Bridge Hydraulics Report

Lem Turner Road (SR 115)
Over Trout River Bridge Replacement
Bridge No. 720033

Duval County, Florida

Financial Management (FM) No: 437437-2-22-01
Federal Aid Project ID No: TBD
ETDM # 14449

Prepared For:

Florida Department of Transportation
District Two

Prepared By:

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The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022, and executed by the Federal Highway Administration and FDOT.

June 2023

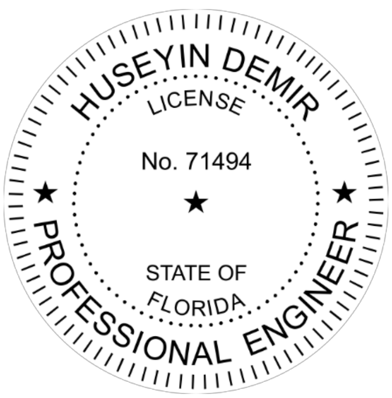
PROJECT INDEX AND ENGINEER'S CERTIFICATION

I. Project Information
Lem Turner Road (SR 115) over Trout River Bridge (No. 720033) Replacement

II. Governing Standards and Specifications
   a. AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms (2008)
   b. FDOT Bridge Scour Manual (2022)
   c. FDOT Drainage Manual (2023)
   d. FDOT Design Manual, Design Criteria (2023)

III. Computer Programs Used for Calculations and Analysis
   a. Advanced Circulation Model for Coastal Ocean Hydrodynamics (ADCIRC) V. 51.52.34
   b. Microsoft Excel for Microsoft Office 365

The official record of this report is the electronic file digitally signed and sealed under 61G15-23.004, F.A.C.



I, Huseyin Demir hereby state that this report, as listed in the following Table of Contents, is, to the best of my knowledge and belief, true and correct and represents the described work in accordance with current established engineering practices. I hereby certify that I am a Licensed Professional Engineer in the State of Florida practicing with INTERA Incorporated, and that I have supervised the preparation of and approve the evaluations, findings, opinions, and conclusions hereby reported.

This document has been digitally signed and sealed by Huseyin Demir with a Digital Signature.

Huseyin Demir
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ACRONYMS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
BDR	Bridge Design Report
BFE	Base Flood Elevation
BHR	Bridge Hydraulics Report
EB	Eastbound
FDEP	Florida Department of Environmental Protection
FDM	FDOT Design Manual
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FPID	Financial Project Identification Number
FWC	Florida Fish and Wildlife Conservation Commission
LME	Low Member Elevation
MP	Milepost
mph	Miles Per Hour
MHW	Mean High Water
MLW	Mean Low Water
MSE	Mechanically Stabilized Earth
MSL	Mean Sea Level
NB	Northbound
PD&E	Project Development & Environment
PE	Professional Engineer
SB	Southbound
SLR	Sea Level Rise
USFWS	United States Fish and Wildlife Service
WB	Westbound
WSE	Water Surface Elevation

1.0 Introduction

The Florida Department of Transportation (FDOT) District 2 has tasked Parsons Corporation (Parsons) to design the replacement for the Lem Turner Road over Trout River replacement bridge (Figure 1-1). In turn, Parsons contracted INTERA, Inc. (INTERA) to determine the design hydraulic and scour conditions for the study. This report documents INTERA's data collection, methodology, results, and recommendations. Chapter 2 summarizes the site observations, proposed structure geometry, and data collection efforts supporting hydraulic model construction. Chapter 3 discusses hydraulic model mesh development, input, and results. Chapter 4 details the 100- and 500-year scour conditions. Finally, Chapter 5 includes other design considerations.

Figure 1-1 Location Map for Lem Turner Road Over Trout River

2.0 Study Area

Calculation of a bridge's hydraulic characteristics and associated scour requires detailed knowledge of the study area and bridge substructure characteristics. The Lem Turner Road bridge crossing lies approximately 5.2 river miles (mi) upstream of the Trout River and St. Johns River confluence (). The Trout River is tidally influenced at the bridge crossing; thus, this study considered hurricane storm surge and riverine runoff events to determine the design hydraulic and scour conditions. The following sections summarize the data collection results, site observations, and proposed structure geometry applicable to hydraulic model development.

Figure 2-1 Waterways Map for Lem Turner Road Over Trout River

2.1 Tidal Benchmarks

The nearest National Oceanic and Atmospheric Administration (NOAA) tidal benchmark stations are Station 8720213 located 2.0 river miles upstream of the Lem Turner Road bridge (Figure 2-1) and Station 8720217 (Figure 2-2) located 3.5 river miles downstream of the bridge. Table 2-1 contains the tidal datum information for both stations from NOAA's Tides & Currents website (https://tidesandcurrents.noaa.gov) as well as elevations interpolated to the bridge location with NOAA VDatum software. The elevations reference the North American Vertical Datum of 1988 (NAVD). This study uses the VDatum elevations for the bridge.

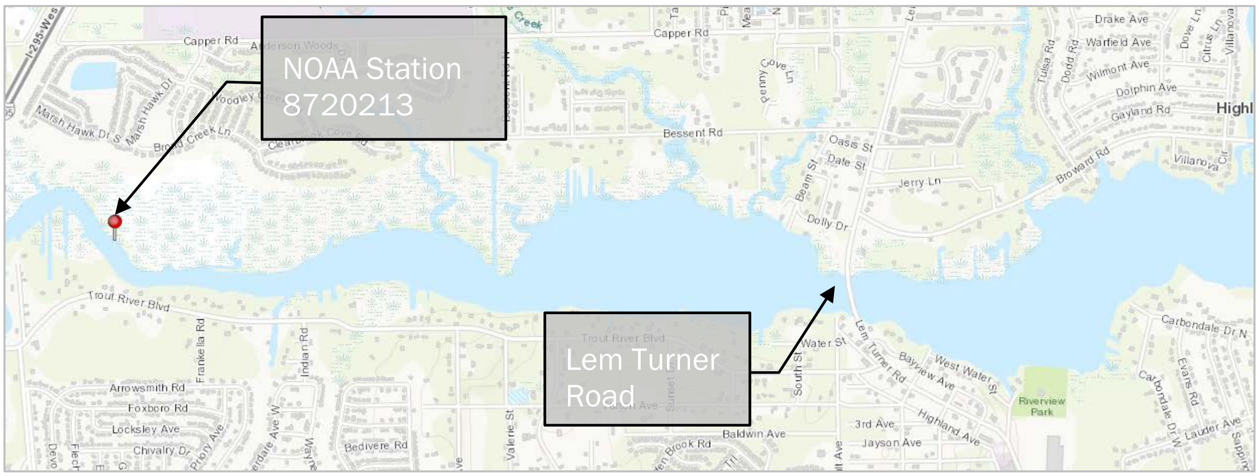


Figure 2-2 Location Map for NOAA Station 8720213 Trout R., Sherwood Forest, FL (Source: NOAA)

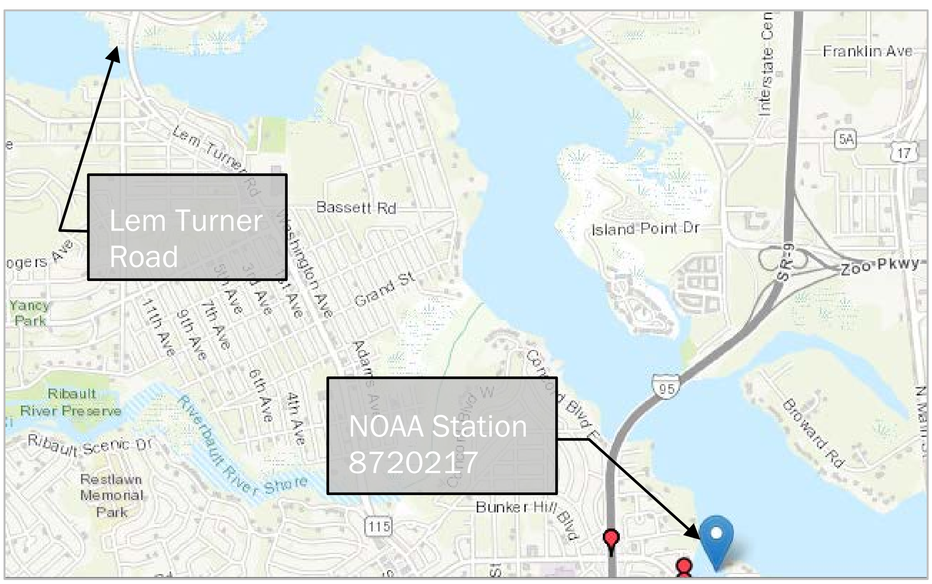


Figure 2-3 Location Map for NOAA Station 8720217 Moncrief Creek Entrance, FL (Source: NOAA)

Table 2-1 Tidal Datums at NOAA Stations and Predicted by VDatum Software

Tidal Datum	Elevation (ft-NAVD)		
	8720213	8720217	VDatum
Mean Higher High Water (MHHW)	1.25	1.04	1.18
Mean High Water (MHW)	1.11	0.91	1.06
Mean Tide Level (MTL)	-0.20	-0.34	-0.23
Mean Sea Level (MSL)	-0.22	-0.36	-0.25
Mean Low Water (MLW)	-1.51	-1.60	-1.52
Mean Lower Low Water (MLLW)	-1.60	-1.68	-1.60

2.2 Storm Surge Hydrographs

Given the bridge's location crossing the Trout River, a tidally influenced waterway with a significant contributing drainage area, analysis of both storm surge and riverine runoff events proves imperative in determining the appropriate design conditions. The FDOT storm surge hydrographs (Sheppard and Miller, 2003) at Manhattan Beach were selected due to their close proximity to the St. Johns River Entrance. Figure 2-3 illustrates these hydrographs, which serve as Atlantic Ocean boundary conditions for an existing calibrated ADCIRC model.

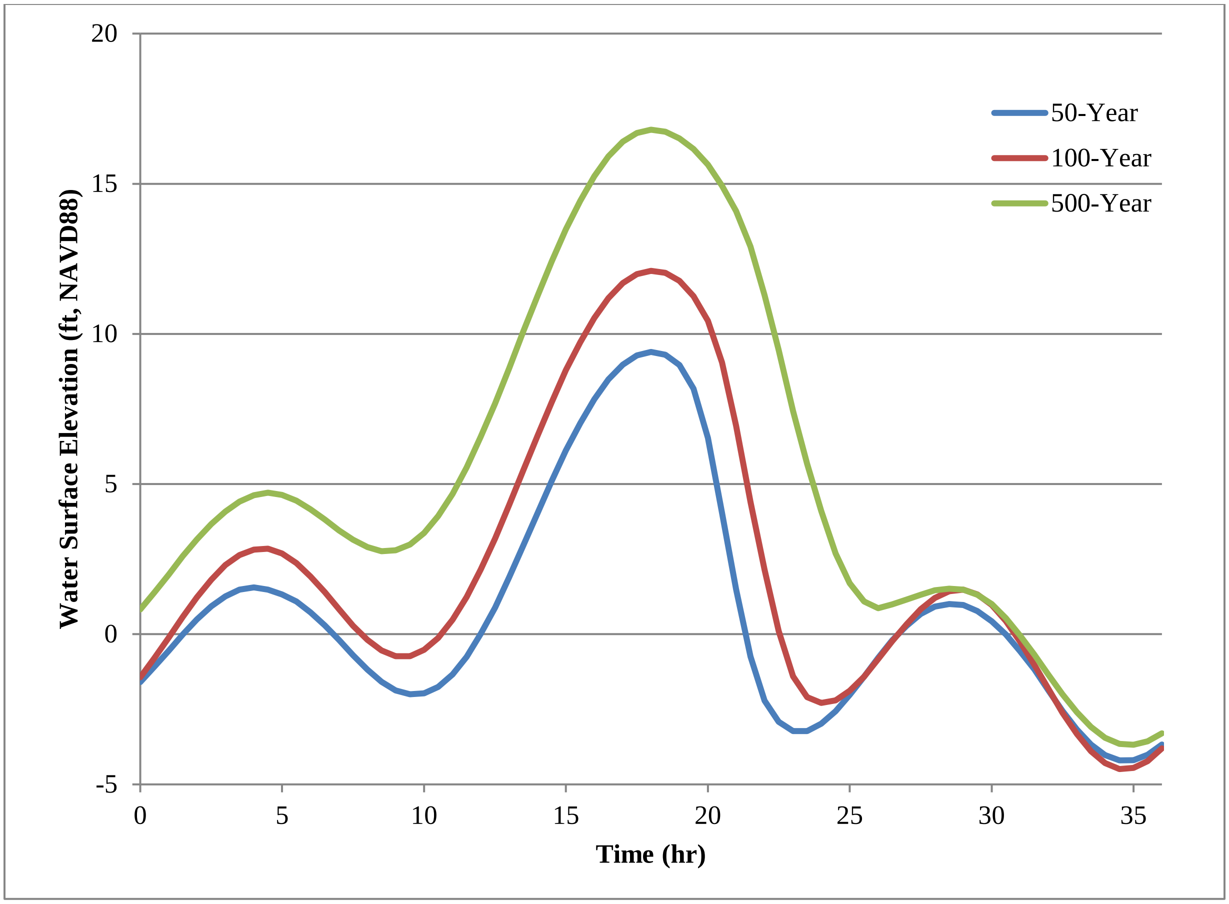


Figure 2-4 FDOT Storm Surge Hydrographs at Manhattan Beach

2.3 Sea Level Rise Analysis

FDOT Drainage Manual Section 3.4.1 requires sea level rise (SLR) to be included in new designs and describes a methodology based on historical analysis of long-term NOAA tidal stations. The nearest tidal station for analyzing sea-level rise is the NOAA station at Mayport, FL (Station ID:8720218). FDOT requires using the straight-line regression extrapolation for this gage to develop sea-level rise. At Mayport, this rate is 2.83 mm/yr. MSL for NOAA tidal benchmarks is reported for the 1983-2001 tidal epoch. Sea-level rise will be calculated from the midpoint of this period (1992) and projected to the end of service date for the new bridge (assuming 75-year design life and construction completion in 2025). This results in a sea-level rise of 1.00 ft at the structure's end of design life (Table 2-2). This value was included in the model simulations.

Table 2-2 Sea Level Rise Calculations

Beginning of Epoch	1983
End of Epoch	2001
Midpoint of Epoch	1992
Construction Year	2025
Bridge Life (years)	75
Total SLR duration (years)	108
Annual SLR (mm/year)	2.83
Total SLR (mm)	306
Total SLR (feet)	1.00

2.4 FEMA Flood Zones and Elevations

Lem Turner Bridge is not in a regulatory FEMA floodway. It is in FEMA Zone AE with a base flood elevation (BFE) of +5 ft NAVD (Figure 2-4) (FEMA, 2018). The AE designation shows that the area is subject to inundation by the 1-percent-annual-chance flood event and wave heights are less than 1.5 ft if any. FEMA maps show the 100-yr still water elevation (SWE) is between 4.5 and 5.5 ft-NAVD. Given the BFE is +5 ft-NAVD, the wave heights are limited to below one foot.

The closest coastal transect which provides still water elevations for different return periods is Transect 52. This transect is at the confluence of St. Johns River and Trout River and is not very close to the bridge but has similar 100-yr still water elevations to the bridge location. The SWEs for Transect 52 are summarized in Table 2-3.

Table 2-3 FEMA Transect 52 Still Water Elevations (ft-NAVD)

50-yr	+4.2
100-yr	+5.0
500-yr	+6.6

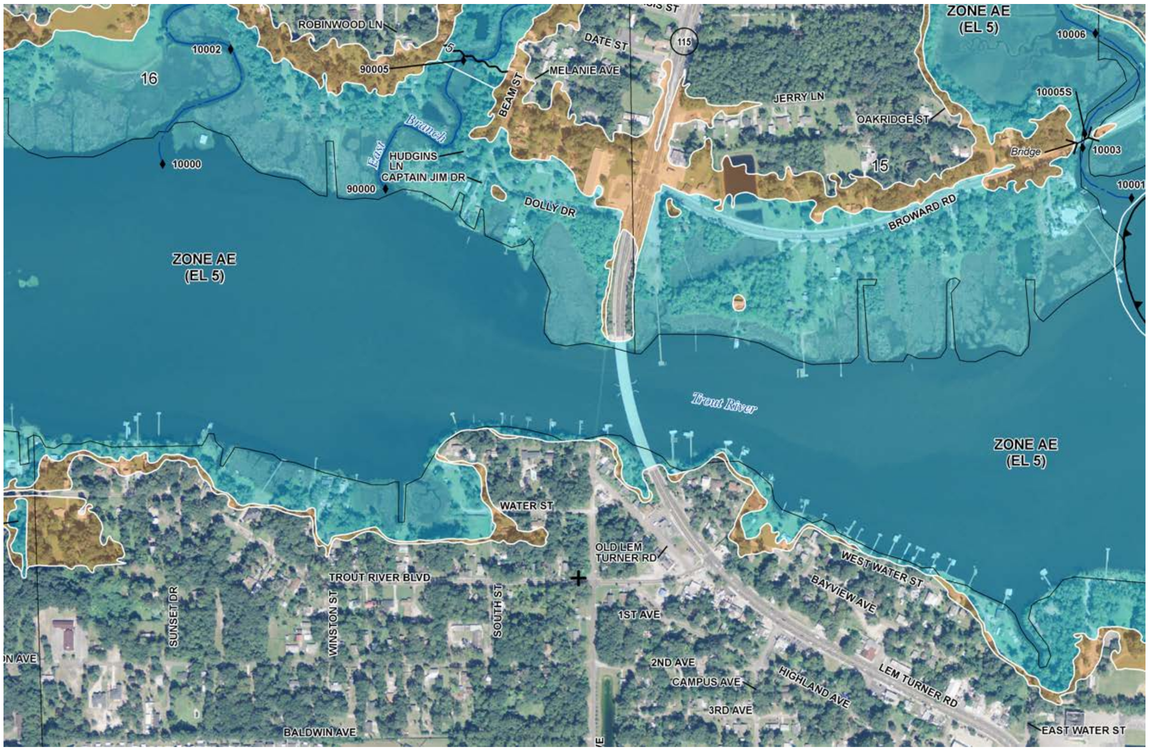


Figure 2-5 FEMA Flood Map

2.5 Hydrology

FEMA (2018) developed flow rates for all the riverine sources in the study area for different return periods. Sources upstream of the bridge are summarized in Table 2-4.

Table 2-4 FEMA Discharges

Flooding Source /Return Period	Peak Discharge (cfs) 10-year	50-year	100-year	500-year
Trout River	1430	2395	2620	2919
Gulley Branch	308	542	629	934
Half Creek	660	1245	1474	2188
Ninemile Creek	1055	1715	1958	2805
West Branch	631	1016	1143	1581
East Branch	283	369	390	470
SUM	4367	7282	8214	10897

2.6 Geotechnical Information

Wood Environment & Infrastructure Solutions, Inc. (Wood) completed a geotechnical study at the project location on May 2019 for FDOT. Wood conducted 26 borings and sieve analysis on 22 samples from these borings. The median grain size varied between 0.11 mm and 1.7 mm. However, most of these samples are from depths much deeper than the possible scour ranges. The three samples within the scour depth ranges are summarized in Table 2-5. Median sediment sizes for these samples are 0.11, 0.18, and 0.21 mm. Larger grain sizes create larger local scour in this range, so the median diameter is assumed 0.20 mm for scour calculation purposes. Excerpts from the Geotechnical Report are in Appendix A.

