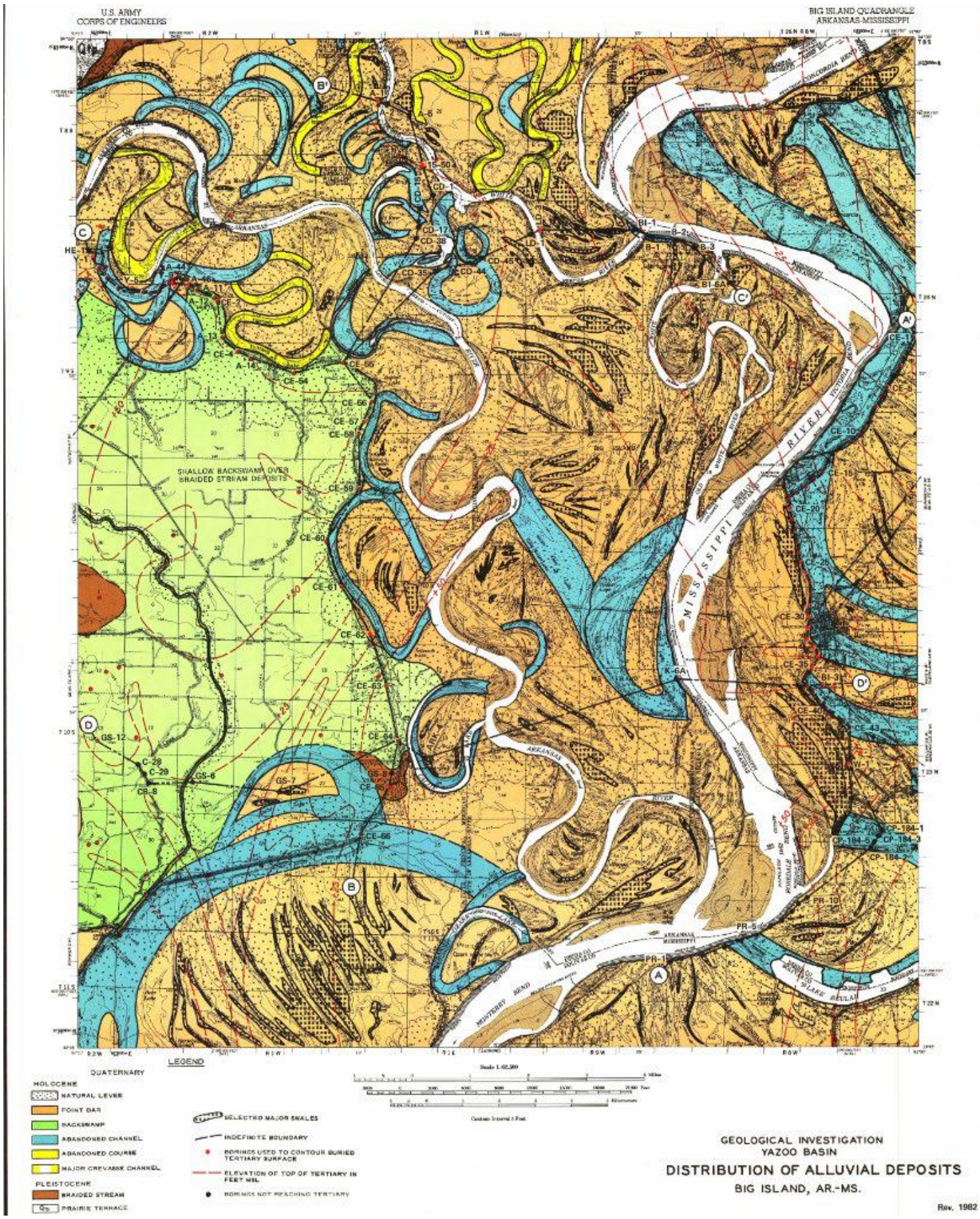


Figure 2.18. Regional Geology of the Big Island Quadrangle incorporating Port of Rosedale project site at Rosedale, MS.

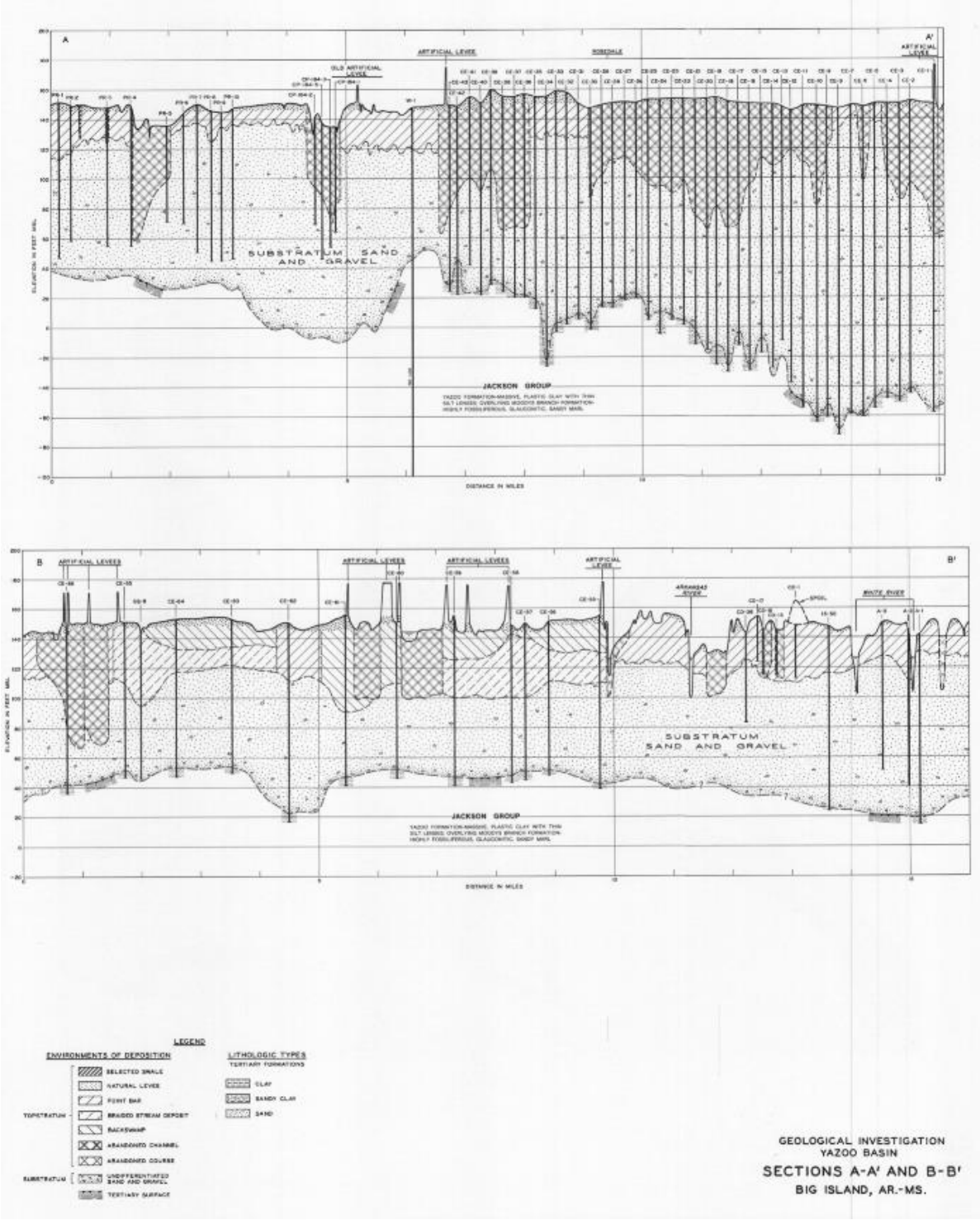


Figure 2.19. Cross sections A-A' and B-B' delineating lateral pinching and swelling of different soils at the project site. The section lines are denoted in plan view on Figures 2.17 and 2.18.

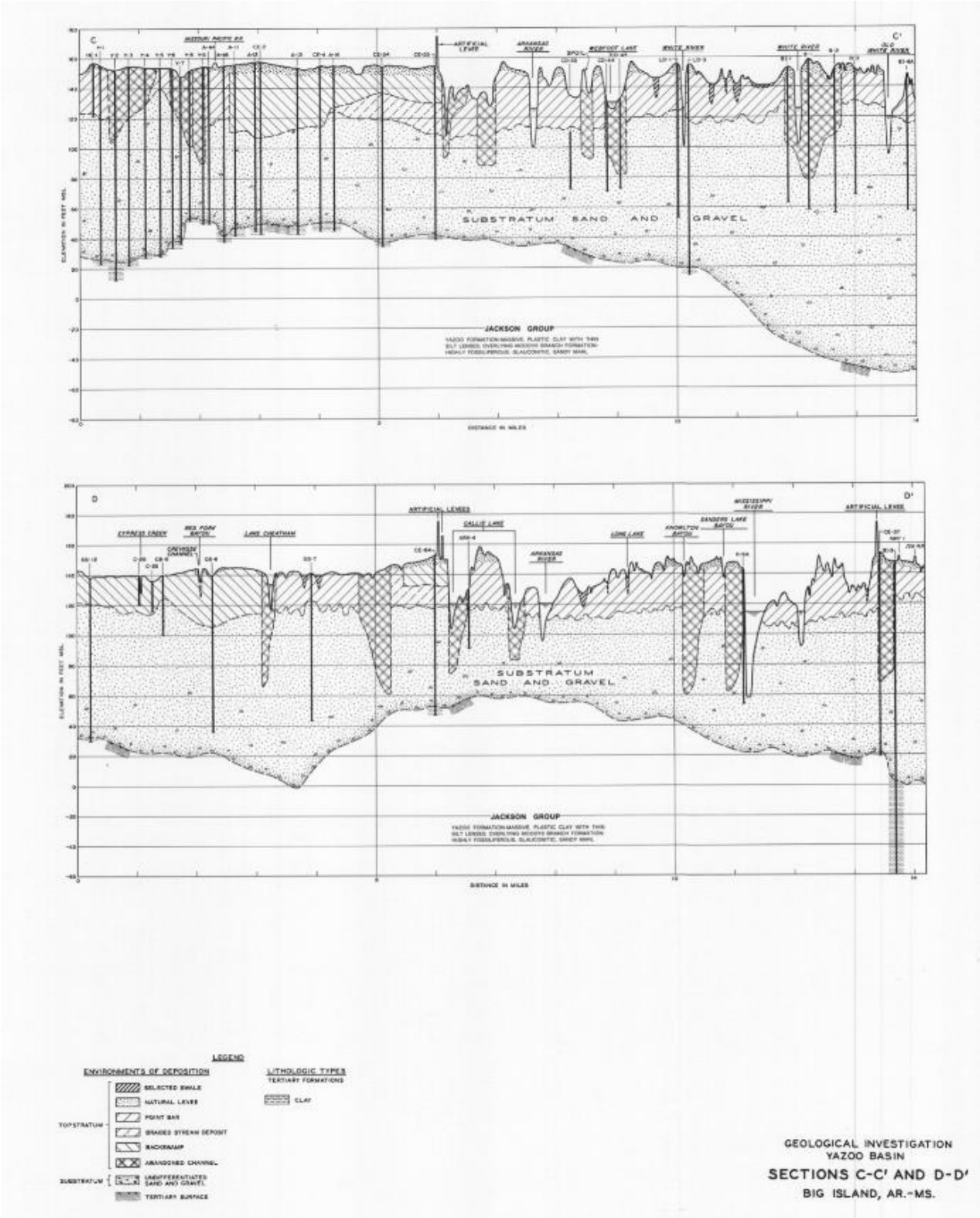


Figure 2.20. Cross sections C-C' and D-D' delineating lateral pinching and swelling of different soils at the project site. The section lines are denoted in plan view on Figures 2.17 and 2.18.

Figure 2.21. MRL 587 with recent foundation and Tertiary borings plotted with respect to river entry. Furthest from river entry point at the harbor is 1.28 miles and closest in 0.25 miles.

2.5 CIVIL

Autodesk's AutoCAD Civil3D was used to compute quantities and footprints for all alternatives described in the sections below. For each alternative, the proposed modification was drawn as a feature line, then set to the proposed excavation grade. Grading tools were then used to create a cut slope at the proposed 1V:3H slope described in paragraph 2.4. The excavation grading and modified footprint feature line were then combined into a TIN surface. Surface-to-surface triangle volumes were generated between the proposed surface and the existing ground surface described in paragraph 2.1. All alternatives described herein are for a navigation depth of nine (9) feet. The Low Water Reference Plane (LWRP) elevation at the Port of Rosedale is at an elevation of 102.0 ft. Therefore, all alternatives use a bottom grade elevation of 93.0 ft. For alternatives that required enlarging the channel into wooded areas above top bank, aerial imagery was used to compute approximate areas of ground above top bank that would be affected by the proposed modification.

2.5.1 Alternative 1 (No Action)

The existing authorized navigation footprint consists of a 150' wide navigation channel which extends from the confluence of the harbor and the Mississippi River Channel up to the existing 400' by 1,000' turning basin. This alternative required no computations or analysis. The footprint below was provided to the PDT by the Operations Dredging unit. It portrays the existing project limits that are currently dredged for maintenance, and this footprint was used as the basis for all alternatives described hereafter.

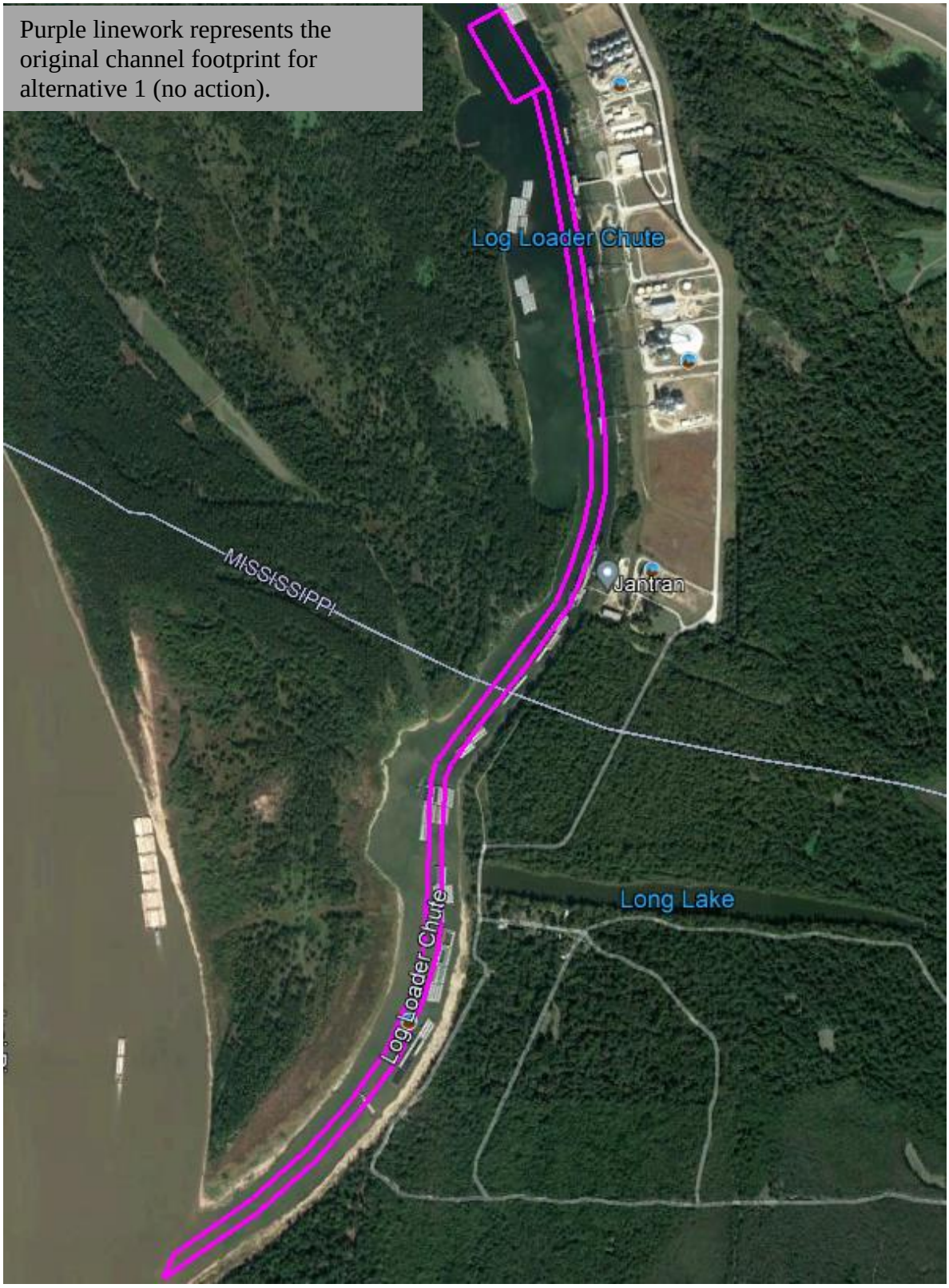


Figure 2.19 Alternative 1

2.5.2 Alternative 2 (Widen Channel at JANTRAN)

Alternative 2 considered widening the channel adjacent to the JANTRAN facility located on the outside of the bendway in the navigational channel. When this facility is in operation, barge traffic can create a navigational encroachment on the channel, thus restricting barge traffic while barges are loading or being repositioned at the JANTRAN facility. This alternative widens the existing channel 200' through this bendway, with tapered transitions in the upper and lower channel crossovers. This channel width was determined through coordination with the local sponsor and river pilots who utilize the port. A two wide barge width totals to 70', two lane traffic would amount to a side by side total of 140'. 200' would be adequate for maneuvering through the channel at JANTRAN.