Table 2-5 Summary of Geotechnical Data Obtained from Waterway Cores

Core Boring	Sample Depth (ft)	D50 Diameter (mm)	Soil Classification
B-16R	11-12.5	0.18	SP-SM
B-18L	13.5-15	0.21	SP-SC
B-18R	8.5-10	0.11	SM

2.7 Site Observation

INTERA engineers visited the project site on August 24, 2021. FDOT road maintenance crews were working at the site during the visit. The existing structure is supported by inline pile bents with eight piles at each bent. Some of the piles were repaired with pile jackets. Beneath the bridge the waterway is generally clear except low density grass towards the bridge ends. The abutments are protected by sand cement bags under the bridge and grout on the sides. There is vegetation growth on sand cement and various cracks. There have been numerous repairs of the sand cement with grout. There was fresh repair on the south side. The sand cement bags at the toe of the south side abutment are scattered below the water level. Figure 2-5 shows the east face of the existing bridge. Additional photos are contained in Appendix B.

Figure 2-6 Downstream Face of Existing Bridge

2.8 Proposed and Existing Bridge Design

The existing bridge consists of nineteen 36' spans and one 48' navigational span with a total length of 732' (Appendix C). The eighteen interior inline bents have eight 20" square concrete piles. As a part of a repair project some of the piles have pile jacket increasing the width to 32" and some pile bents have brackets and cross-braces.

The proposed Lem Turner Bridge Replacement Alt E Mod 1 will move the bridge alignment slightly east, switching from a curved to straight alignment. It will consist of eight 96' spans with a total bridge length of 768' (Figure 2-6). The seven interior inline pile bents consist of eight 24" square concrete piles spaced at 12'. The inline bents are not skewed from the roadway centerline.

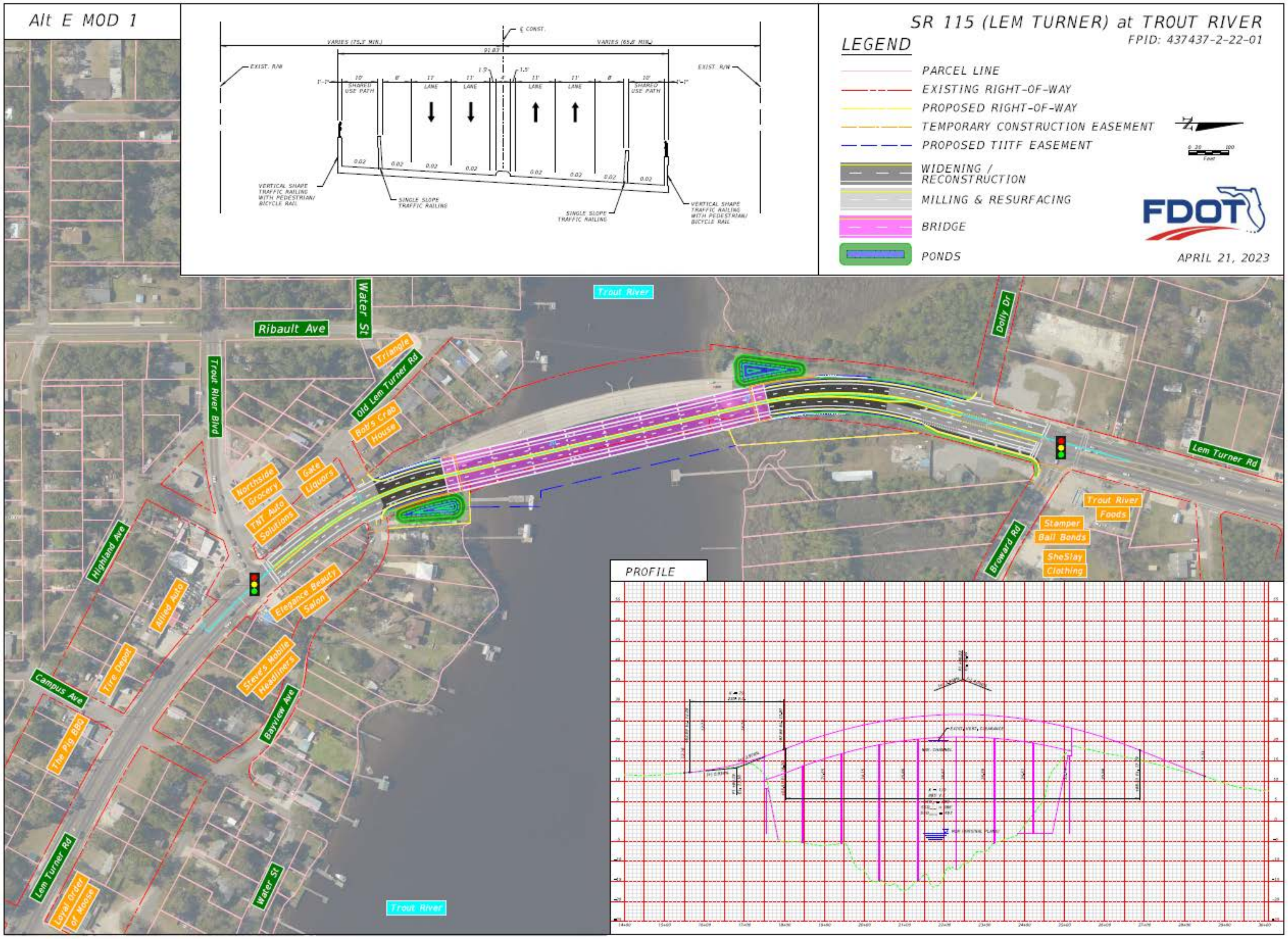


Figure 2-7 Proposed Bridge (Alt E-Mod1) Plan and Elevation (Source: Parsons)

2.9 Bathymetric/Topographic Data Collection

An accurate representation of bathymetry and topography within the hydraulic model is critical to achieve realistic design hydraulic parameters at the bridge location. In support of this study, a bathymetric survey was conducted on 3/8/21 by DRMP. The survey points are shown in Figure 2-7. The modified section of the model outside the survey area used NOAA's Continuously Updated Digital Elevation Model (CUDEM) with a resolution of 1/9 Arc-Second.

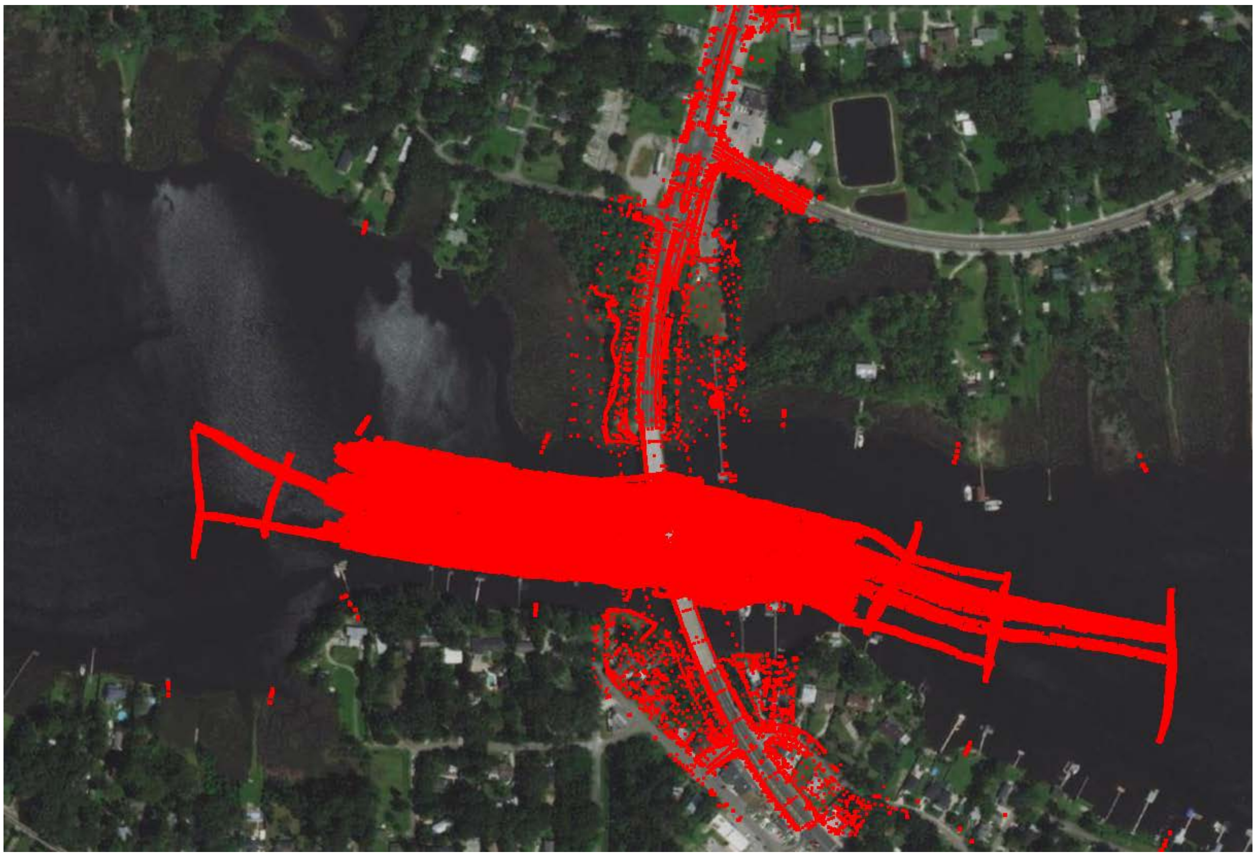


Figure 2-8 Bathymetric Survey Extents

3.0 Hydraulic Modeling

According to FHWA and FDOT guidelines, computation of scour and design of abutment protection requires knowledge of specific hydraulic parameters. This study employed the circulation model ADCIRC to hindcast design conditions. This chapter explains the employed methodology. The design conditions at the Lem Turner Bridge over Trout River are controlled both by hurricane storm surge events and riverine runoff. Both cases are simulated, and the design conditions use the worst-case scenario for all parameters.

3.1 Model Mesh

INTERA developed a calibrated ADCIRC model of the St. Johns River and its tributaries including Trout River (INTERA, 2018). This model was modified to increase resolution at the bridge site and along the Trout River. The mesh extends 100 miles to the north and south of the mouth of St. Johns River and 130 miles offshore into the Atlantic Ocean (Figure 3-1). St Johns River is included down to Lake George. The model mesh resolution changes from 4.5 miles at the offshore boundary to 50 ft at the bridge location (Figure 3-2 - Figure 3-4). This unstructured mesh provides high resolution along the important waterways, while keeping the total number of nodes and runtime manageable.