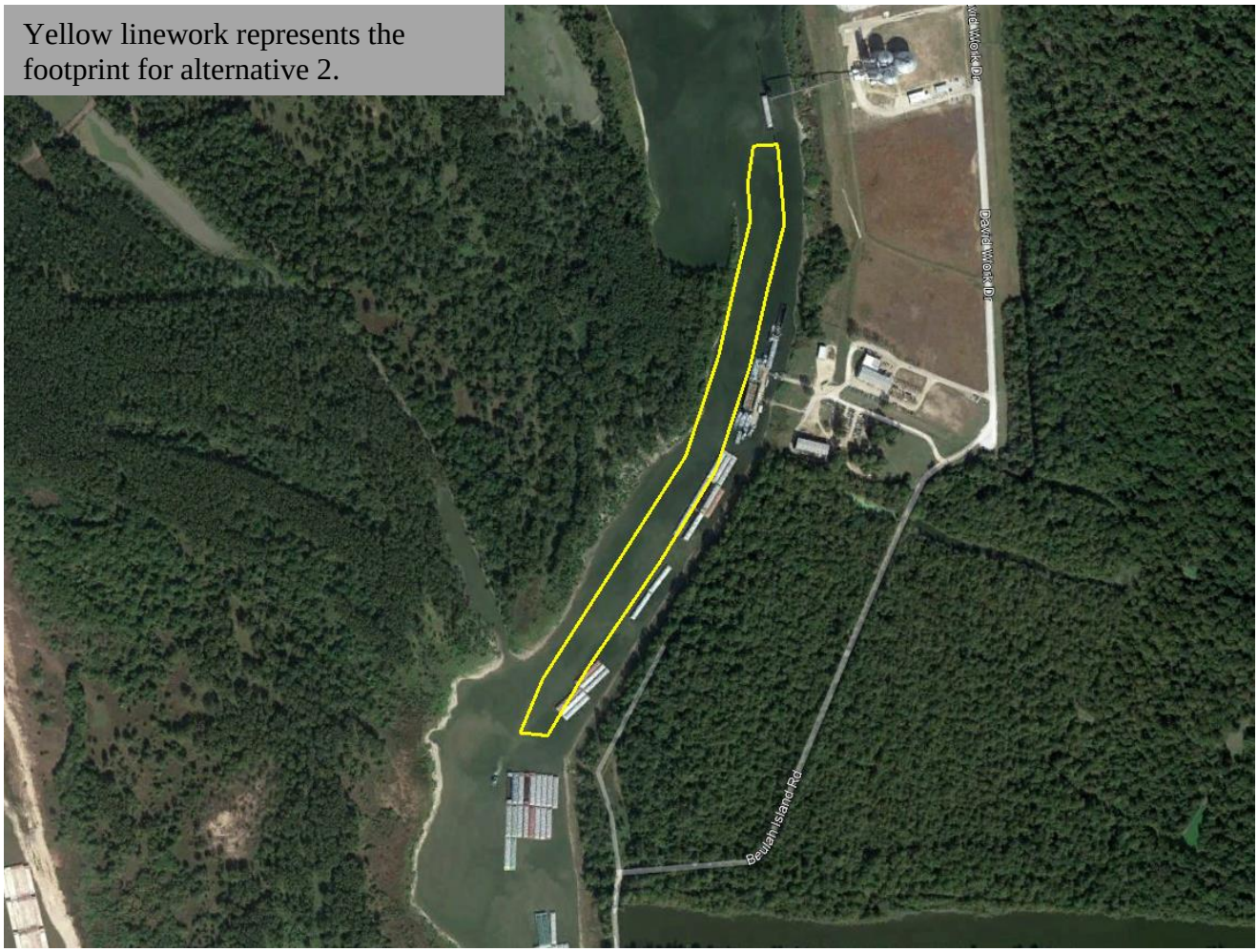


Figure 2.20 Alternative 2

This alternative results in a dredge quantity of approximately 91,300 CY and the removal of approximately 3.25 acres of wooded area above the existing top bank.

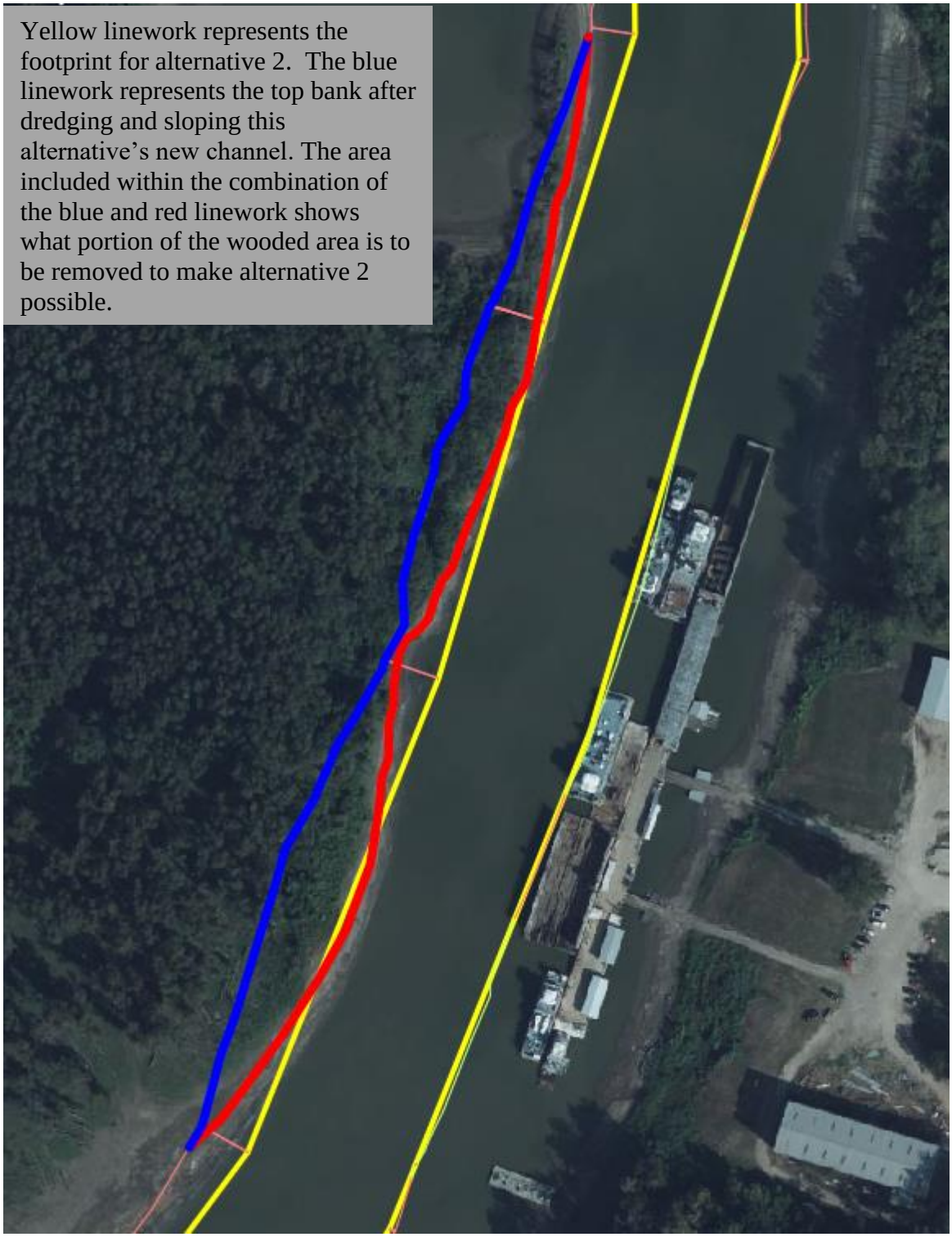


Figure 2.21 Alt. 2 Wooded Area Removal

2.5.3 Alternative 3 (Widen Entire Channel)

Alternative 3 considered widening the entire channel between its confluence with the Mississippi River and the turning basin. A channel width of 185' was selected assuming one way traffic for two by two barge configurations. This width was computed following the methods described in EM 1110-2-1611 Layout and Design of Shallow Draft Waterways. The alignment of the existing channel was approximated in AutoCAD to obtain the existing curve radius of the controlling bendway located adjacent to the JANTRAN facility.

Assumptions:	
Barge Dimensions:	70' W x 510' L
Bendway Angle at JanTran:	40°
Curve Radius:	2250'
Water Velocity:	0 fps

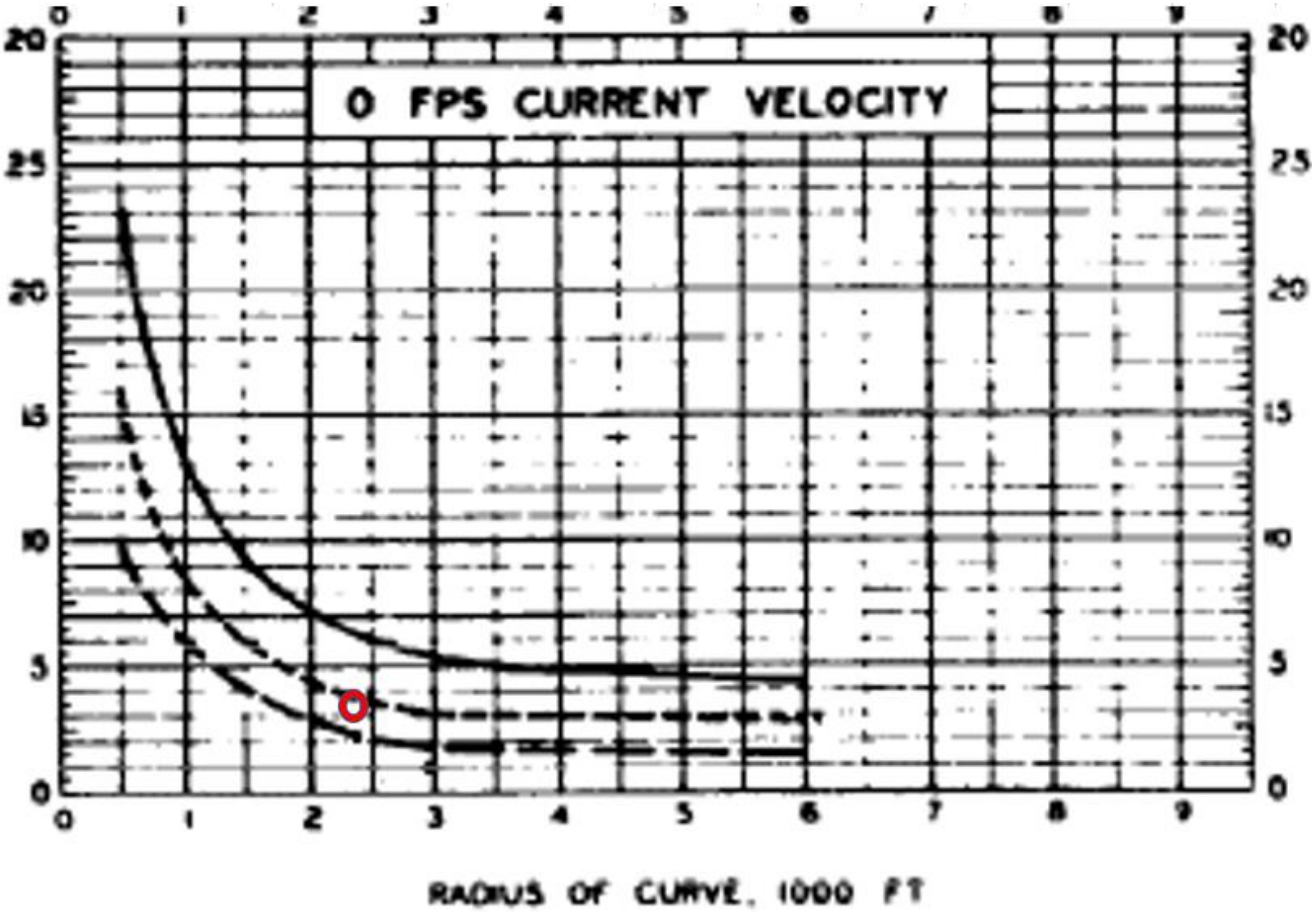


Figure 2.22 Downstream Deflection Angle (3.5 Degrees)

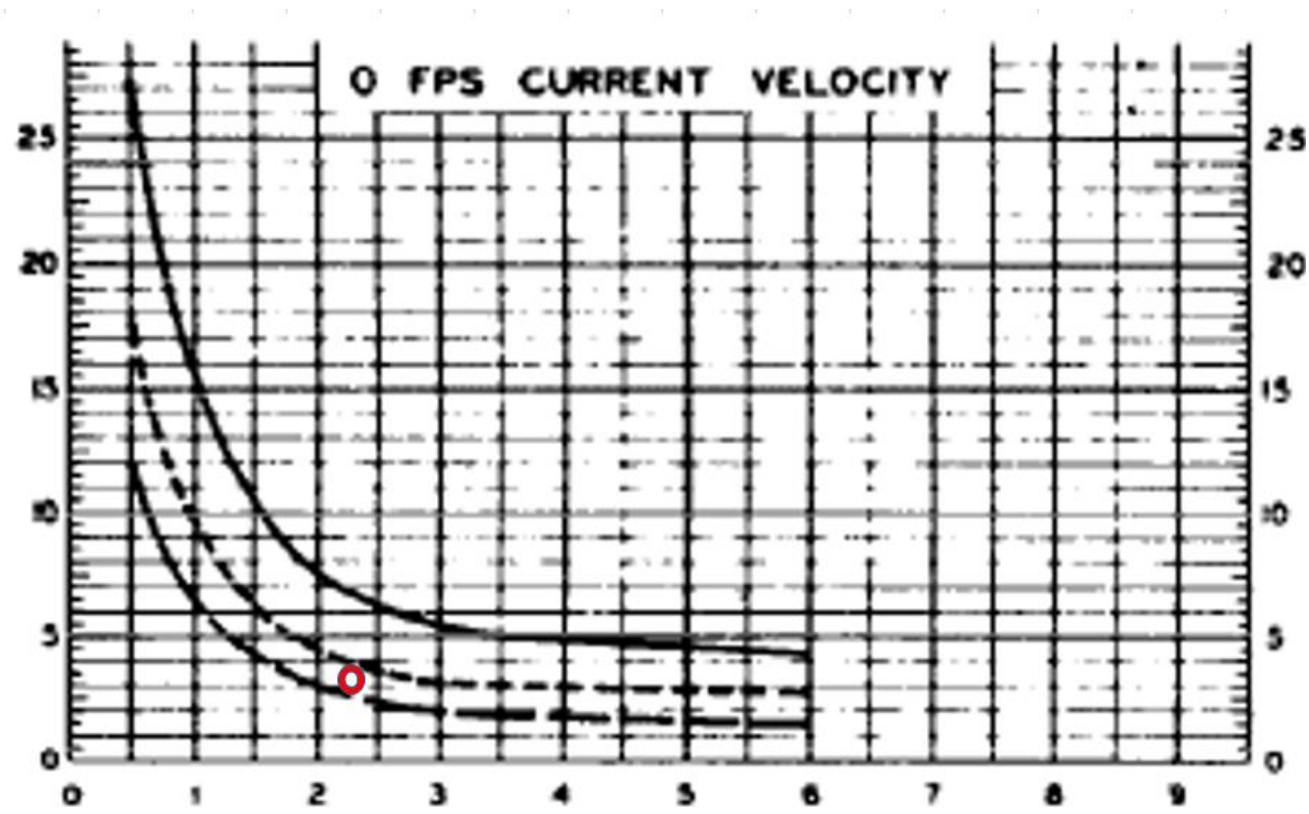


Figure 2.23 Upstream Deflection Angle (3.0 Degrees)

The formulas used for determination of channel width are shown from the excerpt of EM 1110-2-1611 below.

a. $CW_1 = (\sin \alpha_d \times L_1) + W_1 + 2C$

b. $CW_2 = (\sin \alpha_u \times L_1) + W_1 + (\sin \alpha_d \times L_2) + W_2 + 2C + C_t$

where

CW_1 = channel width required for one-way traffic, feet

CW_2 = channel width required for two-way traffic, feet

Figure 2.10 Channel Width Formulas

Formula a. results in a channel width of 181.1', which was rounded to 185'. However, the local sponsor and river pilots communicated that the width of 200' used in Alternative 2 was the preferred channel arrangement in the bendway where the JANTRAN facility was located. As a result, this alternative considered widening the channel to 185' everywhere except the JANTRAN facility where to 200' wide footprint used for Alternative 2 was used in conjunction with tapered transitions to and from the widened 185' channel.