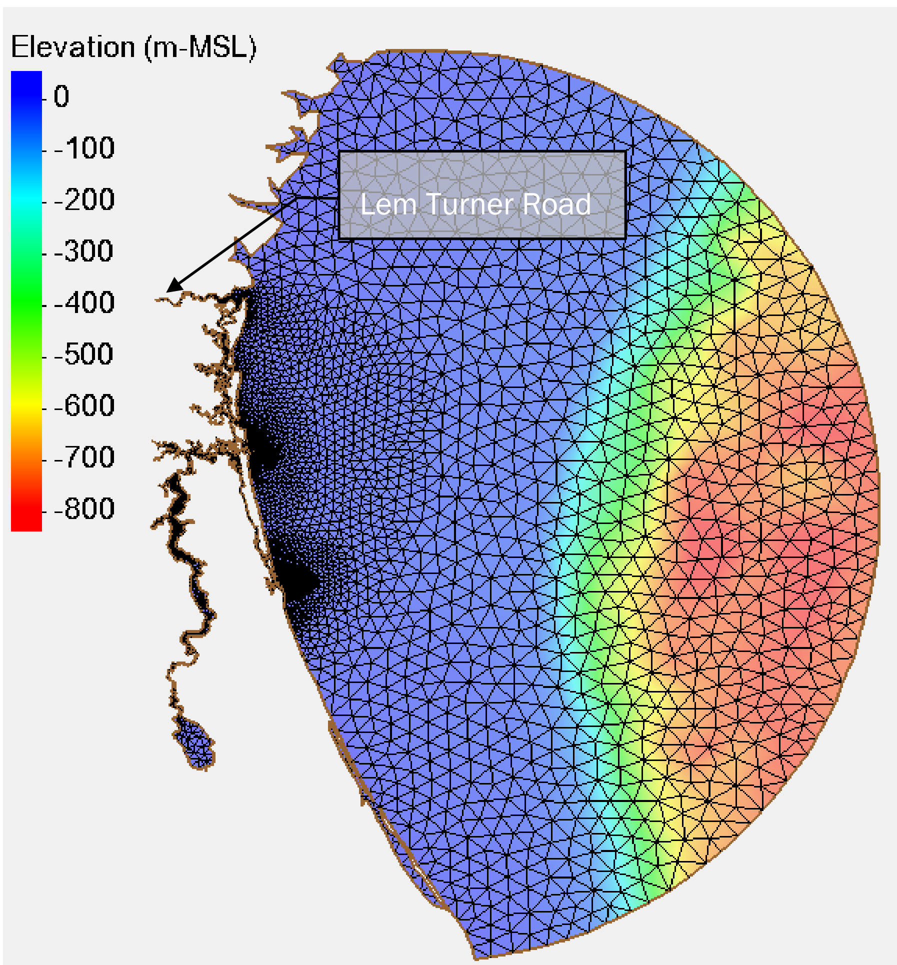


Figure 3-1 ADCIRC Mesh Full Extent

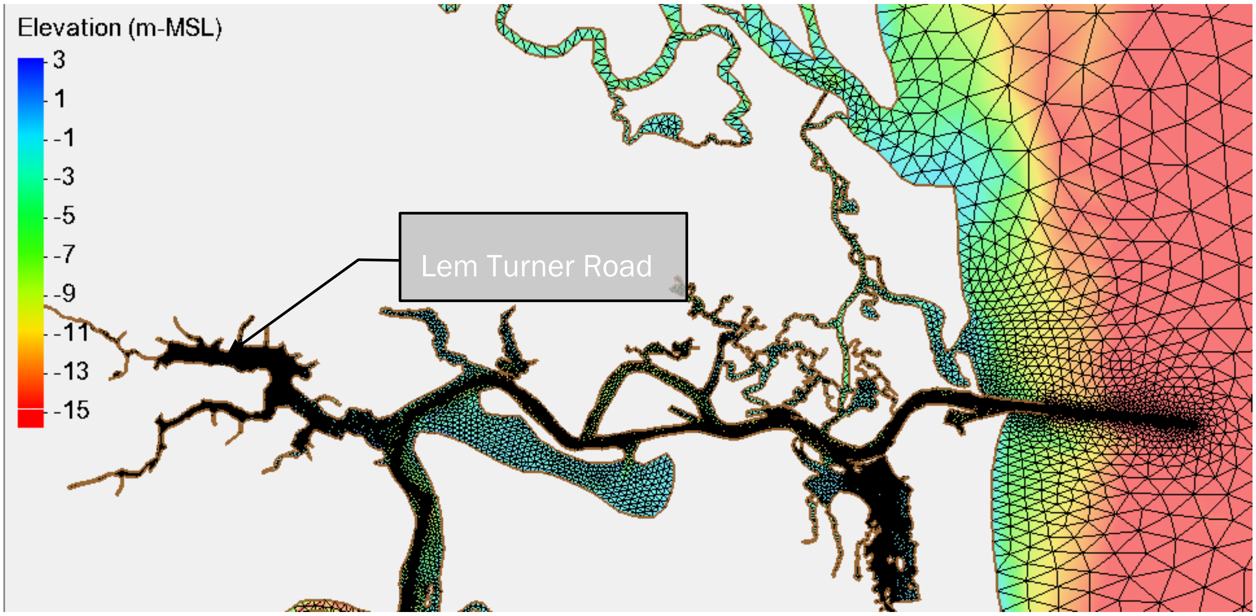


Figure 3-2 ADCIRC Mesh St. Johns River and Trout River

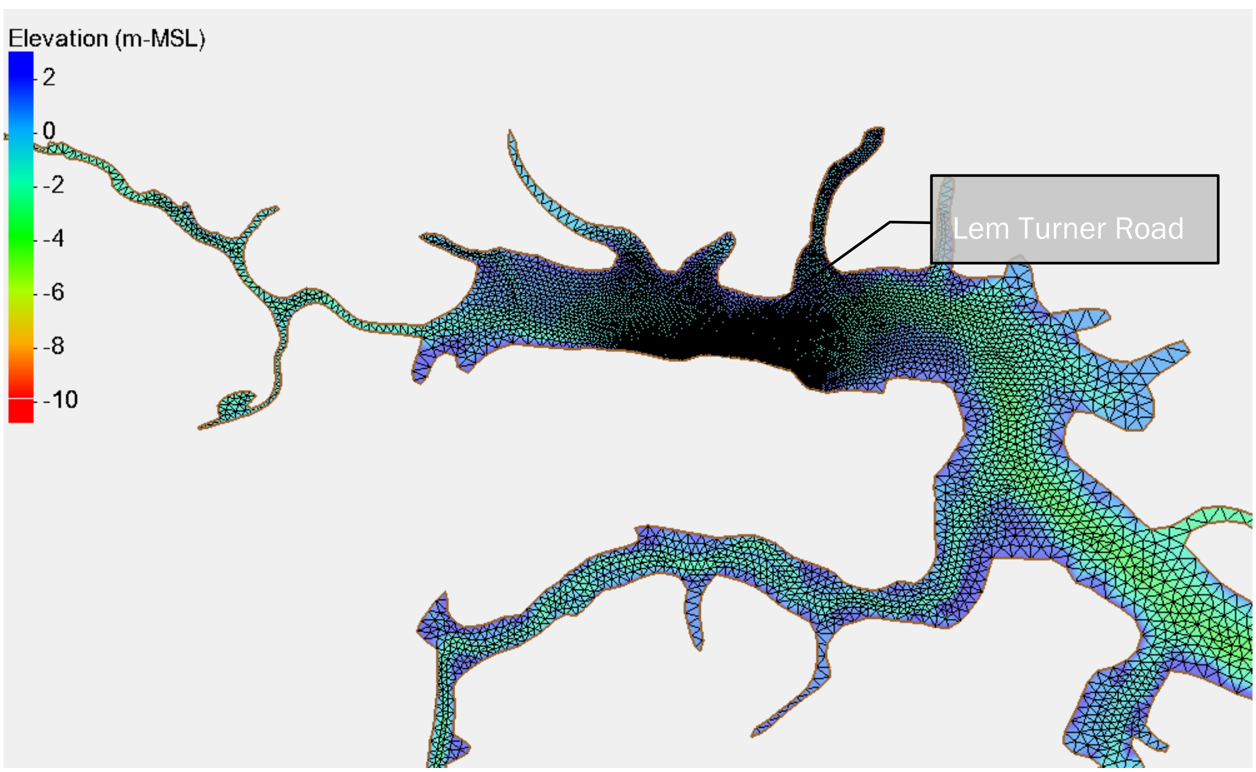


Figure 3-3 ADCIRC Mesh Trout River and Ribault River

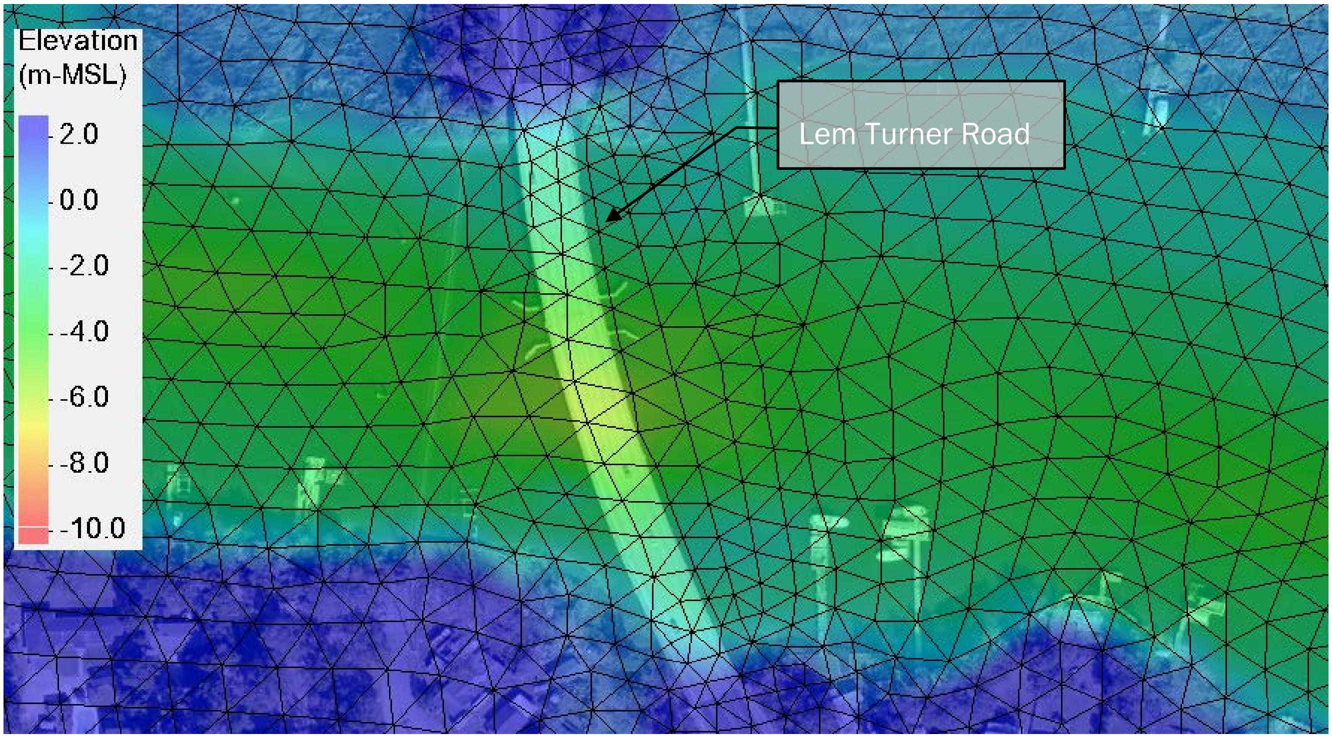


Figure 3-4 ADCIRC Mesh Lem Turner Bridge

3.2 Existing Model Calibration

Tidal calibration of the existing ADCIRC model was performed with NOAA tide gage data collected in August 2007. The calibration period extended for 31 days, such that a full tidal cycle is included in the data. The calibration was performed with data collected from the nearest NOAA tidal station (8720226) located at Main St. Bridge, in Jacksonville. Tidal signal from the same period at the NOAA Mayport Tidal station (8720218) was applied to the eastern ADCIRC model boundary as a water surface elevation hydrograph. Table 3-1 summarizes the model calibration results.

Table 3-1 Summary of Model Calibration at the NOAA Main St Bridge Gage (8720226)

Parameter	Value
Tidal Range (ft)	3.2
Average Error (ft)	-0.24
RMS Error (ft)	0.33
Percent Error (%)	10.2

Where:

Average error is calculated as:

$$Average\ Error = \frac{\sum_0^n \left(Elev_{gage} - Elev_{model}\right)_i}{n}$$

RMS error is calculated as:

$$RMS\ Error = \sqrt{\frac{\sum_0^n \left(Elev_{gage} - Elev_{model}\right)_i^2}{n}}$$

Percent error is calculated as:

$$Percent\ Error = \frac{RMS\ Error}{Tidal\ Range} * 100$$

3.3 Riverine Runoff Results

Runoff conditions are simulated using the total flow rates upstream of the bridge as the upstream boundary condition and the mean low water (MLW) as the downstream boundary condition. This creates the largest elevation gradients and velocities. Higher water elevations at the downstream boundary would create higher surge elevations, but these would still be much lower than the storm surge elevations, so they were not modeled.

Results of the riverine simulations are summarized in Table 3-2. Riverine runoff with MLW downstream boundary condition causes no increase in stage but leads to high velocities. Figure 3-5 shows the 500-year flow velocities at the bridge location.

Table 3-2 Riverine Runoff Results

Parameter	Design (50-Year) Flood	Base (100-Year) Flood	Greatest (500-Year) Flood
Stage Elevation (ft-NAVD)	-0.1	0.0	+0.1
Discharge (cfs)	8,014	9,047	12,132
Maximum Velocity (ft/s)	1.74	1.93	2.59
Average Velocity (ft/s)	1.39	1.54	2.03

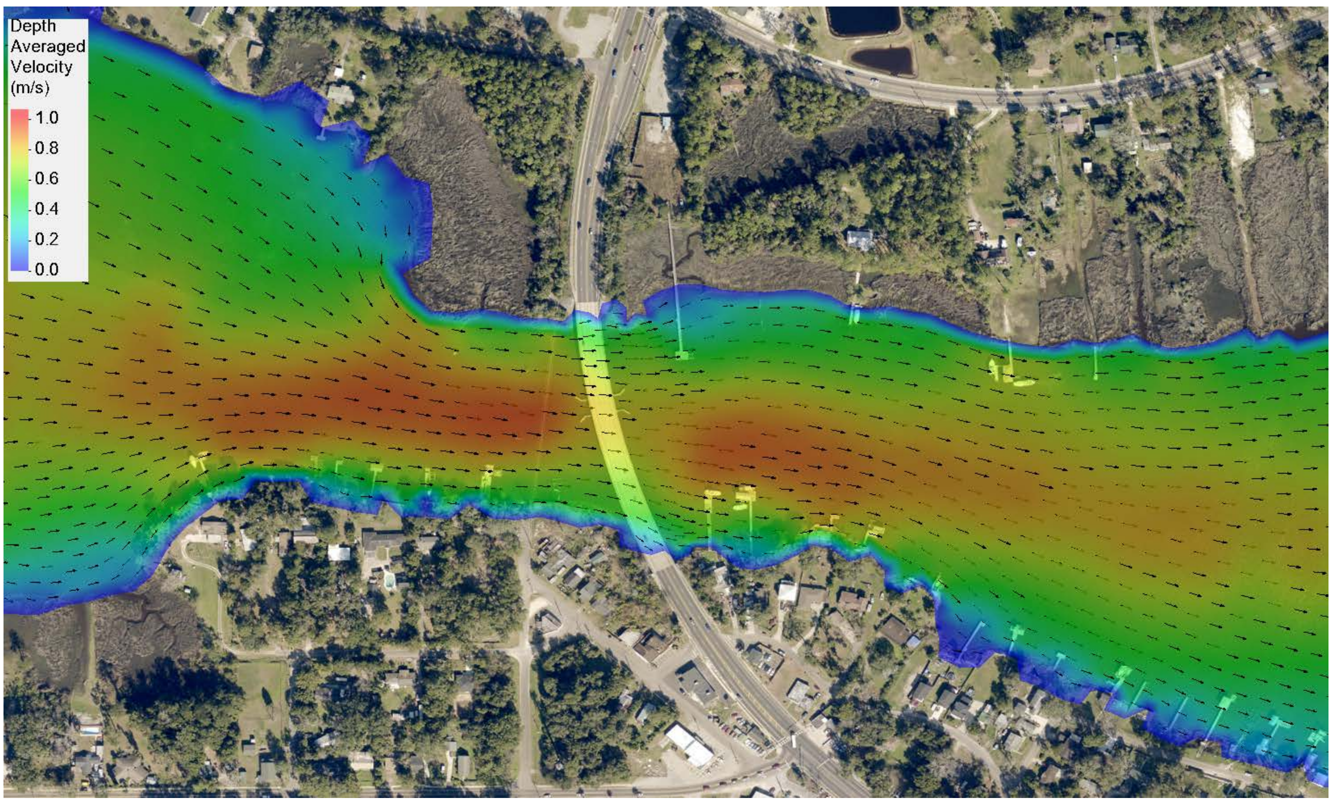


Figure 3-5 500-Year Runoff Velocity Magnitude Contour Plot

3.4 Storm Surge Results

Storm surge hydrographs presented in Section 2.2 provide the surge model boundary conditions. However, applying these hydrographs across the long offshore boundary is unrealistic and leads to excessive surge conditions. Hydrographs were applied at the center of the offshore boundary creating more realistic conditions. The extent of the boundary condition was adjusted to match the surge conditions predicted by FEMA models. After matching the FEMA surge elevations, sea level rise (Section 2.3) was included in the simulations to produce the design conditions. Hurricanes produce rainfall in addition to storm surge. For bridges with relatively small drainage basins and a small time of concentration, it is recommended a combination of storm surge and rainfall runoff is considered. Phasing of peak storm surge and rainfall runoff is highly variable, so a steady rainfall runoff discharge was applied at the upstream model boundary to account for phasing variability. Per Section 4.7.2 of the FDOT Drainage Manual, a steady 10-year discharge (Section 2.5) was applied at the upstream model boundary for the combined flow simulations.

Results of the storm surge simulations are summarized in Table 3-3. Velocities decrease for larger return period events. This counterintuitive condition occurs frequently in storm surge simulations since water surface gradients are not a linear function of the maximum surge. Furthermore, discharges also decrease with increasing return period. Total amount of flux is larger for larger events, but due to the change in the shape of the hydrograph lower maximum flows may be observed. Figure 3-6 shows the 50-year flow velocities at the bridge location at the time of maximum velocities. Velocities peak before and after the maximum surge. The ebb flow creates the largest velocities.

Table 3-3 Storm Surge Results

Parameter	Design (50-Year) Flood	Base (100-Year) Flood	Greatest (500-Year) Flood
Stage Elevation* (ft-NAVD)	+5.5	+6.3	+8.6
Discharge (cfs)	15,641	15,602	16,623
Maximum Velocity (ft/s)	2.45	2.44	2.30
Average Velocity (ft/s)	1.83	1.80	1.69

* including SLR

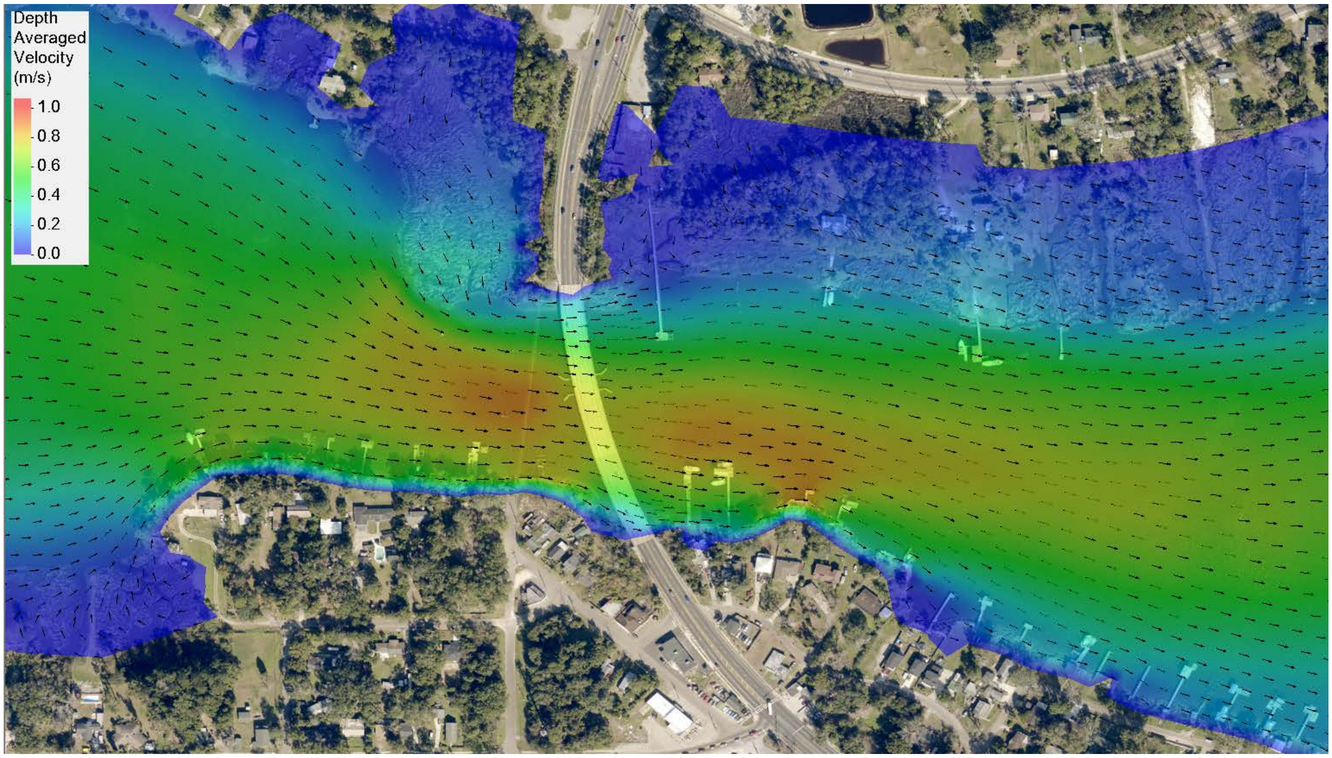


Figure 3-6 50-Year Storm Surge Velocity Magnitude Contour Plot

3.5 Design Conditions

The worst-case conditions from the riverine runoff and storm surge simulations create the hydraulic design conditions. Additionally, the 50-year simulation results larger than the 100-year results replaced the 100-year results as the base flood. The final hydraulic design data is summarized in Table 3-4.

Table 3-4 Hydraulic Design Data

Parameter	Design (50-Year) Flood	Base (100-Year) Flood	Greatest (500-Year) Flood
Stage Elevation (ft-NAVD)	+5.5	+6.3	+8.6
Discharge (cfs)	15,641	15,641	16,623
Maximum Velocity (ft/s)	2.45	2.45	2.59
Average Velocity (ft/s)	1.83	1.83	2.03
Exceedance Probability (%)	2	1	0.2
Frequency (year)	50	100	500

4.0 Scour Analysis

Total scour consists of three components: (1) long-term scour (aggradation/degradation and channel migration), (2) contraction scour, and (3) local scour. Unlike long-term scour, the contributions of local and contraction scour are derived from the results of the hydraulic analysis presented in Chapter 3. Their corresponding scour computations apply empirical equations developed by FDOT in conjunction with the University of Florida (Sheppard & Renna, 2013). The formulation of the complex pier scour calculation methodology follows techniques described in the Hydraulic Engineering Circular No. 18 (HEC-18) (Federal Highway Administration, 2009). These equations require inputs such as stream flow rate, local velocities (magnitude and direction) at the piers, and depth of flow. The model simulations presented in Chapter 3 provide the values for these parameters. This chapter discusses scour components and the results of these scour calculations for the proposed replacement bridge.

Scour depth computations require values for the depth-averaged critical velocity of the waterway necessary to initiate sediment motion on the bed. Calculating the onset of sediment transport, requires a representative median sediment size (D_{50} = 0.20 mm). In Chapter 3, hydraulic results from two types of simulations were assessed: riverine runoff, and storm surge. Scour calculations are highly sensitive to flow velocity, and conditions produced in the storm surge simulations create higher velocities, and as such, contraction scour, and local scour are computed with hydraulic inputs from the simulations with higher velocities.

4.1 General Scour

Most of the bridges in the National Bridge Inventory (NBI) that cross alluvial streams continually adjust their beds and banks (Legasse, et al. 2012). Channel stability at the bridge crossing depends on the stream system. Changes upstream and downstream affect stability at the bridge crossing. Natural and man-made disturbances may result in changes in sediment load and flow dynamics resulting in adverse changes in the stream channel at the bridge crossing. These changes may include channel bank migration, aggradation, or degradation of the channel bed. During channel migration, one bank tends to erode laterally while the opposite bank tends to accrete. During aggradation or degradation of a channel, the channel bed and thalweg tend to accrete or erode.

Channel stability, as characterized by channel migration and aggradation/degradation of the channel bed, is an important consideration in evaluating the potential scour at a bridge for two reasons. First, because aggradation and degradation influence the channel's hydraulic properties, any hydraulic modeling must consider their effects when determining design scour conditions. Second, bank migration, thalweg shifting, and degradation may cause foundation undermining regardless of whether the bridge experiences the design storm event. This section presents an analysis of channel migration and aggradation/degradation of the channel bed at the Lem Turner Road over Trout River. This analysis forecasts channel stability based on historic observations near the bridge. The analysis incorporates a review of available historic aerial imagery and historic bed cross sections in the vicinity of the bridge. These help to evaluate channel migration and thalweg position within the channel banks and aggradation or degradation of the bed.

4.1.1 Aggradation/Degradation

Aggradation and degradation refer to the long-term raising or lowering of the stream bed. Aggradation and degradation are the result of excess or insufficient sediment transport in a stream to maintain its bed elevation. Aggradation and degradation are typically long-term processes, but significant changes in an upstream drainage basin, such as the installation of a dam or construction of a large development resulting in a drastic change in land-use, may result in accelerations in aggradation or degradation. The most reliable method for assessing aggradation and degradation is through inspection of historic bed profiles at the bridge crossing. These are often cataloged within bridge inspection reports.

For this bridge, the FDOT provided channel cross-sections from Mar-1956, Oct-2014, 2Apr-2018, Sep-2018, and Apr-2019. Figure 4-1 presents the left and right profiles, and Figure 4-2 presents the left and right average change across bents 2-20 since 1956. Bent 1 was not included in the average change, because it was not measured some years. The waterway experienced 2.5 ft degradation from 1956 to 2014, but it is relatively stable from 2014 to 2019 with fluctuations around 0.5 ft. It is not clear if the waterway became stable after an initial adjustment after the bridge construction or still going through a slow degradation. There is no survey between 1956 to 2019 to confirm the long-term stability of the waterway, so a linear degradation pattern is assumed. The waterway degraded 2.5 ft in 63 years, so 3.0 ft degradation will be assumed for the 75-year planned lifetime of the bridge.