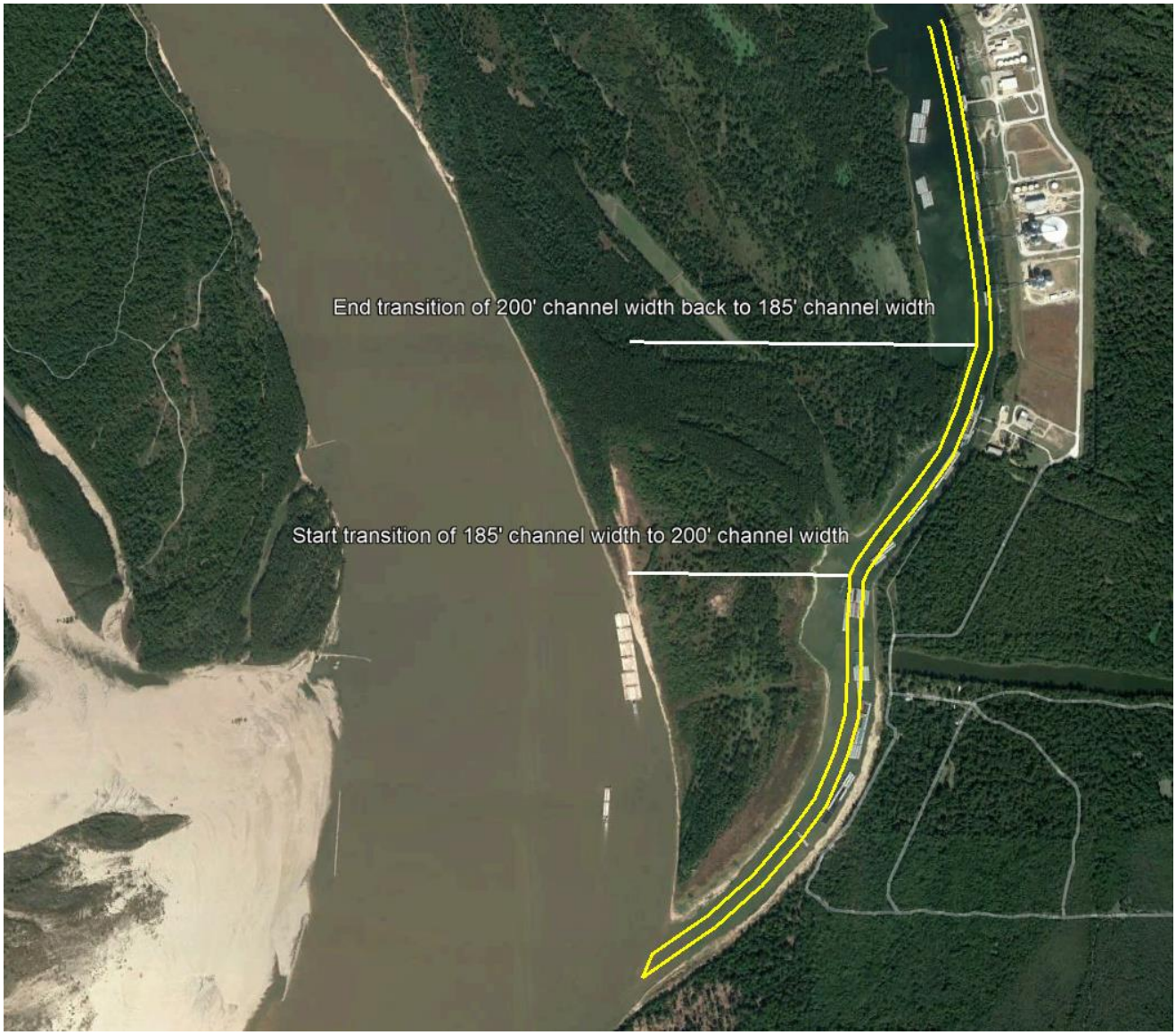


Figure 2.24 Alternative 3

This alternative resulted in a dredge excavation volume of 269,600 CY of material and the removal of approximately 4 acres of wooded area above top bank.

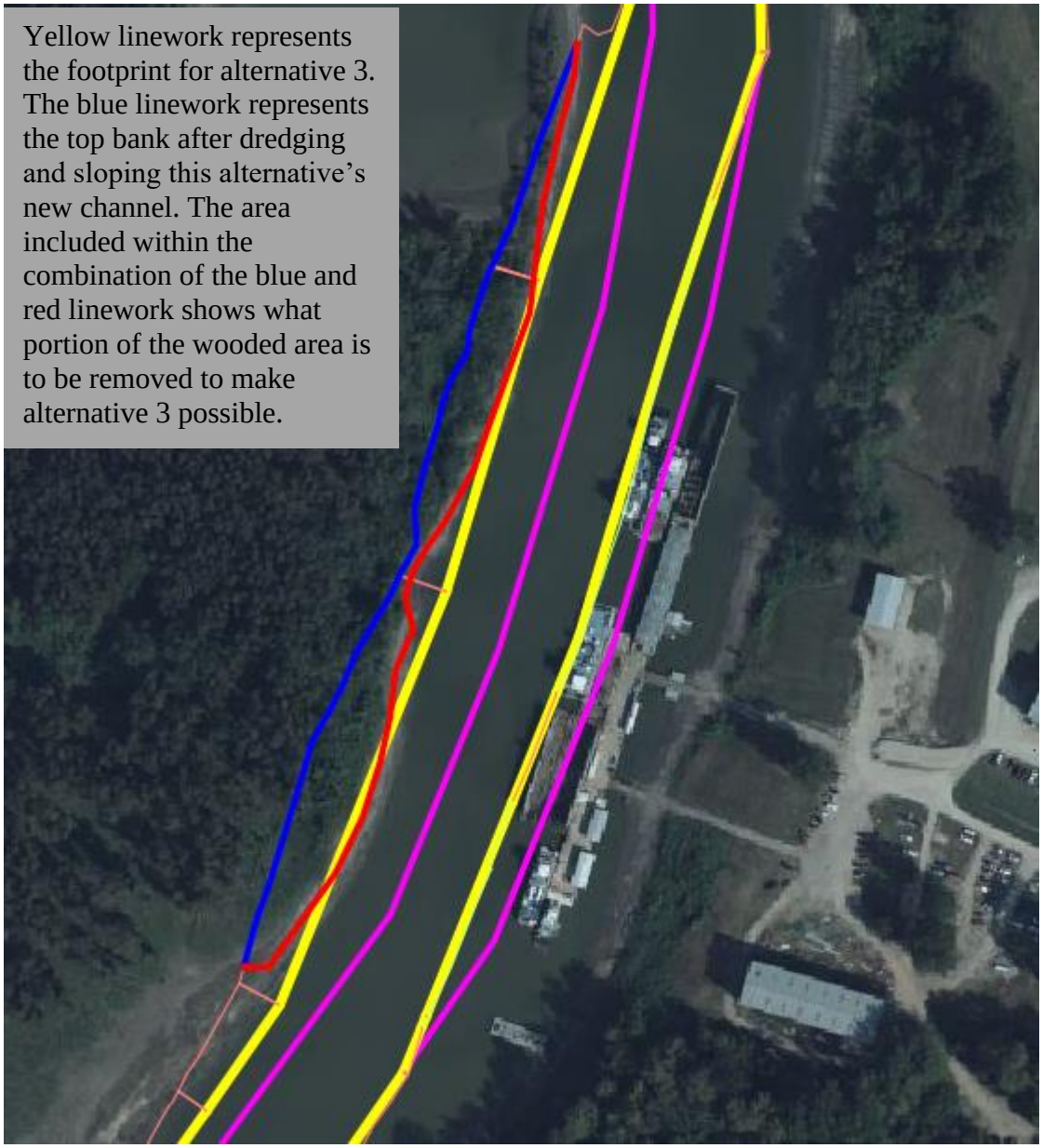


Figure 2.25 Alternative 3 Wooded Area

2.5.4 Alternative 4 (Expand Turning Basin)

This alternative considered expanding the existing turning basin from 400' by 1,000' to 600' by 1,000'. The west edge of the turning basin was extended an additional 200'. This additional width would allow a 2 by 2 barge configuration to utilize the turning basin.

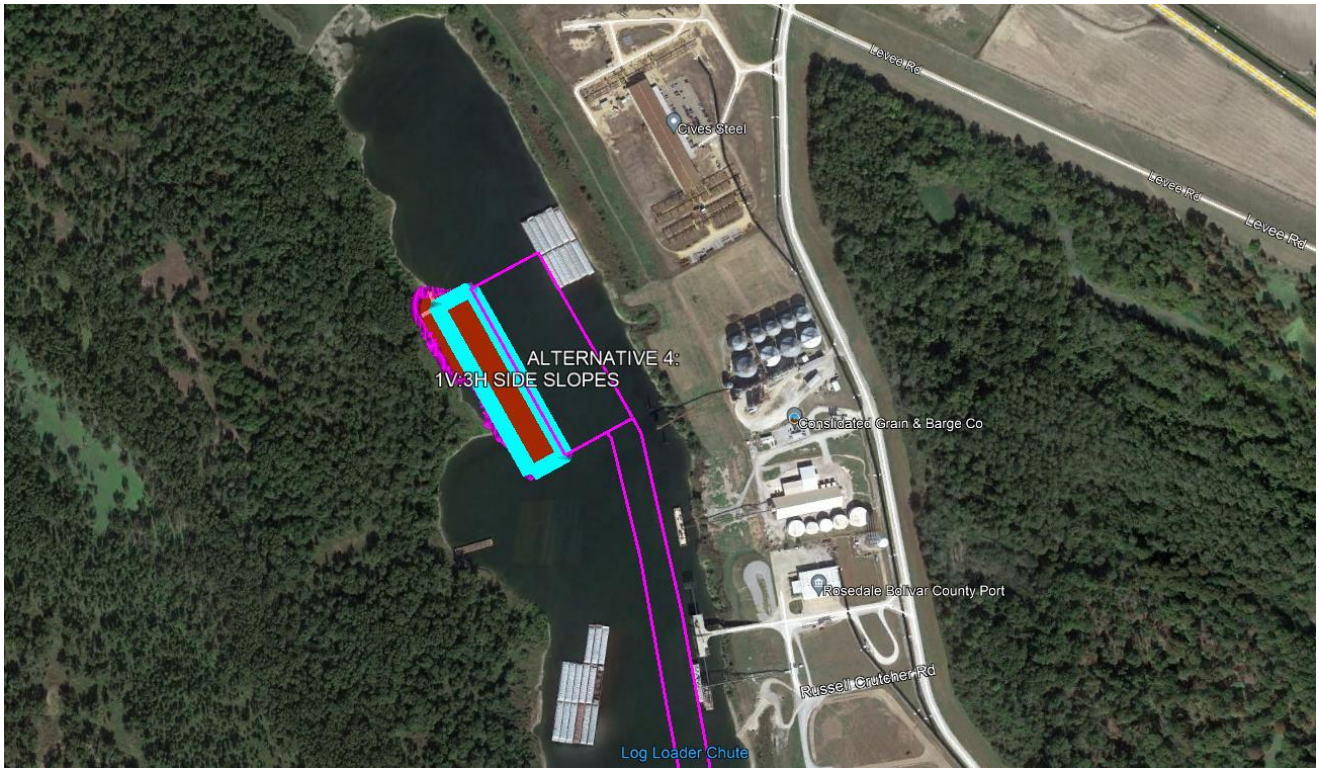


Figure 2.26 Alternative 4

This alternative resulted in a dredge excavation volume of 52,300 CY of material and the removal of approximately 1.2 acres of wooded land above the existing top bank.

2.5.5 Alternative 5 (Extend Channel and Expand Turning Basin)

This alternative considered extending the channel through the existing turning basin and relocating the turning basin such that its new southern edge is adjacent to the northern edge of its existing location. The 600' by 1,000' dimensions used for alternative 4 were used for this alternative as well, thus resulting in an enlarged turning basin that could support a two by two barge configuration.

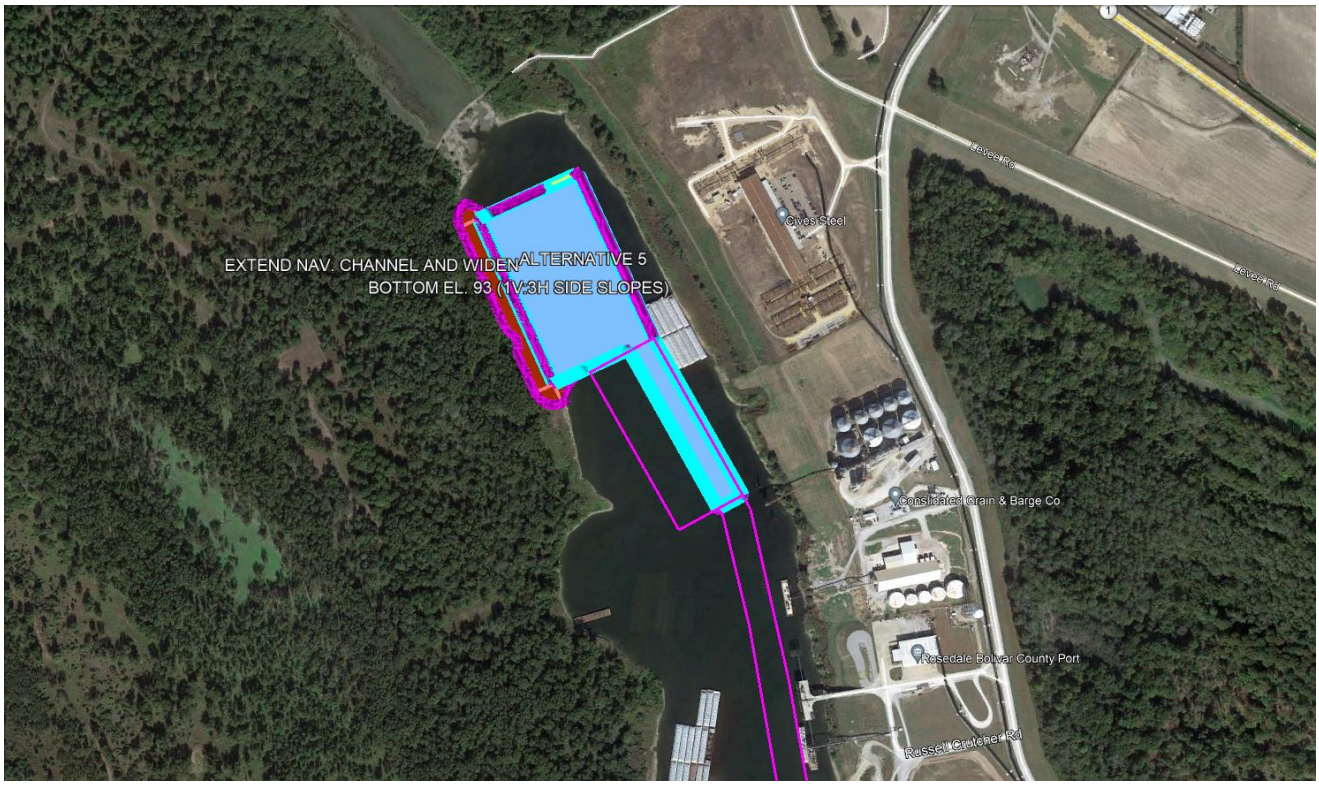


Figure 2.27 Alternative 5

This alternative resulted in a dredge excavation volume of 198,400 CY of material and the removal of approximately 3.0 acres of wooded land above the existing top bank.

2.5.6 Alternative 6 (Relocate Channel at JANTRAN)

This alternative considered relocating the channel at its existing width in the vicinity of the JANTRAN facility. The new channel was situated through shifting the entire channel to the west 100', then widening the new channel to the west 50' for a new channel width of 200'. The new channel was transitioned into the existing channel in the upstream and downstream crossovers.