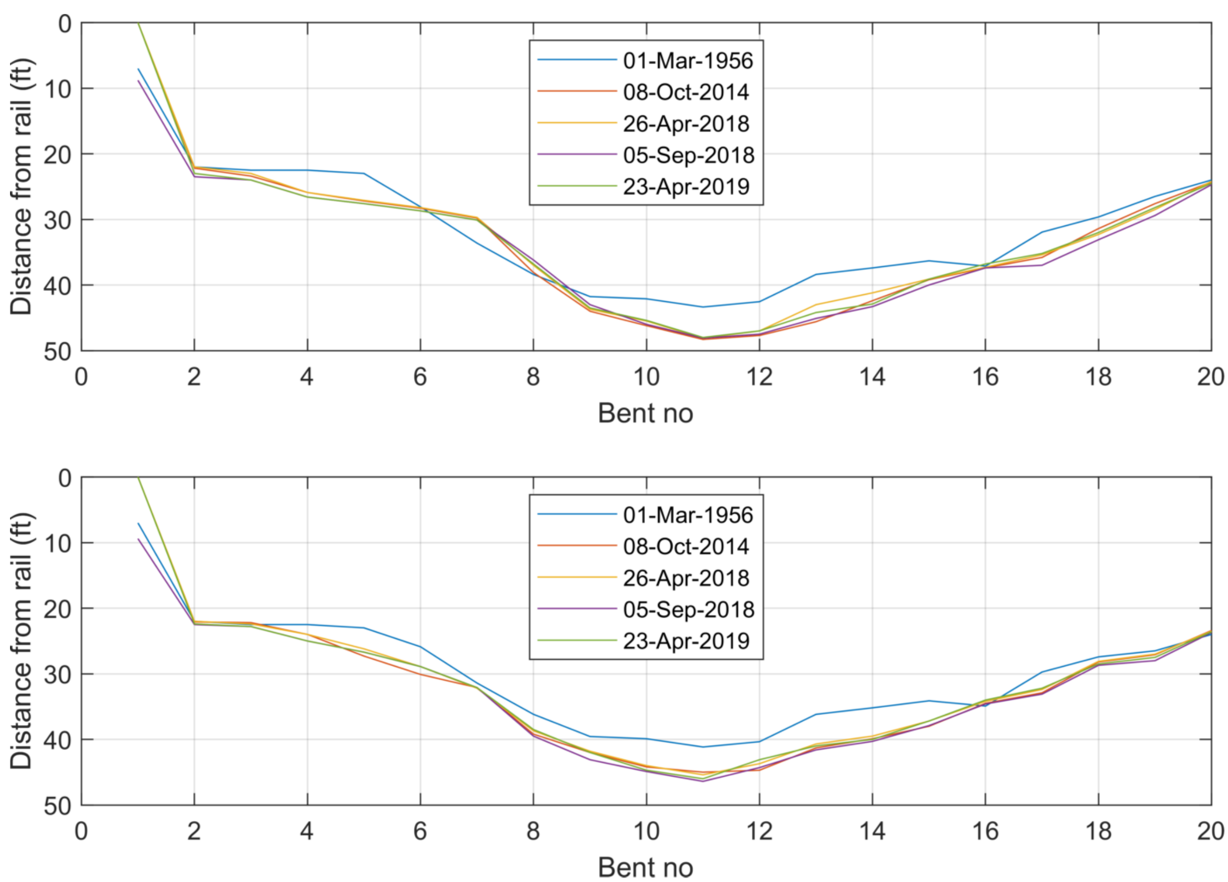


Figure 4-1 Left (Top) and Right (Bottom) Profiles (Source: FDOT Bridge Inspection Reports)

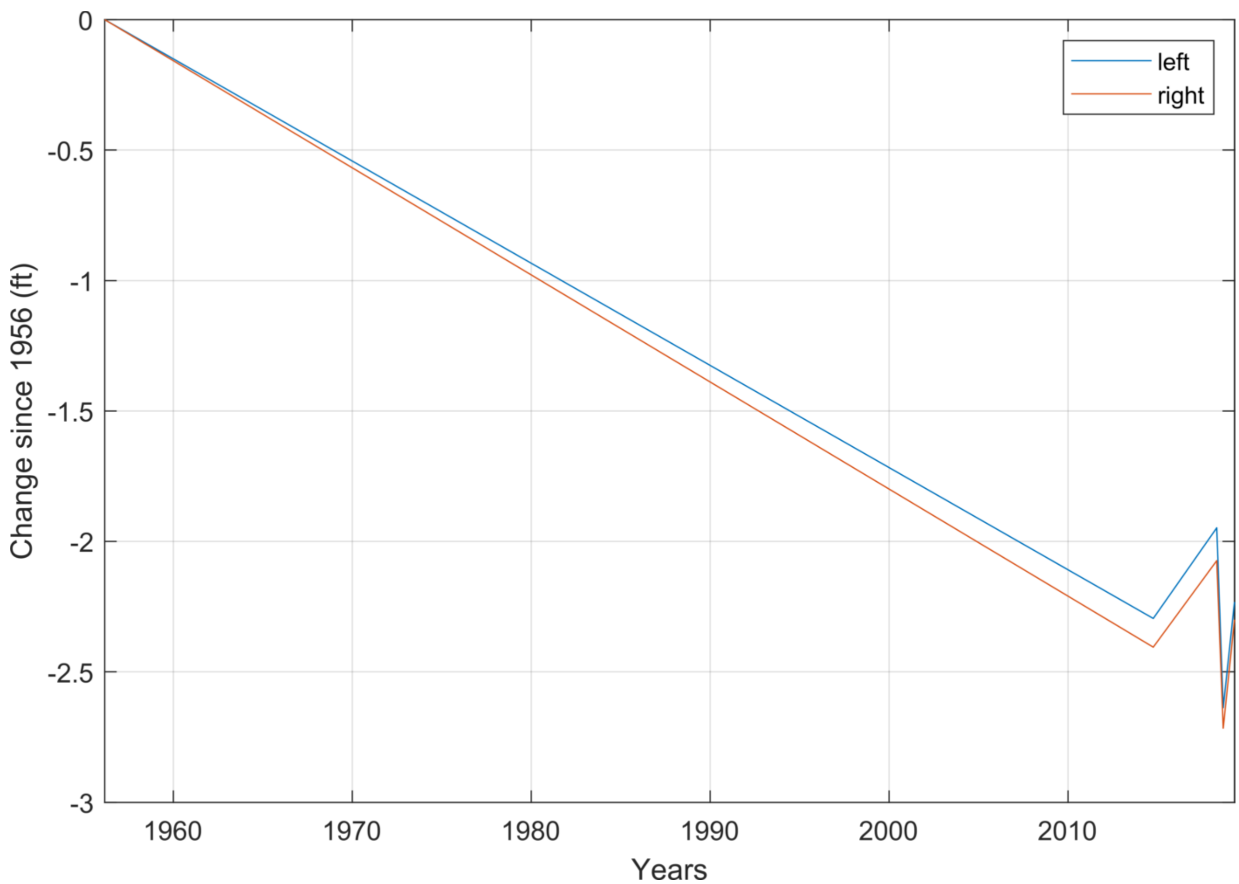


Figure 4-2 Average Change in Bed Elevation since 1956

4.1.2 Channel Lateral Migration

Lateral channel migration is an important factor to consider when deciding on a bridge's location. Rivers and streams, dynamic entities, can continually shift banklines and move both laterally and downstream. Bridges, on the other hand, are static entities that fix the river/stream at a specific location. This juxtaposition of a bridge's immobility and a river's instability can lead to erosion of the approach embankment, changes in the contraction or local scour due to changes in flow direction or increases in abutment scour. Factors affecting lateral channel migration include stream geomorphology, bridge crossing location, flood characteristics, characteristics of the bed and bank material, and wash load (Arneson et al., 2012).

Identification of lateral channel migration occurs through examination of historic aerial photographs, historic shoreline locations, historic bathymetries, bridge inspection reports, and current condition of the upstream and downstream banks.

Figure 4-3 through Figure 4-12 present historic aerial images of the project location spanning from 1959 to 2021. During this period, the area surrounding the bridge was lightly developed, but the riverbank lines appear stable in the imagery record. Lateral migration is not a likely source of long-term scour for this bridge.

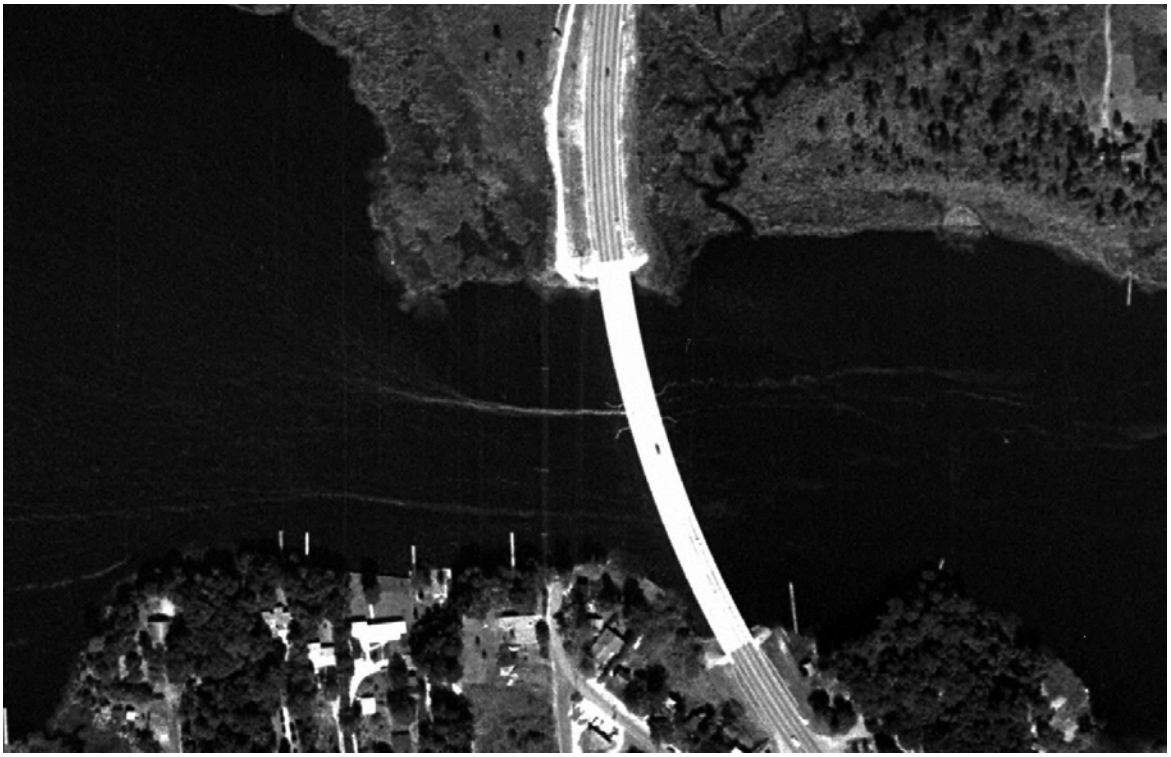


Figure 4-3 1959 FDOT Aerial Image

Figure 4-4 1969 FDOT Aerial Image

Figure 4-5 1975 FDOT Aerial Image

Figure 4-6 1982 FDOT Aerial Image

Figure 4-7 1994 Google Earth Aerial Image

Figure 4-8 1999 Google Earth Aerial Image

Figure 4-9 2002 Google Earth Aerial Image

Figure 4-10 2008 Google Earth Aerial Image

Figure 4-11 2013 Google Earth Aerial Image

Figure 4-12 2021 Google Earth Aerial Image

4.2 Contraction Scour

An abrupt decrease in cross-sectional area at a bridge induces an increase in velocity, which causes contraction scour (a lowering of the channel bottom over the entire width of the cross section). Changes in cross-sectional area can result from natural channel constriction and encroachment of a bridge structure by both the abutments and the piles. HEC-18 presents equations and procedures for computing contraction scour under various encroachment conditions (cases). Case 1B (Figure 4-13) — abutments at edge of channel — best approximates the conditions at the bridge.

Computing contraction scour for the bridge requires determining whether the scour occurs as live-bed or clear-water. That is, scour depth computations require values for the depth-averaged critical velocity in the channel necessary to begin sediment motion on the bed. Calculating these values requires representative sediment sizes (generally the median grain size, *D50*). This analysis applied a median grain size of 0.20 mm (Section 2.6).

For clear-water conditions, contraction scour computations follow Laursen (1963)'s clear-water contraction scour equation contained in HEC-18 (Section 6.4):

$$y_2 = \left[\frac{K_u Q^2}{D_m^{2/3} W^2} \right]^{3/7} \tag{4.1}$$

where y_2 is the average depth in the contracted section after contraction scour, K_u is a constant (0.0077), Q is the flow rate through the cross section, D_m equals 1.25 times *D50* (median diameter of the bed material), and W is the bottom width of the cross section (less the pier widths). The average contraction scour depth (y_s) then equals

$$y_s = y_2 - y_0 \tag{4.2}$$

where y_0 is the average existing depth in the contracted section.

Live bed contraction scour computation follows the Modified Laursen Live Bed Contraction Scour Equation found in HEC-18 (Section 6.3):

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1} \right)^{6/7} \left(\frac{W_1}{W_2} \right)^{k_1} \tag{4.3}$$

where y is the average depth of the cross section, Q is the flow rate through the cross section, and W is the width of the cross section. The subscripts 1 and 2 refer to the locations upstream of the bridge and at the bridge. For live bed conditions, sediment transport primarily occurs as suspended load. As such, k_1 ranges from 0.64 to 0.69. If primarily bed load sediment transport, then k_1 equals 0.59. One then applies Equation 4.2 to determine scour depth. Figure 4-14 shows the locations of the upstream and bridge cross sections employed in the analysis. Selection of the appropriate upstream cross section (located either east or west of the bridge) pivoted based on the direction of the flow at the time of maximum flow at the bridge.

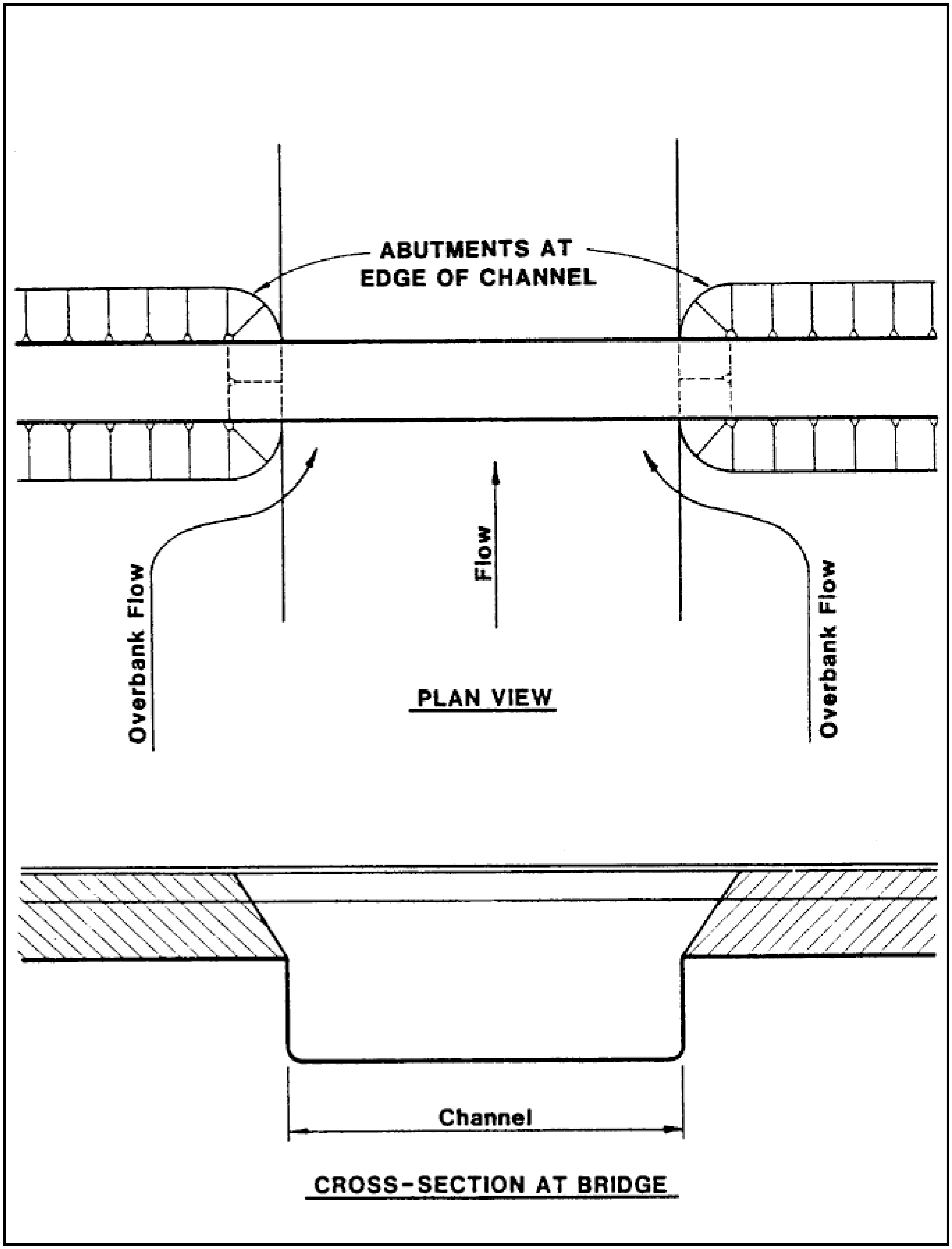


Figure 6.2. Case 1B: Abutments at edge of channel.