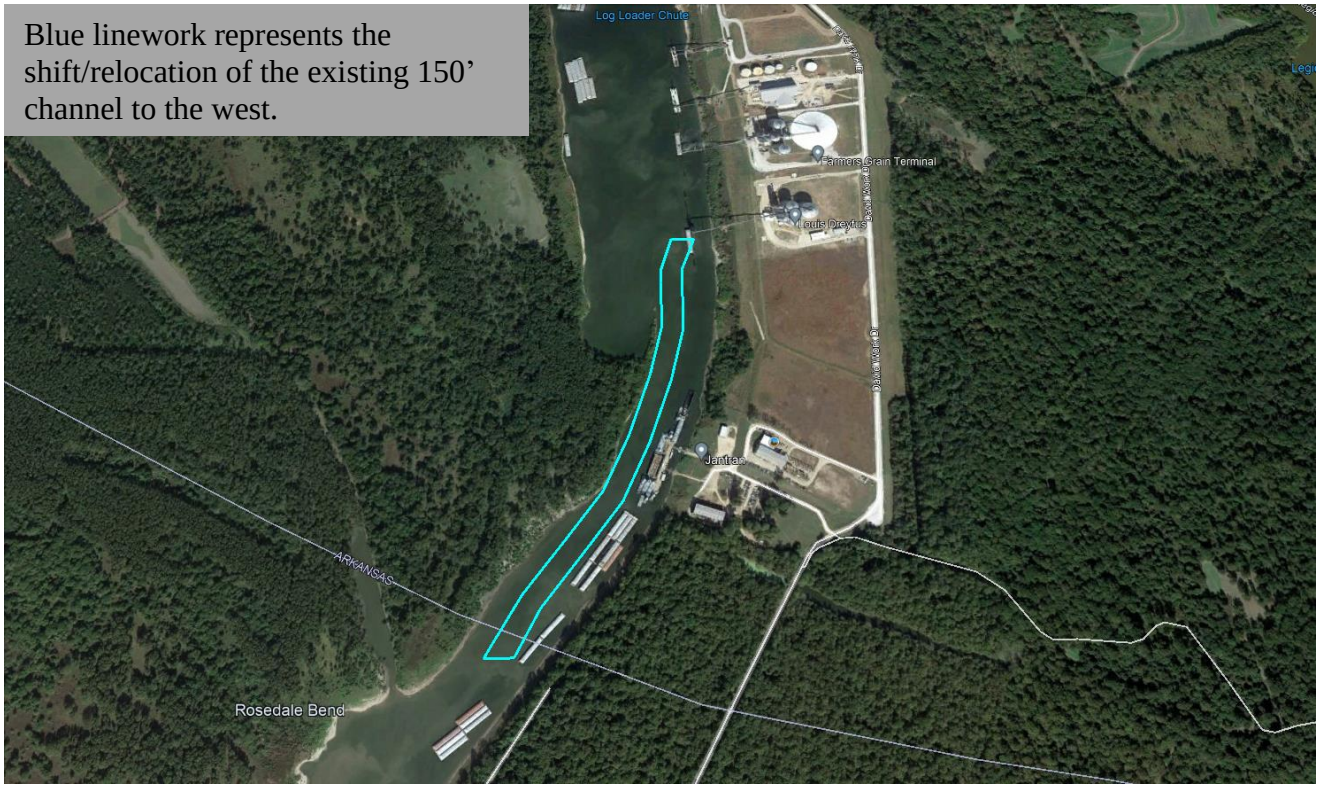


Figure 2.28 Alternative 6

This alternative resulted in a dredge excavation volume of 96,900 CY of material and the removal of approximately 3.5 acres of wooded land above the existing top bank.

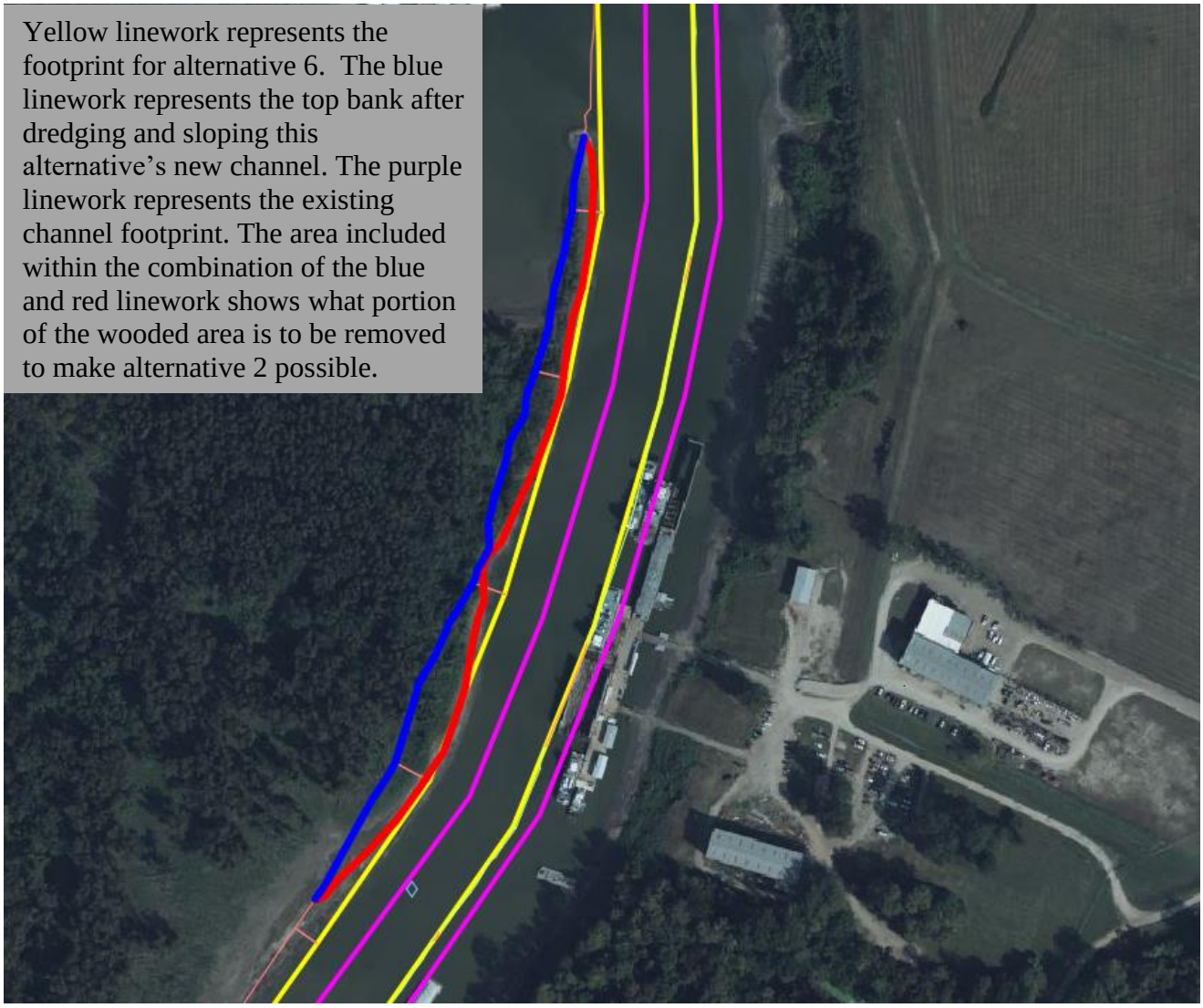


Figure 2.29 Alt 6 Wooded Area

2.5.7 Selected Alternative - Alternative 7 (Widen Entire Channel, Extend Channel, and Expand Turning Basin)

This alternative is a combination of alternatives 3 and 5. The entire channel is widened to 185' except near JANTRAN, where it is widened to 200'. The turning basin is relocated and enlarged to 600' by 1,000'. The wooded area to be cleared will be equal to that of alternative 3.