Figure 4-13 Case 1B: Abutments at the edge of Channel (Source: HEC-18)

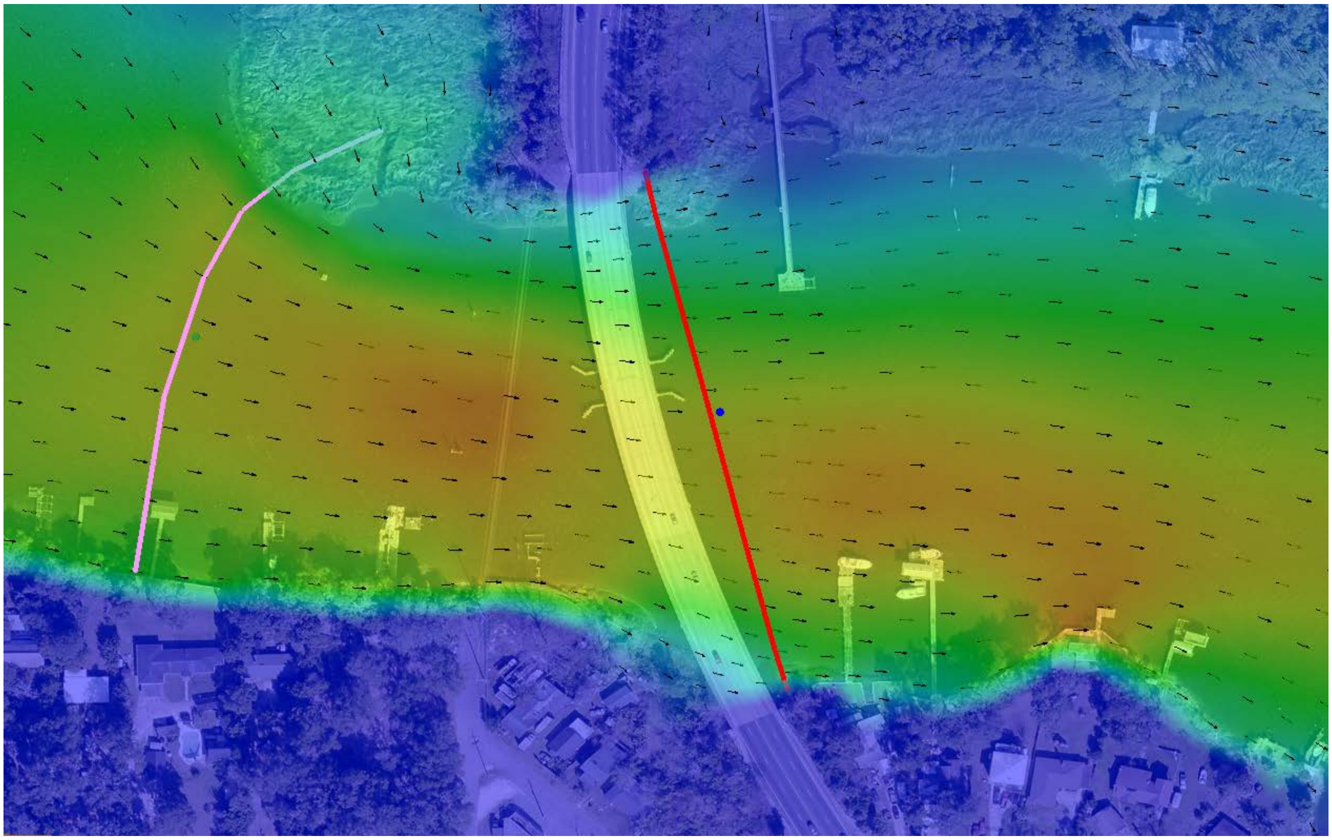


Figure 4-14 Contraction Scour Upstream and Bridge Cross Section Locations

Table 4.1 presents the contraction scour results for the base flood and greatest flood events. Surge conditions create larger flow rates and were used for contraction scour. As discussed in section 3.5 50-year surge created larger flow rates than 100-year surge and was used as the base flood. Based on their average flows, water depths, velocities, and replacement bridge geometry, both the base flood and the greatest flood produce zero contraction scour (Table 4.1). This is mainly due to the depths at the bridge cross-section already being larger than the approach cross-section.

Table 4-1 Contraction Scour				
Variable	**Units**	**Definition**	**Base (100-Year) Flood**	**Greatest (500-Year) Flood**
y_1	ft	Average depth in the upstream main channel	10.3	12.2
V_1	ft/s	Average velocity in the upstream main channel	2.2	1.9
D_{50}	mm	Median diameter of bed material	0.20	0.20
K_u		V_c Coefficient	6.1900	6.2
V_c	ft/s	Critical velocity	1.44	1.48
$V_1>V_c$?		Scour Mode	livebed	livebed
y_1	ft	Average depth in the upstream main channel	10.3	12.2
y_2	ft	Average depth in the contracted section	10.4	12.5
y_0	ft	Existing depth in the contracted section before scour	12.3	14.3
Q_1	ft³/s	Flow in the upstream channel transporting sediment	15,277	15,932
Q_2	ft³/s	Flow in the contracted channel	15,641	16,623
W_1	ft	Bottom width of the upstream main channel that is transporting bed material	668	668
W_2	ft	Bottom width of main channel in contracted section less pier width(s)	684	684
K_1		Exponent	0.64	0.69
y_s	ft	Contraction scour	0	0

4.3 Local Scour

Local scour refers to bed erosion around obstacles in the path of flow such as bridge piers and abutments. Local scour results from increased shear and normal stresses applied to the bed near the structure due to the presence of the structure. Local pier scour depends on structure geometry, current velocity, angle of attack (the angle between the flow direction and the major axis of the pier/pile group), flow depth, and soil characteristics. Local scour may occur at bridge piers and abutments, but this report only addresses local pier scour since the abutments will have scour protection. This section provides local scour for two hydraulic conditions — the 100-year (base event) and the 500-year (check event).

The local pier scour calculation involved application of the Florida DOT methodology. The Florida DOT guidelines for calculating local pier scour require application of the scour equations developed by the FDOT and based on the latest research from the University of Florida for the analysis of complex pier geometries, which includes the equations developed for NCHRP for scour at wide piers (Sheppard et al 2011). This methodology combines the individual scour depths produced by the column, pile cap, and pile group. The local scour is then added to the general and contraction to produce the final bed elevation. The FDOT equations predict the scour hole depth based on sediment characteristics, flow parameters, and bent geometry. The flow parameters include depth, velocity, and angle of attack. The bent geometry includes the dimensions of the pier column, pile cap, and pile group. The inline bents are oriented 90-degrees from the roadway centerline.

As discussed in Section 3.5, 50-year surge conditions were used as the 100-year event and the 500-year runoff conditions as the 500-year event. Table 4-2 and Table 4-3 list the 100-year and 500-year results, respectively. Scour is a function of depth, velocity, and angle of attack. Conditions that create the largest scour coincided with large skew angles with lower velocities. Design elevations are calculated by rounding down to the nearest foot and taking the minimum of the neighboring piles to account for lateral movements. Any 500-year scour design elevation more than the 100-year was decreased to match the 100-year elevation. Scour calculations including all the inputs and outputs are in Appendix C.

Table 4-2 100-Year Scour Calculation Summary

Bent	Initial Bed Elevation (ft-NAVD)	Degradation (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)	Final Bed Elevation (ft-NAVD)	Design Elevation (ft-NAVD)
2	-5.9	3.0	0.0	7.8	10.8	-17	-19
3	-6.3	3.0	0.0	9.0	12.0	-19	-28
4	-14.9	3.0	0.0	9.5	12.5	-28	-30
5	-16.8	3.0	0.0	9.2	12.2	-30	-30
6	-13.3	3.0	0.0	8.7	11.7	-25	-30
7	-7.8	3.0	0.0	7.4	10.4	-19	-25
8	-3.9	3.0	0.0	4.4	7.4	-12	-19

Table 4-3 500-Year Scour Calculation Summary

Bent	Initial Bed Elevation (ft-NAVD)	Degradation (ft)	Contraction Scour (ft)	Local Scour (ft)	Total Scour (ft)	Final Bed Elevation (ft-NAVD)	Design Elevation (ft-NAVD)
2	-5.9	3.0	0.0	7.9	10.9	-17	-19
3	-6.3	3.0	0.0	9.0	12.0	-19	-28
4	-14.9	3.0	0.0	9.5	12.5	-28	-30
5	-16.8	3.0	0.0	9.3	12.3	-30	-30
6	-13.3	3.0	0.0	8.8	11.8	-26	-30
7	-7.8	3.0	0.0	7.7	10.7	-19	-26
8	-3.9	3.0	0.0	2.7	5.7	-10	-19

4.4 Long Term Scour

Long term scour is the scour that is expected at the bridge piles on a regular day, employed when evaluating vessel impacts. Daily scour conditions occur in the clear water mode for all intermediate bents at this bridge. FDOT Drainage Manual Section 4.9.3.2 recommends the total design scour to be used as the long- term scour for clear water conditions.

5.0 Other Design Considerations

In addition to flow parameters and scour, the bridge hydraulics report includes design guidance for sizing abutment protection, summary of deck drainage and spread calculations, an assessment of bridge length, and an evaluation of the clearances.

5.1 Abutment Protection

Design flow velocities through the bridge opening lie below the allowable limit for FDOT Standard Bank and Shore Rubble Riprap (530-2.2.1). The riprap mattress shall be at least two stone diameters (2.5 ft) thick and underlain by bedding stone (1.0 ft thick) and an FDOT approved geotextile filter fabric. According to FDOT Drainage manual Section 4.9.1, abutment protection must have a horizontal toe berm extending 10-ft beyond the toe of the abutment slope.

5.2 Deck Drainage

The bridge will drain directly into the waterway following the cross-slope.

5.3 Bridge Length

The overall bridge length of 768-ft is slightly longer than the length of the existing bridge which is 732-ft. The replacement bridge will have 96-ft spans versus the 36-ft spans of the existing bridge. The effective flow area will increase compared to the existing structure. With the specified bridge length, the abutments are setback more decreasing the velocities and scour potential at the abutments.

5.4 Clearances

The proposed bridge low member elevation (LME) will be +10.52 ft-NAVD providing 5.02 ft clearance over the +5.5 ft-NAVD design water elevation (including SLR), satisfying the 2 feet drift clearance requirement.

The LME at the navigational span will be 20.57 ft-NAVD providing 18.51 ft clearance over the +2.06 ft-NAVD MHW with SLR, satisfying the 6 ft clearance requirement. The horizontal clearance of 96 ft satisfies navigational clearance requirement of 10 ft.

6.0 References

Arneson, L.A., L.W. Zevenbergen, P.F. Lagasse, and P.E. Clopper. (2012). Evaluating Scour at Bridges Fifth Edition, Hydraulic Engineering Circular No. 18. U.S. Department of Transportation, Federal Highways. Washington: U.S. Department of Transportation.

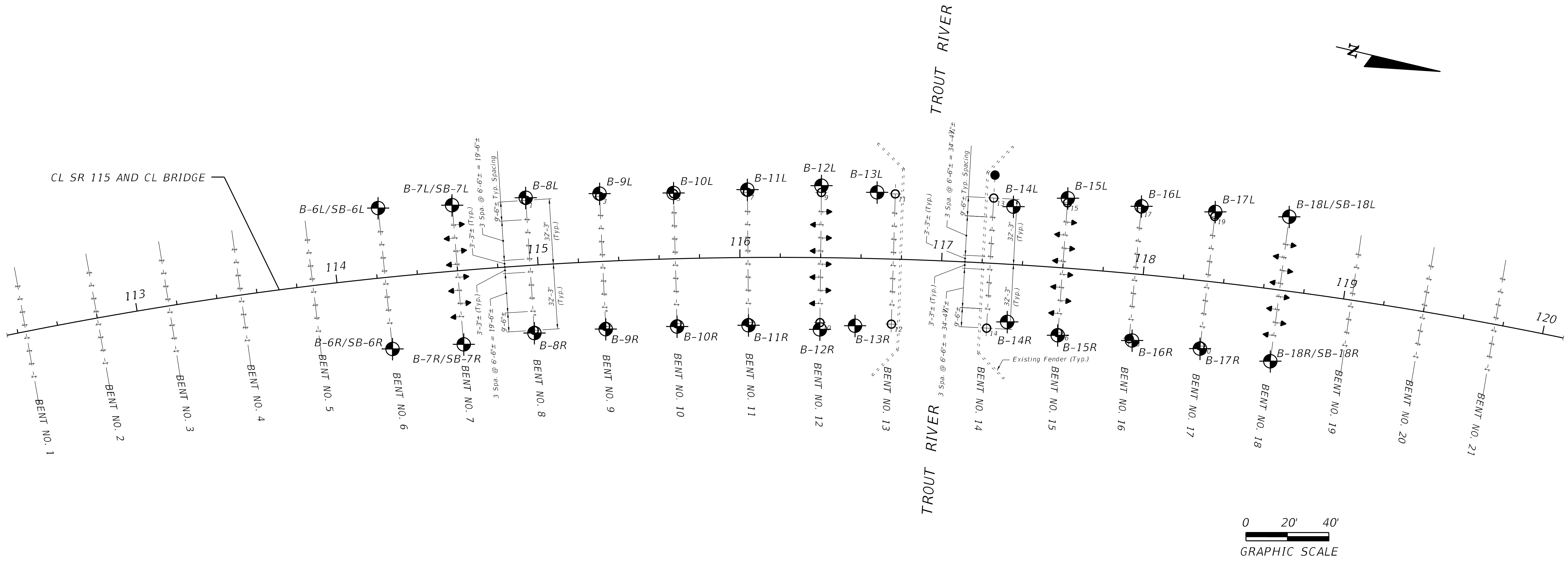
Federal Emergency Management Agency. (2018). Flood Insurance Study Duval County, FL (All Jurisdictions). Federal Emergency Management Agency. Washington: FEMA.

Federal Highway Administration. (2009). Bridge Scour and Stream Instability Countermeasures. Hydraulics Engineering Circular No. 23. Washington, DC: U.S. Department of Transportation.

Florida Department of Transportation (2021). Drainage Manual. Florida Department of Transportation. Tallahassee: FDOT.

Sheppard, D. M., and R. Renna. (2013). Florida Bridge Scour Manual. Florida Department of Transportation. Tallahassee: FDOT.

Appendix A:
Geotechnical Information



NOTE: PLAN AND STATIONING SHOWN DERIVED FROM PLAN SHEET PREPARED BY STV, INC., PROVIDED VIA EMAIL ON JUNE 20, 2018. THIS PLAN IS FOR REPRESENTATION OF BORING LOCATIONS ONLY AND MAY NOT BE INDICATIVE OF EXISTING SITE CONDITIONS.

LEGEND

STANDARD PENETRATION TEST (SPT) BORING LOCATION

BRIDGE NO. 720033

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Wood Environment & Infrastructure Solutions, Inc.
6256 Greenland Road
Jacksonville, FL 32258

CERTIFICATE OF AUTHORIZATION NO. 5392
E.O.R.: KIRK A. MCINTOSH, FL. PE NO. 33703

DRAWN BY: JP 11-2018
CHECKED BY: MBW 11-2018
DESIGNED BY: JP 11-2018
CHECKED BY: MBW 11-2018

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 115	DUVAL	437437-1

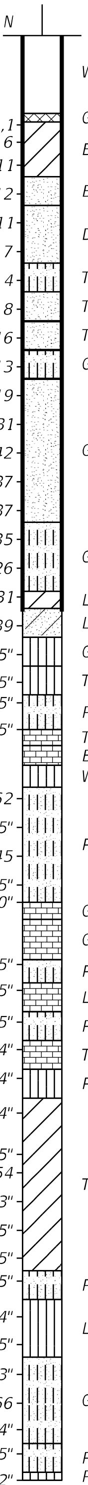
SHEET TITLE: REPORT OF CORE BORINGS (BORING LOCATION PLAN)

PROJECT NAME: SR 115 BRIDGE OVER TROUT RIVER

REF. DWG. NO.

SHEET NO.

BOR # B-16R
STA. 117+97.5
OFF. 33.0' RT
ELEV. -1.30
DATE 5/4/2017 - 5/9/2017
DRILLER James Watson (IDI)
RIG Diedrich D-25
LATITUDE, LONGITUDE 30.418233, -81.696730



ELEVATION (Feet, NAVD88)

	N	
		Water
	1/12",1	Gray sandy organic SILT (OH)
	6, 11	Blue-gray CLAY (CH) with a few sand seams (Su=1500 psf)
	12	Blue-green fine SAND with clay (SP-SC) with a trace of organics
-200=9	11, 7	Dark gray and blue-green fine to medium SAND with silt (SP-SM) and a trace of mica particles
	4	Tan calcareous silty fine SAND (SM) with a trace of limestone fragments
	8	Tan fine to medium SAND with clay (SP-SC) and a trace of mica particles
-200=8, NM=33	16	Tan and gray-green fine SAND with silt (SP-SM) and a trace of mica particles
	13	Gray silty fine SAND (SM)
-200=10, NM=18	19, 31, 42, 37, 37	Gray fine to medium SAND with silt (SP-SM) and a trace of mica particles
	35, 26	Gray silty fine SAND (SM) with a trace of mica particles
	31	Light gray CLAY (CH)
	39	Light gray to gray slightly calcareous clayey fine SAND (SC) with a few cemented particles
-200=96, NM=31, LL=67, PI=33	33,39,50/2.75"	Gray slightly calcareous SILT (MH)
	27,50/5.5"	Tan-gray calcareous SILT (MH) with a trace of limestone fragments (Dissolutioned Limestone)
	50/2.25"	Partially cemented gray and tan slightly calcareous silty fine to medium SAND (SM) (Dissolutioned Limestone)
UC=1732.4 (156.8), ST=183.2 (143.5), REC=58, RQD=45	50/0.25"	Tan-gray fossiliferous LIMESTONE
		Brown-gray porous fossiliferous LIMESTONE
		Weakly cemented light gray calcareous sandy SILT (ML) (Dissolutioned Limestone)
-200=20, NM=15	62, 25,25,50/2.5", 45, 31,32,50/5"	Partially cemented tan-gray calcareous silty fine SAND (SM) with some limestone fragments and seams (Dissolutioned Limestone)
UC=137.1 (124.1), ST=44.9 (122.8), REC=20, RQD=15	50/0"	Gray sandy LIMESTONE
		Gray-brown slightly porous fossiliferous LIMESTONE
	50/4.5"	Partially cemented tan-gray calcareous silty fine SAND (SM) with some limestone fragments and seams (Dissolutioned Limestone)
	50/1.5"	Light gray-tan sandy dolomitic LIMESTONE with a trace of phosphate
	50/5"	Partially cemented tan slightly calcareous silty fine to medium SAND (SM) (Dissolutioned Limestone)
	50/4"	Tan-gray fossiliferous LIMESTONE with a trace of phosphate
	50/4"	Partially cemented tan slightly calcareous sandy SILT (ML) with a trace of phosphate (MARL)
-200=84, NM=45, LL=136, PI=115	43,50/4", 35,50/5", 54, 32,39,50/3", 24,36,50/5", 29,50/5"	Tan-gray and light gray to gray slightly calcareous sandy CLAY (CH) with a trace of phosphate (MARL)
	50/5"	Partially cemented light gray to dark gray calcareous silty fine to medium SAND (SM) with a trace of phosphate (MARL)
	43,43,50/4", 36,50/5.5"	Light gray-tan calcareous sandy SILT (ML) with a trace of phosphate (MARL)
	29,36,50/3", 66, 19,50/4"	Gray silty fine SAND (SM) with a trace of phosphate (MARL)
	50/5.5"	Partially cemented tan-gray calcareous silty fine SAND (SM) with a trace of phosphate (MARL)
	50/2"	Partially cemented tan-gray sandy SILT (ML) with a trace of phosphate (MARL)

Boring Terminated
at Elev. -126.8ft

Casing Length 50ft

NOTES:

1. Subsurface conditions shown on the borings represent the conditions at the boring locations. Subsurface variations between borings should be anticipated as indicated in Section 2-4 of the FDOT Specifications. Unified Soil Classification shown on the borings is based on visual classifications and laboratory tests.

2. Environmental classification based on RFP requirements.

SPOON:
Inside diameter - 1-3/8"
Outside diameter - 2"
Length - 18"
No Liner Used

HAMMER:
Weight - 140 lbs.
Average drop - 30"
Type - Manual

ENGINEERING CLASSIFICATION

GRANULAR MATERIALS		
Relative Density	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY LOOSE	Less than 4	Less than 3
LOOSE	4 - 10	3 - 8
MEDIUM DENSE	10 - 30	8 - 24
DENSE	30 - 50	24 - 40
VERY DENSE	Greater than 50	Greater than 40

SILTS AND CLAYS		
Consistency	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY SOFT	Less than 2	Less than 1
SOFT	2 - 4	1 - 3
FIRM	4 - 8	3 - 6
STIFF	8 - 15	6 - 12
VERY STIFF	15 - 30	12 - 24
HARD	Greater than 30	Greater than 24

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: Extremely Aggressive
(Based on Water Sample)
- Electrical Resistivity = 46 ohm-cm
- Chloride Content = 3,000 ppm

SUPERSTRUCTURE: Extremely Aggressive

LEGEND

(SP) Unified soil classification system group based on observation and laboratory tests
N Standard penetration resistance in blows per foot (ASTM D1586), unless noted otherwise
4" Casing
-200 Percent passing No. 200 Sieve
NM Natural Moisture Content (%)
LL Liquid Limit
PI Plasticity Index
Su Undrained Shear Strength (psf) estimated from pocket penetrometer

Silt, Clay, Sand, Limestone, Silty Sand, Organic Silt, Clayey Sand

Rock Core (2.4" Dia.)
REC=100 Percent Recovery
RQD=86 Rock Quality Designation
UC=78.0 (112.0) Unconfined Compressive Strength, ksf (Dry Unit Weight, pcf)
ST=21.6 (111.4) Splitting Tensile Strength, ksf (Dry Unit Weight, pcf)

BRIDGE NO. 720033

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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6256 Greenland Road
Jacksonville, FL 32258

CERTIFICATE OF AUTHORIZATION NO. 5392
E.O.R.: KIRK A. MCINTOSH, FL. PE NO. 33703

DRAWN BY: JP 6-2018
CHECKED BY: CC 6-2018
DESIGNED BY: JP 6-2018
CHECKED BY: KAM 6-2018

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 115	DUVAL	437437-1

SHEET TITLE: REPORT OF CORE BORINGS

PROJECT NAME: SR 115 BRIDGE OVER TROUT RIVER

REF. DWG. NO.

SHEET NO.

BOR # SB-18L
STA. 118+68
OFF. 38.0' LT
ELEV. -0.6
DATE 10/18/2018 - 10/19/2018
DRILLER James Watson (IDI)
RIG Barge Rig - Manual Hammer
LATITUDE, LONGITUDE 30.418405, -81.696983

ELEVATION (Feet, NAVD88): 0, -5, -10, -15, -20, -25, -30, -35, -40, -45, -50, -55, -60, -65, -70, -75, -80, -85, -90, -95, -100, -105, -110, -115, -120, -125, -130

Lab Data	N	Description
		Water
	3,1/12"	Dark grayish brown silty fine SAND (SM) with a trace of shell fragments
-200=47 NM=37	4	Bluish gray clayey fine SAND (SC)
	8, 13, 17	Bluish gray clayey fine SAND (SC) with thin light gray fine sand seams
	15	Bluish gray and light brown silty fine to coarse SAND (SM)
	13	Bluish gray and light grayish brown fine to medium SAND with silt (SP-SM) and a trace of coarse sand
	8	Light grayish brown silty fine SAND (SM)
	6, 30	Grayish brown silty fine to medium SAND (SM)
	25	Gray silty fine to medium SAND (SM)
	37, 23	Gray silty fine to medium SAND (SM) with a trace of clay
-200=9 NM=34	26, 26	Gray fine SAND with silt (SP-SM) and a trace of mica flakes
	50/4.75"	Partially cemented light gray calcareous silty fine SAND (SM) with silt seams and a trace of sandy limestone fragments (Dissolutioned Limestone)
-200=93 NM=71 LL=210 PI=134	11,50/5.5"	Gray and light gray calcareous SILT (MH) with a trace of fine sand (Dissolutioned Limestone)
	50/5"	Gray calcareous silty fine to coarse SAND (SM) with many fossiliferous limestone fragments (Dissolutioned Limestone)
	37	Gray calcareous silty fine to coarse SAND (SM) (Dissolutioned Limestone)
	14,50/4"	Partially cemented gray and light gray calcareous sandy clayey SILT (MH) with a trace of sandy limestone fragments (Dissolutioned Limestone)
	51/6"	Partially cemented gray and light gray calcareous sandy clayey SILT (MH) with fine sand seams (Dissolutioned Limestone)
	50/0.5"	Gray calcareous clayey SILT (MH) with a trace of sandy limestone fragments (Dissolutioned Limestone)
	9,50/4"	Gray fossiliferous LIMESTONE
	50/3.75"	Partially cemented light gray calcareous silty fine to medium SAND (SM) with a trace of sandy limestone fragments (Dissolutioned Limestone)
-200=17 NM=22	74	Light gray calcareous silty fine SAND (SM) (Dissolutioned Limestone)
	33	Light gray calcareous silty fine SAND (SM) with a few sandy limestone fragments (Dissolutioned Limestone)
	44,50/4.25", 44	Light gray calcareous silty fine SAND (SM) with many fossiliferous limestone fragments (Dissolutioned Limestone)
	14,1/10",17	Partially cemented gray calcareous silty fine SAND (SM) (Dissolutioned Limestone)
	50/0.5"	Light gray calcareous silty fine SAND (SM) with many fossiliferous limestone fragments (Dissolutioned Limestone)
REC=2 RQD=0		Light grayish brown slightly fossiliferous sandy LIMESTONE
REC=8 RQD=0	50/1.5"	Light gray and gray fossiliferous LIMESTONE
		Partially cemented gray calcareous silty fine to medium SAND (SM) (Dissolutioned Limestone)
	50/3.25"	Partially cemented light grayish brown calcareous silty fine SAND (SM) (Dissolutioned Limestone)
-200=38 NM=30	15,34,50/4"	Light grayish brown calcareous silty fine SAND (SM) with some fossiliferous limestone fragments (Dissolutioned Limestone)
	50/5"	Light grayish brown calcareous sandy SILT (MH) with a trace of cemented fragments (Dissolutioned Limestone)
	50/2.25"	Light grayish brown slightly fossiliferous sandy LIMESTONE
	23,50/3.75", 19,50/5.5"	Partially cemented light grayish brown calcareous silty fine SAND (SM) with a trace of phosphate grains (MARL)
	43,50/5.875"	Gray calcareous sandy SILT (MH) with a trace of phosphate grains (MARL)
-200=80 NM=38 LL=114 PI=68	34,50/4.5"	Gray calcareous SILT (MH) with sand
	35,50/3.75", 50/5.75", 51/6", 30,46,50/3.5", 50/5.25"	Partially cemented gray calcareous silty fine SAND (SM) with clay and a trace of phosphate grains (MARL)
	30,50/4.5", 50/2.25"	Light greenish gray to gray calcareous silty fine SAND (SM) with a trace of phosphate grains (MARL)
	50/1.75"	Partially cemented light greenish gray to gray calcareous silty fine SAND (SM) with a trace of phosphate grains (MARL)

Boring Terminated
at Elev. -122.7ft

Casing Length 65ft

NOTES:

1. Subsurface conditions shown on the borings represent the conditions at the boring locations. Subsurface variations between borings should be anticipated as indicated in Section 2-4 of the FDOT Specifications. Unified Soil Classification shown on the borings is based on visual classifications and laboratory tests.

2. Artesian conditions were not encountered during drilling operations unless otherwise noted.

SPOON:
Inside diameter - 1-3/8"
Outside diameter - 2"
Length - 18"
No Liner Used

HAMMER:
Weight - 140 lbs.
Average drop - 30"
Type - Manual

ENGINEERING CLASSIFICATION

GRANULAR MATERIALS

Relative Density	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY LOOSE	Less than 4	Less than 3
LOOSE	4 - 10	3 - 8
MEDIUM DENSE	10 - 30	8 - 24
DENSE	30 - 50	24 - 40
VERY DENSE	Greater than 50	Greater than 40

SILTS AND CLAYS

Consistency	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY SOFT	Less than 2	Less than 1
SOFT	2 - 4	1 - 3
FIRM	4 - 8	3 - 6
STIFF	8 - 15	6 - 12
VERY STIFF	15 - 30	12 - 24
HARD	Greater than 30	Greater than 24

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: Extremely Aggressive
(Based on Water Sample)
- Electrical Resistivity = 46 ohm-cm
- Chloride Content = 3,000 ppm

SUPERSTRUCTURE: Extremely Aggressive

LEGEND

(SP)	Unified soil classification system group based on observation and laboratory tests
N	Standard penetration resistance in blows per foot (ASTM D1586), unless noted otherwise
	4" Casing
-200	Percent passing No. 200 Sieve
NM	Natural Moisture Content (%)
LL	Liquid Limit
PI	Plasticity Index

Silt, Clayey Sand, Sand, Limestone, Silty Sand

REC=2 RQD=0 — Rock Core (2.4" Dia.), Percent Recovery, Rock Quality Designation

BRIDGE NO. 720033

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Wood Environment & Infrastructure Solutions, Inc.
6256 Greenland Road
Jacksonville, FL 32258

CERTIFICATE OF AUTHORIZATION NO. 5392
E.O.R.: KIRK A. MCINTOSH, FL. PE NO. 33703

DRAWN BY: JP 11-2018
CHECKED BY: MBW 11-2018
DESIGNED BY: JP 11-2018
CHECKED BY: KAM 11-2018

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 115	DUVAL	437437-1

SHEET TITLE: REPORT OF CORE BORINGS

PROJECT NAME: SR 115 BRIDGE OVER TROUT RIVER

REF. DWG. NO.

SHEET NO.

BOR # SB-18R
STA. 118+68
OFF. 39.4' RT
ELEV. 1.36
DATE 10/16/2018 - 10/18/2018
DRILLER James Watson (IDI)
RIG Barge Rig - Manual Hammer
LATITUDE, LONGITUDE 30.418428, -81.696739

ELEVATION (Feet, NAVD88)

N	Description
	Water
WOR/18" WOR/18"	Brownish gray silty fine SAND (SM) with a trace of sandy silt seams
WOH/18"	Grayish brown sandy SILT (ML) with fine sand seams
10	Bluish gray clayey fine SAND (SC) with fine sand seams
	Bluish green clayey fine SAND (SC)
18	Light gray fine SAND (SP) with a few sandy clay seams
10	Grayish brown clayey fine to medium SAND (SC)
8	Grayish brown silty fine SAND (SM)
5	Brown silty fine SAND (SM) with a few shell fragments and a trace of clay
	Light gray calcareous silty fine SAND (SM) with cemented fragments
7	Light brownish gray fine SAND with clay (SP-SC)
12	Light brownish gray silty fine SAND (SM) with clay and a trace of shell fragments
16	Light brownish gray fine SAND with clay (SP-SC)
11, 22	Gray silty fine SAND (SM) with a trace of mica particles
29, 25	Gray fine to medium SAND with clay (SP-SC)
27	Gray fine SAND with silt (SP-SM) and a trace of mica particles
24, 33	Gray silty fine SAND (SM) with traces of mica and gravel
50/3.5", 50/3.5"	Partially cemented light gray calcareous sandy SILT (ML) with a trace of clay seams
50/5.5"	Partially cemented gray silty fine to medium SAND (SM) with fossiliferous limestone seams or fragments (Dissolutioned Limestone)
	Gray sandy LIMESTONE with calcareous sandy silt seams
	Uncemented material (soil or dissolutioned limestone, no sample recovered)
50/1.5"	Grayish brown sandy LIMESTONE
50/6"	Partially cemented light gray calcareous sandy clayey SILT (MH) with limestone seams or fragments (Dissolutioned Limestone)
80, 58, 14,52/6"	Tannish light gray calcareous fine SAND with silt (SP-SM) and traces of cemented fragments and shell fragments (Dissolutioned Limestone)
24,41,50/4.75"	Partially cemented light gray silty fine SAND (SM) (Dissolutioned Limestone)
	Light grayish brown fossiliferous LIMESTONE
	Light grayish brown sandy LIMESTONE
31,31,50/1.5", 50/3.75", 39,50/5.25"	Partially cemented light gray to gray calcareous silty fine SAND (SM) with fossiliferous limestone lenses or fragments (Dissolutioned Limestone)
10,17,50/3.75"	Partially cemented tannish gray calcareous sandy CLAY (CH) with some cemented lenses (Dissolutioned Limestone)
50/1.5", 42,50/4.5"	Light grayish tan sandy LIMESTONE with uncemented sandy silt seams
35,50/4.25"	Light gray calcareous silty fine SAND (SM)
41,50/4.5"	Partially cemented tannish gray calcareous silty fine SAND (SM) with a few phosphate particles and a trace of clay seams (MARL)
50/5.875"	Tannish gray calcareous sandy clayey SILT (MH) with a few phosphate particles (MARL)
30,50/5"	Gray silty CLAY (CH) (MARL)
40,50/3.5", 15,37,50/2"	Grayish tan calcareous silty fine SAND (SM) with a few phosphate particles and clay seams (MARL)
50/3", 50/5.75"	Partially cemented light gray calcareous clayey SILT (MH) with a trace of phosphate particles (MARL)
50/6", 45,50/3.25", 50/3.5"	Light gray to gray calcareous silty fine SAND (SM) with a few phosphate particles and a trace of clay seams (MARL)
50/5.5", 50/5.875"	Partially cemented grayish brown calcareous silty fine SAND (SM) with a few phosphate particles and clay seams (MARL)
47	Light gray to gray calcareous silty fine SAND (SM) with sandy silt seams and a trace of phosphate particles and clay seams (MARL)

Lab data: -200=46, NM=33 (at -10); -200=11, NM=27 (at -26); -200=47, NM=32, LL=48, PI=19 (at -90); -200=49, NM=35 (at -100)

Rock cores: REC=22, RQD=18; REC=50, RQD=0; ST=222.6 (149.9); REC=72, RQD=53; UC=113.0 (99.7), ST=6.6 (98.7), UC=24.7 (100.6), ST=7.1 (98.8)

Boring Terminated at Elev. -123ft

Casing Length 65ft

NOTES:

1. Subsurface conditions shown on the borings represent the conditions at the boring locations. Subsurface variations between borings should be anticipated as indicated in Section 2-4 of the FDOT Specifications. Unified Soil Classification shown on the borings is based on visual classifications and laboratory tests.

2. Artesian conditions were not encountered during drilling operations unless otherwise noted.

SPOON:
Inside diameter - 1-3/8"
Outside diameter - 2"
Length - 18"
No Liner Used

HAMMER:
Weight - 140 lbs.
Average drop - 30"
Type - Manual

ENGINEERING CLASSIFICATION

GRANULAR MATERIALS

Relative Density	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY LOOSE	Less than 4	Less than 3
LOOSE	4 - 10	3 - 8
MEDIUM DENSE	10 - 30	8 - 24
DENSE	30 - 50	24 - 40
VERY DENSE	Greater than 50	Greater than 40

SILTS AND CLAYS

Consistency	Safety Hammer SPT N-Value (Blows/Foot)	Automatic Hammer SPT N-Value (Blows/Foot)
VERY SOFT	Less than 2	Less than 1
SOFT	2 - 4	1 - 3
FIRM	4 - 8	3 - 6
STIFF	8 - 15	6 - 12
VERY STIFF	15 - 30	12 - 24
HARD	Greater than 30	Greater than 24

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: Extremely Aggressive
(Based on Water Sample)
- Electrical Resistivity = 46 ohm-cm
- Chloride Content = 3,000 ppm

SUPERSTRUCTURE: Extremely Aggressive

LEGEND

(SP) Unified soil classification system group based on observation and laboratory tests
N Standard penetration resistance in blows per foot (ASTM D1586), unless noted otherwise
4" Casing
WOH Weight of hammer and drill rods
WOR Weight of drill rods
-200 Percent passing No. 200 Sieve
NM Natural Moisture Content (%)
LL Liquid Limit
PI Plasticity Index

Silt, Sand, Silty Sand, Clayey Sand, Clay, Limestone

Rock Core (2.4" Dia.)
REC=22 Percent Recovery
RQD=18 Rock Quality Designation
UC=113.0 (99.7) Unconfined Compressive Strength, ksf (Dry Unit Weight, pcf)
ST=222.6 (149.9) Splitting Tensile Strength, ksf (Dry Unit Weight, pcf)

BRIDGE NO. 720033

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Wood Environment & Infrastructure Solutions, Inc.
6256 Greenland Road
Jacksonville, FL 32258

CERTIFICATE OF AUTHORIZATION NO. 5392
E.O.R.: KIRK A. MCINTOSH, FL. PE NO. 33703

DRAWN BY: JP 11-2018
CHECKED BY: MBW 11-2018
DESIGNED BY: JP 11-2018
CHECKED BY: KAM 11-2018

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 115	DUVAL	437437-1

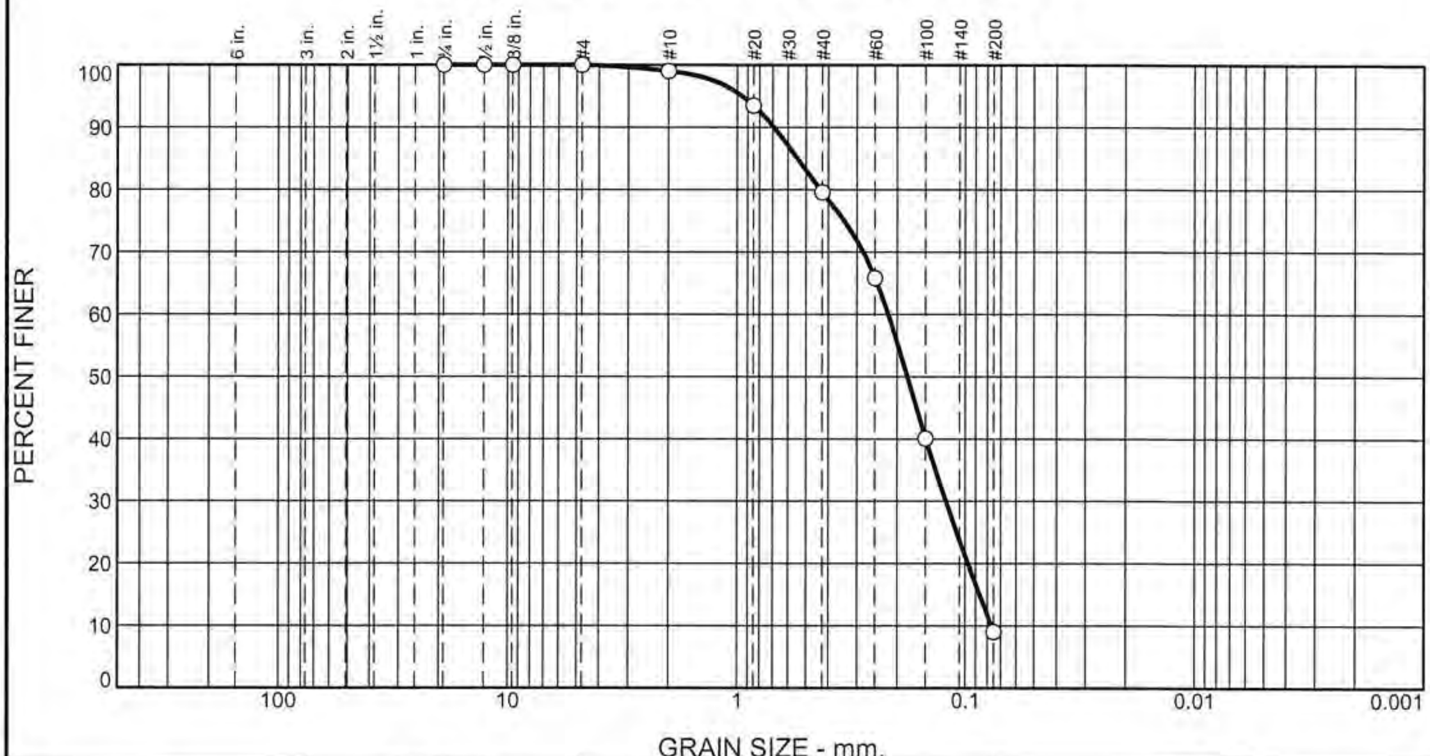
SHEET TITLE: REPORT OF CORE BORINGS

PROJECT NAME: SR 115 BRIDGE OVER TROUT RIVER

REF. DWG. NO.