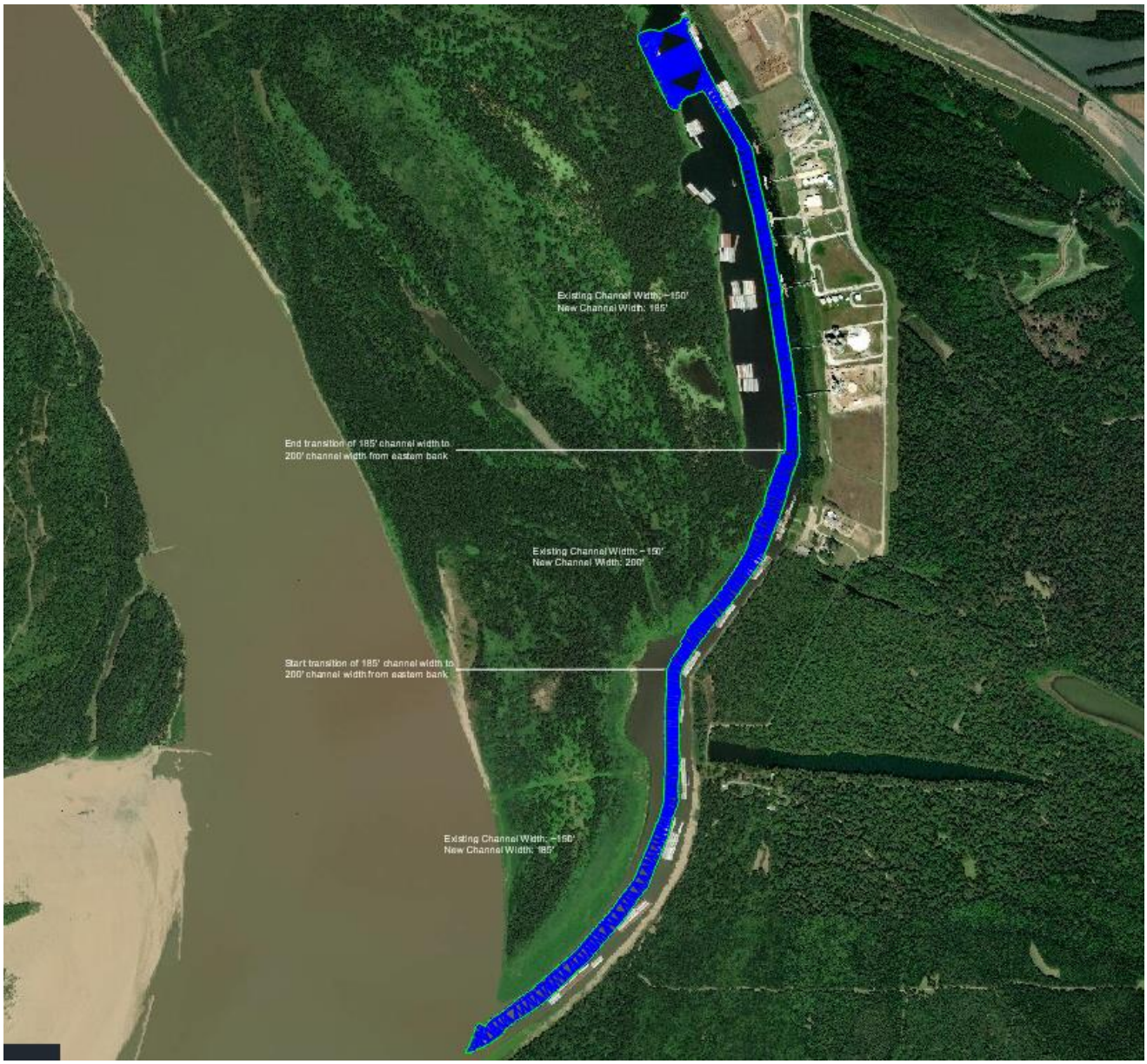


Figure 2.30 Alternative 7

This alternative resulted in a dredge excavation volume of 468,000 CY of material and the removal of approximately 7.0 acres of wooded land above the existing top bank.

2.5.8 Non-structural Alternatives

No engineering analysis was performed on any non-structural alternatives such as relocating the JANTRAN facility, limiting use on the public boat ramps, etc.

2.6 DISPOSAL METHODS

2.6.1 Upland Disposal Area

In an attempt to provide beneficial use of dredge material, an upland disposal area was laid out on an existing 33 Acre tract of land owned by the port. The preliminary layout considered containment dikes, cross dikes to direct effluent flow, and a pad for an elevated weir. Fairly early in the planning process, this alternative was determined to be economically and environmentally prohibitive, so the design was not refined to account for the volume needs of the selected alternative.

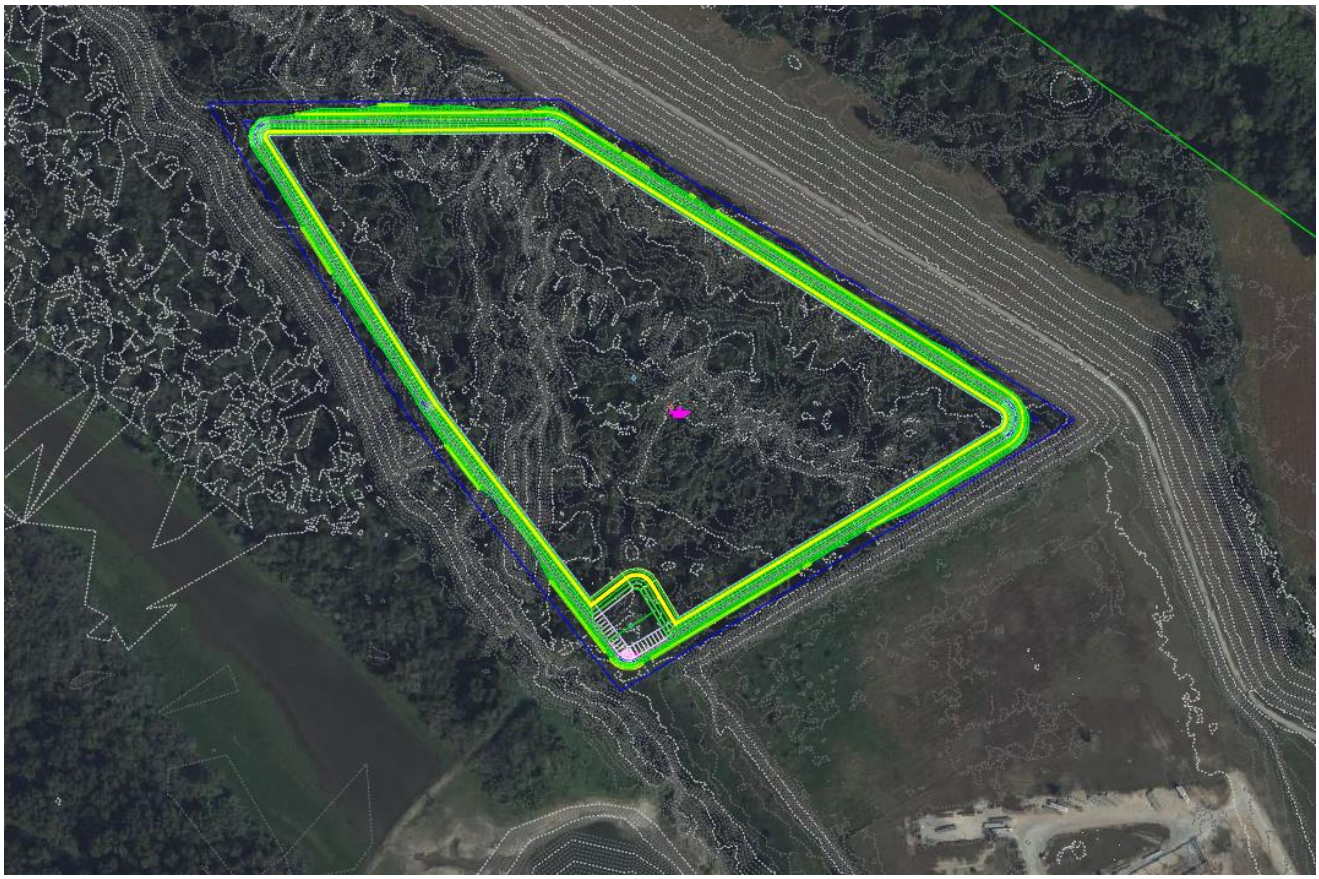


Figure 2.31 Upland Disposal Area

This preliminary layout would have required approximately 53,000 CY of material to construct and would have had a capacity of approximately 261,500 CY of material assuming a 50% swell factor of the dredged material.

2.6.2 Selected Method - Channel Disposal

The selected method for material disposal will be to place the discharge pipe in the Mississippi River outside of the existing main navigation channel. For maintenance dredging, the Operations Dredging unit runs their discharge pipe through the woods and discharges in the outside of the river bendway adjacent to the port. While this method shortens the length of dredge pipe, it has caused operational issues for the port as the discharged material tends to deposit downstream at the mouth of the port, thus requiring additional dredging. For this effort, the contract will require that the discharge be located approximately at the location shown below.

Figure 2.32 Discharge Location

The contract will require floating or submerged dredge pipe depending on final environmental recommendations.

Section 3
Results Summary

Alternative	Description	Required Dredge Excavation	Wooded Area Above Existing Top Bank
Alternative 1	No Action	N/A	N/A
Alternative 2	Widen Channel at JANTRAN	91,300 CY	3.25 AC
Alternative 3	Widen Entire Channel	269,600 CY	4.0 AC
Alternative 4	Expand Turning Basin	52,300 CY	1.2 AC
Alternative 5	Lengthen Channel and Enlarge Turning Basin	198,400 CY	3.00 AC
Alternative 6	Relocate Channel at JANTRAN	96,900 CY	3.50 AC
Alternative 7	Widen Channel and Relocate/Expand Turning Basin	468,000 CY	7.00 AC

Section 4
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