SHEET NO.

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.0	19.4	70.6	9.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.0		
#20	93.5		
#40	79.6		
#60	65.8		
#100	40.1		
#200	9.0		

* (no specification provided)

Material Description

Dark gray and blue-green fine to medium SAND with silt and a trace of mica particles

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)=

Coefficients

D_{90}= 0.6942 D_{85}= 0.5464 D_{60}= 0.2191
D_{50}= 0.1805 D_{30}= 0.1221 D_{15}= 0.0866
D_{10}= 0.0768 C_u= 2.85 C_c= 0.89

Remarks

Date Received: 5/4/17 **Date Tested:** 6/22/17

Tested By: A. Coleman

Checked By: Corey T. Chascin, E.I.

Title: Project Engineer

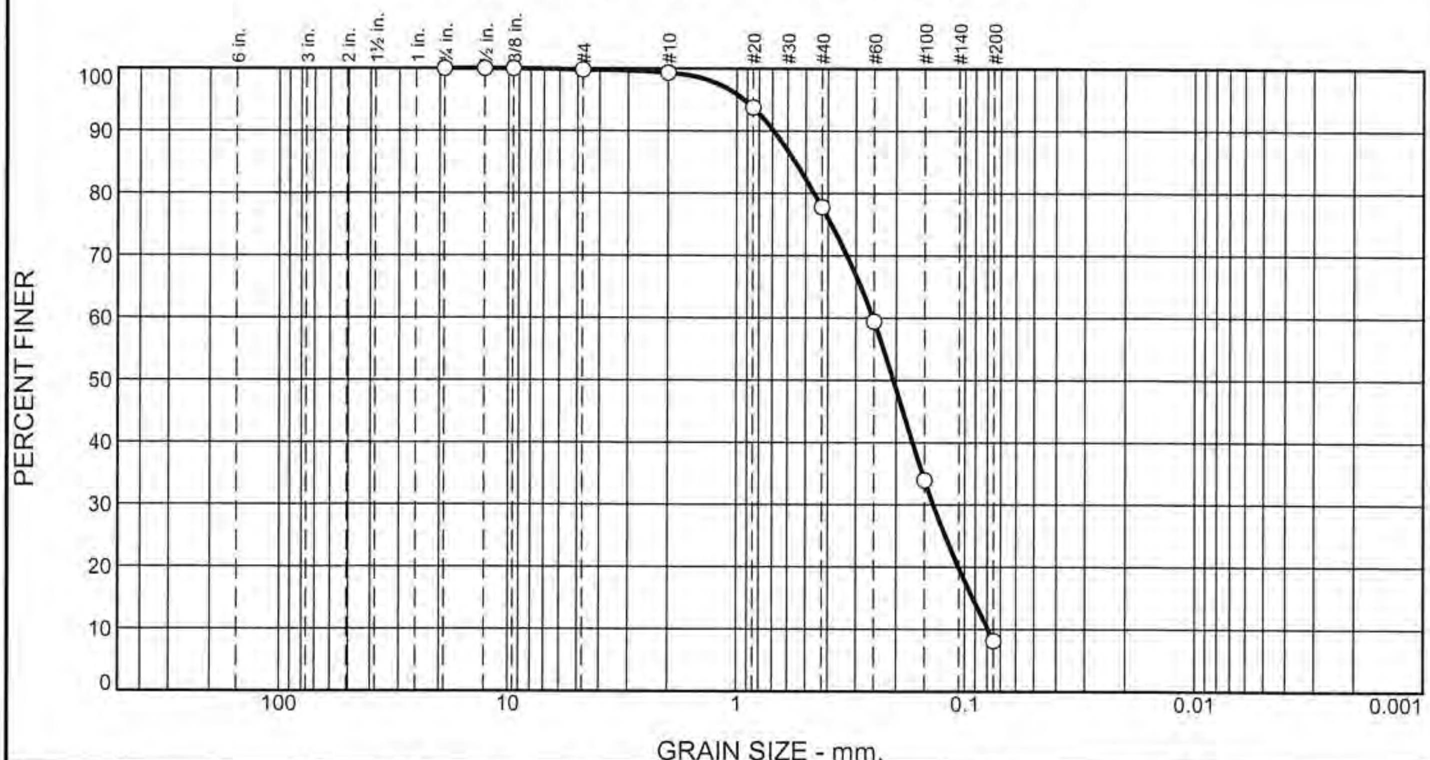
Source of Sample: B-16R **Depth:** 11.0' - 12.5' **Date Sampled:** 5/4/17
Sample Number: 6

AMEC E&I

Jacksonville, Florida

Client: FDOT
Project: 437437-1-52-01 SR 115 at Trout River
Project No: 6734179909 **Figure**

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.5	21.6	69.5	8.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	99.8		
#10	99.3		
#20	93.7		
#40	77.7		
#60	59.4		
#100	33.9		
#200	8.2		

* (no specification provided)

Material Description

Blue-gray and tan fine to medium SAND with clay

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SP-SC AASHTO (M 145)=

Coefficients

D_{90}= 0.6917 D_{85}= 0.5565 D_{60}= 0.2534
D_{50}= 0.2060 D_{30}= 0.1376 D_{15}= 0.0925
D_{10}= 0.0794 C_u= 3.19 C_c= 0.94

Remarks

Date Received: 5/11/17 **Date Tested:** 7/31/17
Tested By: A. Coleman
Checked By: Corey T. Chascin, E.I.
Title: Project Engineer

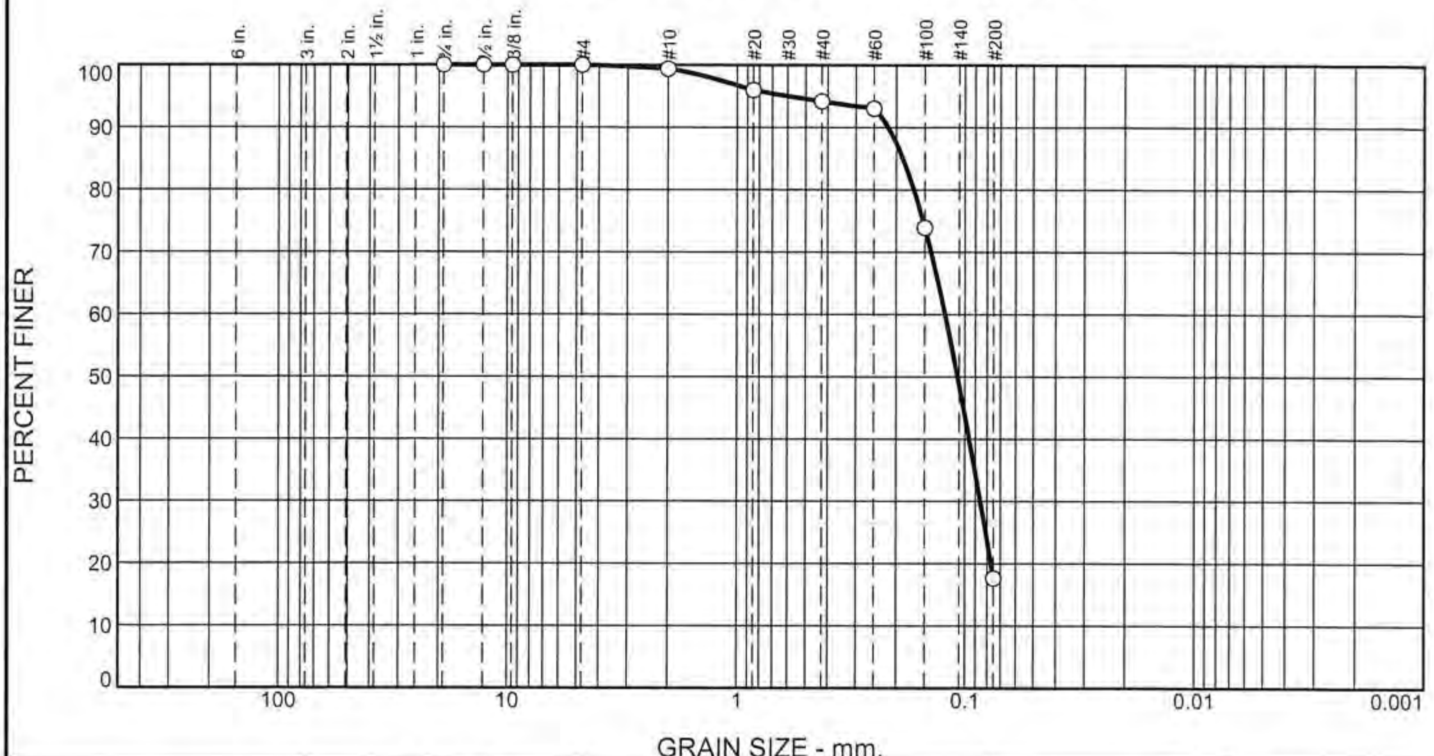
Source of Sample: B-18L **Depth:** 13.5' - 15.0'
Sample Number: 6 **Date Sampled:** 5/11/17

AMEC E&I

Jacksonville, Florida

Client: FDOT
Project: 437437-1-52-01 SR 115 at Trout River
Project No: 6734179909 **Figure**

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.6	5.2	76.5	17.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.4		
#20	96.0		
#40	94.2		
#60	93.1		
#100	73.9		
#200	17.7		

* (no specification provided)

Material Description

Light blue-gray silty fine to medium SAND with a trace of clay seams

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= 0.2168 D_{85}= 0.1871 D_{60}= 0.1224
D_{50}= 0.1080 D_{30}= 0.0859 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 5/11/17 **Date Tested:** 6/22/17
Tested By: A. Coleman
Checked By: Corey T. Chascin, E.I.
Title: Project Engineer

Source of Sample: B-18R **Depth:** 8.5' - 10.0' **Date Sampled:** 5/11/17
Sample Number: 5

AMEC E&I

Jacksonville, Florida

Client: FDOT
Project: 437437-1-52-01 SR 115 at Trout River
Project No: 6734179909 **Figure**

Appendix B:
Site Visit Photos

Appendix B Site Visit Photos

Picture 1: US Face

Picture 2: Approach

Picture 3: Right Approach

Picture 4: Bridge Date

Picture 5: Bridge Number

Picture 6: US Right

Picture 7: US Right

Picture 8: US Right

Picture 9: US Right

Picture 10: Right Abutment

Picture 11: Right Abutment

Picture 12: US Right

Picture 13: Right Abutment

Picture 14: Right Abutment

Picture 15: US Right Shoreline

Picture 16: Bridge Section Looking Left

Picture 17: DS Right Shoreline

Picture 18: DS Right

Picture 19: DS Right

Picture 20: DS Right

Picture 21: DS Face

Picture 22: DS Face

Picture 23: DS Right

Picture 24: Bridge Number

Picture 25: DS Right

Picture 26: DS Right

Picture 27: DS Right

Picture 28: DS Right

Picture 29: DS Right

Picture 30: Right Abutment

Picture 31: DS Face

Picture 32: DS Right

Picture 33: DS Right

Picture 34: DS Right

Picture 35: Riprap Right Abutment

Picture 36: Riprap Right Abutment

Picture 37: Riprap Right Abutment

Picture 38: Right Abutment

Picture 39: US Right Bank

Picture 40: FDOT Spraying Concrete

Picture 41: US Right Bank

Picture 42: US Right Bank

Picture 43: US Right Bank

Picture 44: US Right Bank

Picture 45: US Right Bank

Picture 46: US Channel

Picture 47: US Left Bank

Picture 48: US Left Bank

Picture 49: DS Channel

Picture 50: DS Channel

Picture 51: DS Right Bank

Picture 52: DS Left Bank

Picture 53: DS Left Bank

Picture 54: DS Left Bank

Picture 55: DS Left Shoreline

Picture 56: DS Left Shoreline

Picture 57: Left Approach

Picture 58: DS Left Slope

Picture 59: DS Left

Picture 60: DS Left

Picture 61: DS Left

Picture 62: Left Abutment

Picture 63: Left Abutment

Picture 64: DS Left


Picture 65: DS Left


Picture 66: US Face

Picture 67: Left Abutment

Picture 68: Left Abutment

Picture 69: Left Abutment

Picture 70: Bridge Section Looking Right

Picture 71: DS Left

Picture 72: Left Bank

Picture 73: Left Bank Sparse Rock

Picture 74: Bridge Section Looking Right

Picture 75: US Left Shoreline

Picture 76: US Left Freshly Sprayed

Picture 77: US Left Freshly Sprayed

Picture 78: Left Abutment

Picture 79: Left Abutment

Picture 80: Left Abutment

Picture 81: Left Bank

Picture 82: Left Bank

Picture 83: DS Left Sparse Rock

Picture 84: Left Approach

Picture 85: US Left

Picture 86: US Left

Picture 87: US Left

Picture 88: US Left

Picture 89: US Left

Picture 90: US Left Bank

Picture 91: US Left Bank

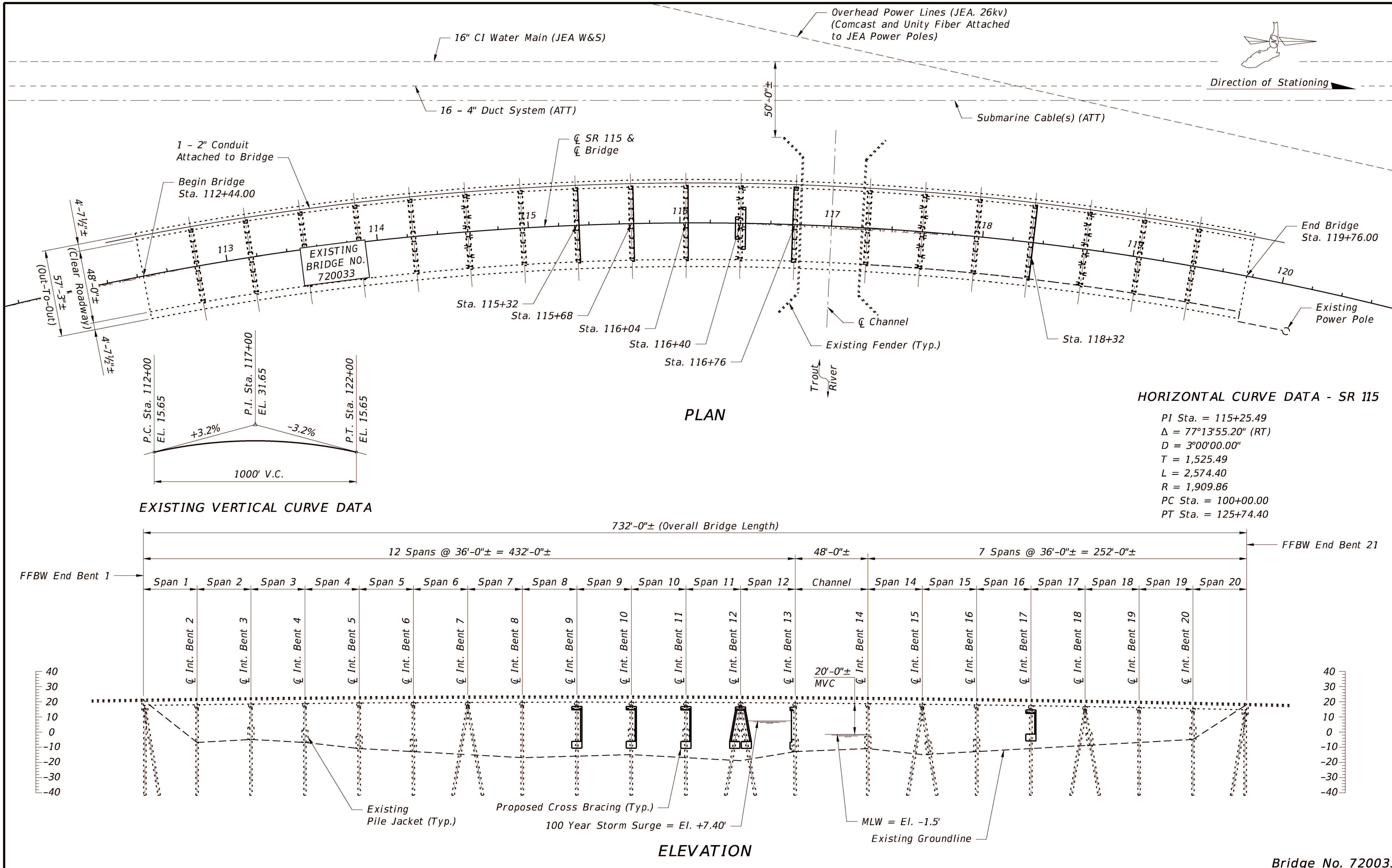
Picture 92: Bridge Deck Looking Left

Picture 93: Bridge Deck Looking Right

Picture 94: DS Right Bank

Picture 95: US Right Bank

Appendix C:
Existing Bridge Plan and Profile



REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Paul L. Free, P.E.
P.E. NO.: 62917
STV Incorporated
5200 Belfort Road, Suite 400
Jacksonville, Florida 32256
Certificate of Authorization No. 390

DRAWN BY:	MM 10-17
CHECKED BY:	PLF 10-17
DESIGNED BY:	PLF 06-17
CHECKED BY:	RAP 04-18

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 115	DUVAL	437437-1-52-01

SHEET TITLE: PLAN AND ELEVATION

PROJECT NAME: SR 115 OVER TROUT RIVER

REF. DWG. NO.

SHEET NO. B1-1

mmoore 2/14/2020 11:35:31 AM I:\Projects\4019050\4019050_0001\50_Deliverables & Submittals\43743715201\struct\B1Pl

Appendix D:
Local Scour Calculations

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 2	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

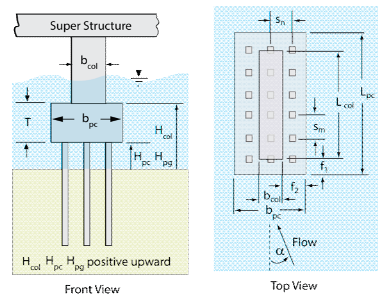
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (°)	20.41
y_0 (ft)	11.53
V (ft/s)	1.36

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.58
K_{pgpe} (ft)	6.29
K_{pgh}	1.00
D^*_{pg} (ft)	8.81

Effective Diameter of Complex Pier

D^*_{cs} = 8.8 ft

Local Scour at Complex Pier

y_{scs} = 7.8 ft

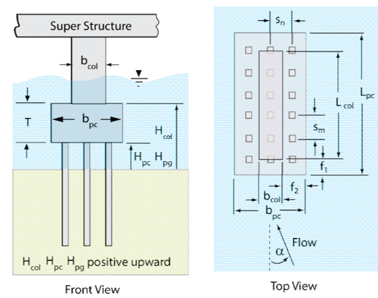
FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 3	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	26.85
y_0 (ft)	11.91
V (ft/s)	2.23



Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	21.50
K_{pgpe} (ft)	6.60
K_{pgh}	1.00
D^*_{pg} (ft)	9.24

Effective Diameter of Complex Pier

D^*_{cs} = 9.2 ft

Local Scour at Complex Pier

y_{scs} = 9.0 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 4	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

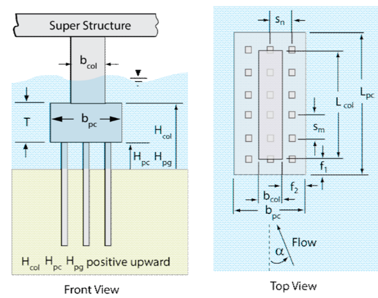
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (°)	21.34
y_0 (ft)	20.02
V (ft/s)	2.44

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.72
K_{pgpe} (ft)	6.34
K_{pgh}	1.00
D^*_{pg} (ft)	8.88

Effective Diameter of Complex Pier

D^*_{cs} = 8.9 ft

Local Scour at Complex Pier

y_{scs} = 9.5 ft

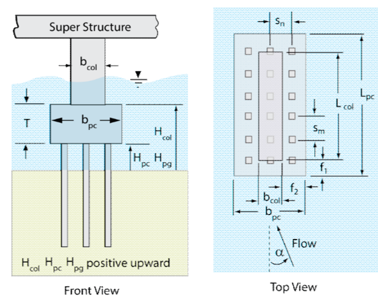
FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 5	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	16.21
y_0 (ft)	21.91
V (ft/s)	2.40



Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.83
K_{pgpe} (ft)	6.02
K_{pgh}	1.00
D^*_{pg} (ft)	8.43

Effective Diameter of Complex Pier

D^*_{cs} = 8.4 ft

Local Scour at Complex Pier

y_{scs} = 9.2 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 6	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

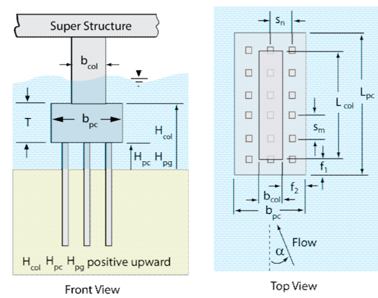
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	13.75
y_0 (ft)	18.87
V (ft/s)	2.07

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.34
K_{pgpe} (ft)	5.84
K_{pgh}	1.00
D^*_{pg} (ft)	8.18

Effective Diameter of Complex Pier

D^*_{cs} = 8.2 ft

Local Scour at Complex Pier

y_{scs} = 8.7 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 7	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

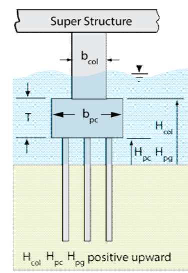
Input Data

Flow and Sediment Data

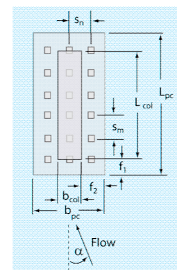
D50 (mm)	0.20
Angle of Attack, α (^{o})	11.14
y_0 (ft)	12.86
V (ft/s)	1.39

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Front View



Top View

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	18.57
K_{pgpe} (ft)	5.58
K_{pgh}	1.00
D^*_{pg} (ft)	7.82

Effective Diameter of Complex Pier

D^*_{cs} = 7.8 ft

Local Scour at Complex Pier

y_{scs} = 7.4 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 8	Waterway:	Trout River
Return Period:	50-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

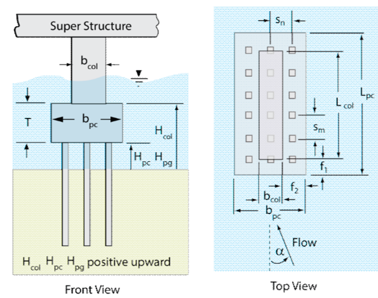
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	14.79
y_0 (ft)	7.31
V (ft/s)	0.64

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.55
K_{pgpe} (ft)	5.92
K_{pgh}	1.00
D^*_{pg} (ft)	8.28

Effective Diameter of Complex Pier

D^*_{cs} = 8.3 ft

Local Scour at Complex Pier

y_{scs} = 4.4 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 2	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

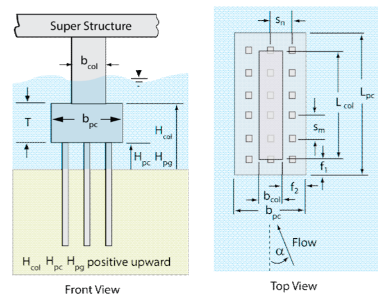
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	20.34
y_0 (ft)	11.95
V (ft/s)	1.32

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.56
K_{pgpe} (ft)	6.29
K_{pgh}	1.00
D^*_{pg} (ft)	8.80

Effective Diameter of Complex Pier

D^*_{cs} = 8.8 ft

Local Scour at Complex Pier

y_{scs} = 7.8 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:	
Route:	Lem Turner Road
Pier Number:	Pier 3
Waterway:	Trout River
Return Period:	100-yr
Calculated by:	HD
Date:	5/10/2023
Notes:	

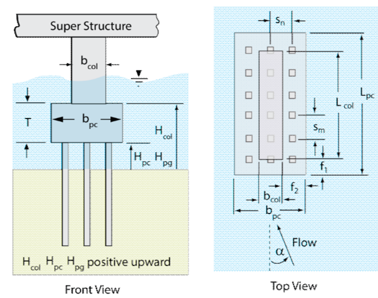
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	26.91
y_0 (ft)	11.82
V (ft/s)	2.22

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	21.51
K_{pgpe} (ft)	6.60
K_{pgh}	1.00
D^*_{pg} (ft)	9.25

Effective Diameter of Complex Pier

D^*_{cs} = 9.2 ft

Local Scour at Complex Pier

y_{scs} = 9.0 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 4	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

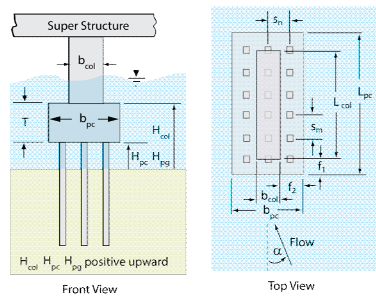
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (°)	21.13
y_0 (ft)	20.44
V (ft/s)	2.43

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.69
K_{pgpe} (ft)	6.33
K_{pgh}	1.00
D^*_{pg} (ft)	8.87

Effective Diameter of Complex Pier

D^*_{cs} = 8.9 ft

Local Scour at Complex Pier

y_{scs} = 9.5 ft

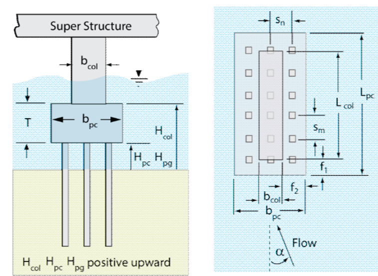
FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 5	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	16.21
y_0 (ft)	22.33
V (ft/s)	2.39



Front View

Top View

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.83
K_{pgpe} (ft)	6.02
K_{pgh}	1.00
D^*_{pg} (ft)	8.43

Effective Diameter of Complex Pier

D^*_{cs} = 8.4 ft

Local Scour at Complex Pier

y_{scs} = 9.3 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 6	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

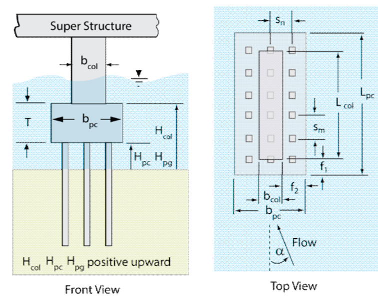
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (°)	13.88
y_0 (ft)	18.78
V (ft/s)	2.05

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.37
K_{pgpe} (ft)	5.85
K_{pgh}	1.00
D^*_{pg} (ft)	8.19

Effective Diameter of Complex Pier

D^*_{cs} = 8.2 ft

Local Scour at Complex Pier

y_{scs} = 8.6 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 7	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

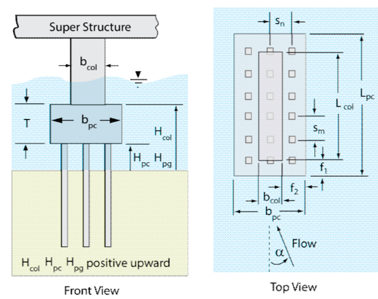
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	13.88
y_0 (ft)	11.15
V (ft/s)	1.20

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.37
K_{pgpe} (ft)	5.85
K_{pgh}	1.00
D^*_{pg} (ft)	8.19

Effective Diameter of Complex Pier

D^*_{cs} = 8.2 ft

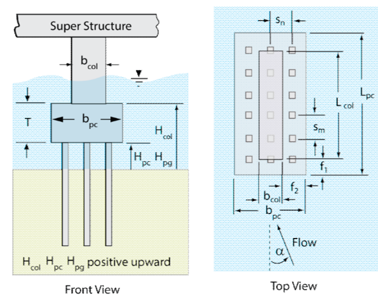
Local Scour at Complex Pier

y_{scs} = 7.3 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 8	Waterway:	Trout River
Return Period:	100-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data



Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (°)	14.97
y_0 (ft)	7.26
V (ft/s)	0.64

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.59
K_{pgpe} (ft)	5.93
K_{pgh}	1.00
D^*_{pg} (ft)	8.30

Effective Diameter of Complex Pier

D^*_{cs} = 8.3 ft

Local Scour at Complex Pier

y_{scs} = 4.4 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 2	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

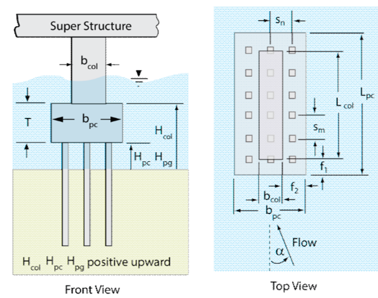
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	20.35
y_0 (ft)	12.98
V (ft/s)	1.30

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.56
K_{pgpe} (ft)	6.29
K_{pgh}	1.00
D^*_{pg} (ft)	8.80

Effective Diameter of Complex Pier

D^*_{cs} = 8.8 ft

Local Scour at Complex Pier

y_{scs} = 7.9 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 3	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

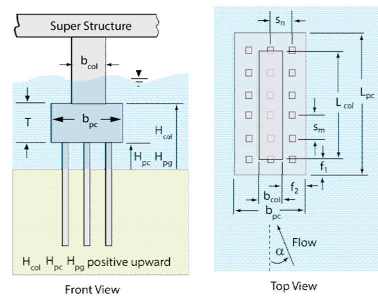
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	26.29
y_0 (ft)	13.36
V (ft/s)	2.10

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	21.43
K_{pgpe} (ft)	6.58
K_{pgh}	1.00
D^*_{pg} (ft)	9.21

Effective Diameter of Complex Pier

D^*_{cs} = 9.2 ft

Local Scour at Complex Pier

y_{scs} = 9.0 ft

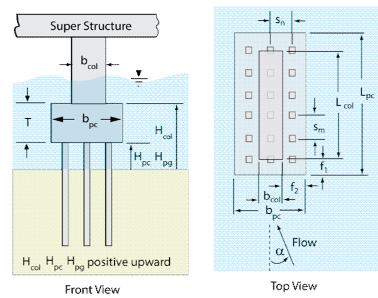
FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 4	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	21.19
y_0 (ft)	21.98
V (ft/s)	2.30



Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	20.70
K_{pgpe} (ft)	6.34
K_{pgh}	1.00
D^*_{pg} (ft)	8.87

Effective Diameter of Complex Pier

D^*_{cs} = 8.9 ft

Local Scour at Complex Pier

y_{scs} = 9.5 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 5	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

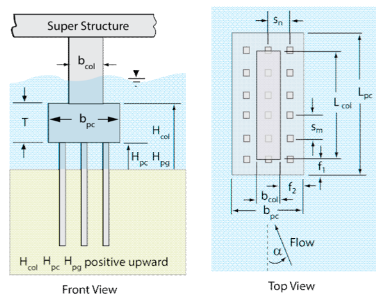
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	16.76
y_0 (ft)	24.36
V (ft/s)	2.26

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.93
K_{pgpe} (ft)	6.06
K_{pgh}	1.00
D^*_{pg} (ft)	8.48

Effective Diameter of Complex Pier

D^*_{cs} = 8.5 ft

Local Scour at Complex Pier

y_{scs} = 9.3 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 6	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

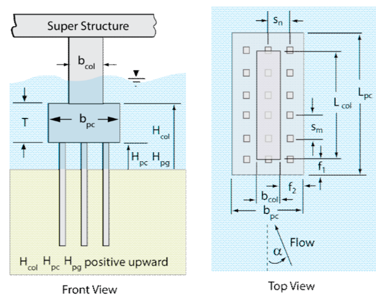
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	15.13
y_0 (ft)	20.81
V (ft/s)	1.99

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.62
K_{pgpe} (ft)	5.94
K_{pgh}	1.00
D^*_{pg} (ft)	8.32

Effective Diameter of Complex Pier

D^*_{cs} = 8.3 ft

Local Scour at Complex Pier

y_{scs} = 8.8 ft

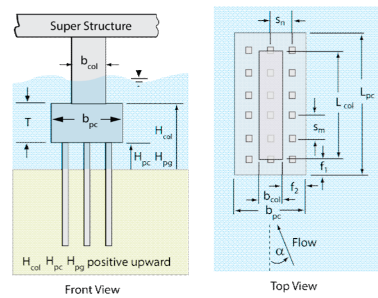
FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 7	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	12.68
y_0 (ft)	15.31
V (ft/s)	1.33



Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	

Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	19.12
K_{pgpe} (ft)	5.76
K_{pgh}	1.00
D^*_{pg} (ft)	8.06

Effective Diameter of Complex Pier

D^*_{cs} = 8.1 ft

Local Scour at Complex Pier

y_{scs} = 7.7 ft

FDOT Complex Pier Local Scour Calculator Version 6.2

Bridge Number:		Route:	Lem Turner Road
Pier Number:	Pier 8	Waterway:	Trout River
Return Period:	500-yr		
Calculated by:	HD	Date:	5/10/2023
Notes:			

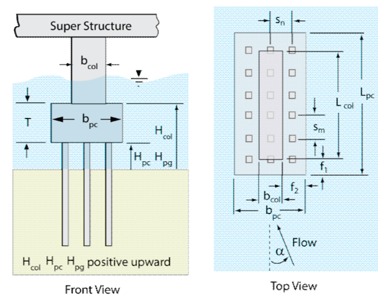
Input Data

Flow and Sediment Data

D50 (mm)	0.20
Angle of Attack, α (^{o})	3.55
y_0 (ft)	10.92
V (ft/s)	0.62

Column Data

b_{col} (ft)	No Column
L_{col} (ft)	
H_{col} (ft)	
Shape	



Pile Cap Data

b_{pc} (ft)	No Pile Cap
L_{pc} (ft)	
T (ft)	
H_{pc} (ft)	
Shape	

Pile Group Data

n	1
m	8
b (ft)	2.0
s_n (ft)	0.0
s_m (ft)	12.0
Shape	rectangular

Output Data

Column Data

K_{cols}	No Column
K_{colp} (ft)	
K_{colh}	
f_{ratio}	
K_{colf}	
K_{LOBcol}	
D^*_{col} (ft)	

Pile Cap Data

K_{pcs}	No Pile Cap
K_{pcp} (ft)	
K_{pch}	
K_{LOBpc}	
D^*_{pc} (ft)	

Pile Group Data

K_{pgs}	1.40
K_{pgp} (ft)	7.32
K_{pgpe} (ft)	3.05
K_{pgh}	1.00
D^*_{pg} (ft)	4.26

Effective Diameter of Complex Pier

D^*_{cs} = 4.3 ft

Local Scour at Complex Pier

y_{scs} = 2.7 ft

Appendix E:
Bridge Hydraulics Recommendation Sheet

(Reference)	EXISTING STRUCTURES (1)	(2)	(3)	(4)	PROPOSED STRUCTURE
Foundation	Concrete Piles				Concrete Piles
Overall Length	732’				768’
Span Length	36’,48’				96’
Type Construction	CONCRETE				CONCRETE
Area of Opening @ D.F.	9084 sq-ft				9846 sq-ft
Bridge Width	57’-3”				91.83’
Elev. Low Member	+16.2				+10.52

HYDRAULIC DESIGN DATA

Note:

The hydraulic data is shown for informational purposes only to indicate the flood discharges and water surface elevations which may be anticipated in any given year. This data was generated using highly variable factors determined by a study of the watershed. Many judgments and assumptions are required to establish these factors. The resultant hydraulic data is sensitive to changes, particularly antecedent conditions, urbanization, channelization, and land use. Users of this data are cautioned against the assumption of precision which cannot be obtained.

Terms:

Design Flood: Utilized to assure a desired level of hydraulic performance.
Base Flood: Has a 1% chance of being exceeded in any given year (100 year frequency)
Overtopping Flood: Causes flow over the highway, over a watershed divide, or thru emergency relief structures.
Greatest Flood: The most severe that can be predicted where overtopping is not practicable.

Water Surface Elevations:				
	N.H.W. (Non-Tidal)	NA	M.H.W. (Tidal)	+1.06 ft-NAVD88
	Control (Non-Tidal	NA	M.L.W. (Tidal)	-1.52 ft-NAVD88

Flood Data:	Max Event of Record	Design Flood	Base Flood	□ Overtopping or ■ Greatest Flood
Stage Elev. NAVD88 (ft)	UNKNOWN	+5.5	+6.3	+8.6
Discharge (cfs)	NA	15,641	15,641	16,623
Average Velocity (ft/s)	NA	1.8	1.8	2.0
Exceedance Prob. (%)	NA	2	1	0.2
Frequency (yr)	NA	50	100	500

Scour Predictions for proposed structure described above:

Pier Information		Total Scour Elevation		
Numbers	Size and Type	Long Term Scour Elev.	Worst Case < 100 yr. Freq. (yr) 100	Worst Case < 500 yr. Freq. (yr) 500
2	24” SQUARE PILES	-19	-19	-19
3	24” SQUARE PILES	-28	-28	-28
4-6	24” SQUARE PILES	-30	-30	-30
7	24” SQUARE PILES	-25	-25	-26
8	24” SQUARE PILES	-19	-19	-19

HYDRAULIC RECOMMENDATIONS

1. Begin Bridge Station 17+49.75 End Bridge Station 25+17.75 Skew Angle 0
2. Clearance Provided: Nav: Horiz. 96 Vert. 18.51 Above El. +2.06 Drift: Horiz. 96 Vert. 5.02 Above El. +5.5
3. Minimum Clearance: Nav: Horiz. 10 Vert. 6 Above El. +2.06 Drift: Horiz. - Vert. 2.0’ Above El. +5.5
4. Abutments:

	Begin Bridge	End Bridge
Rubble Grade:	BANK AND SHORE	BANK AND SHORE
Slope:	2H:1V	2H:1V
Buried or Non-Buried Horiz. Toe:	HORIZONTAL Non-Buried	HORIZONTAL Non-Buried
Toe Horiz. Distance:	10’-0” MIN	10’-0” MIN
Limit of Protection	15’-0” MIN TO STA: 17+34.75	15’-0” MIN TO STA: 25+32.75

5. Deck Drainage: The bridge will drain directly into the waterway following the cross-slope.

Remarks: Navigational clearance is calculated above MHW + Sea Level Rise